Studying the Status of Variations in Construction Contracts in Jordan

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ABSTRACT

The research aims to perform an analytical study to actual variations in construction contracts in Jordan through recognizing the types of variations which occur in the contracts, and reasons which affect those variations.

In order to realize the research purpose , the related data which were gained from the sources of all sides of the contract (clients , consultants, and contractors) through several interviews; and historical data of pre executed contracts , besides a questionnaire form distributed to three parties.

The results of analyzing historical data of (640) cases of variations occurred in (58) contracts showed that the variations in quantities within the ratio 20% of the works were the most usual types of variations occurred in contracts , as they reached more than 40% of the total variations (studied), followed by other types of variations (Variations in quantities more than 20% , additions , quality variations , deleting, etc. The results of the same matters came in the questionnaire showed the same sequence but slightly different figures.

In additional, the study showed that the three parties (Clients, Consultants, and Contractors) share almost equal responsibility for the reasons of variations occurrence. Reasons beyond the control of these parties received less attention.

THE CONSTRUCTION INDUSTRY IN JORDAN

The construction sector has been one of the most active sectors of the Jordanian economy lately. Construction sector accounted for 4.4 % of the Gross Domestic Product (GDP) on average over the period 2008-10. The sector has grown at a CAGR of 13.7 % during the same period. Credit to the construction sector has also expanded by a CAGR of 20.5 %, with the highest growth rates of 34.3 % and 24.4 % registered for 2009 and 2010 respectively (Global Investment House, September 2012).

VARIATIONS IN CONSTRUCTION PROJECTS

Definition of variations: Variations or changes are any deviation from the scope and schedule. This is stated in many research works. Baxendale and Schofield (1986) defined variations as any changes that can occur to the basis that is different from the agreed and signed contract. This includes change to plans, specifications or any other contract documents. Variations also defined by (Sun et al. 2004) as modification or alterations to pre-existing conditions, assumptions or requirements. While Parker (2001) described variations as work, state, process or methods that deviate from the original construction plan and specifications.

The variations are common in all types of construction projects (CII, 1949; Fisk, 1997; O'Brien, 1998). They are inevitable in any construction projects (Ibbs et al., 2001).

Causes of variations. Different authors and researchers claimed different causes of variations. Arian and Low (2005a) identified the design phase as the most likely area on which to focus to reduce the variations in future projects. Zawawi et al., 2010) reviewed different literatures and case studies on causes, effects, and control of variations. Based on review, they recorded that changing plans by owner (client) through generating conflicting design documents or through change in design afterward are the main causes of changes. The same was concluded by Mohammed et al., 2010) as they claimed that the most significant causes of variations are change in plans and substitution of material by owner and change of design by consultant. Al-Jishi and Marzoug (2008) also concluded that the owner is the major source and most changes are architectural.

Effect of variations. Variations frequently pose serious problems to owners and contractors, leading to cost overruns and costly disputes (Moselhi et al., 2005). This is agreed by Arian and Low (2005) as they mentioned that they cause problems for every one that is involved in the project. Variations can cause considerable amount of adjustment to the contract duration, total direct and indirect cost, or both (Ibbs, 1997; Ibbs, Lee, & Li 1998). This is agreed by (Ijaola et al. 2012) as they concluded that changes occurred during construction has significant impact on cost and time of project and worst cause could lead to delay, abandonment of project and disputes.

The change orders. The change order is the official document that is issued to modify the original contractual agreement and becomes part of the project's documents (Fisk, 1997; O'Brien, 1998). It is a written order issued to the contractor after execution of the contract by the owner, which authorize a change in the work or an adjustment in the contract sum or even the contract time (Clough and Sears, 1994). The change orders are issued to modify the original scope design (Alnuami 2010).
The change orders have great effect on the project performance. It has been proved by several authors that variation orders are responsible in most cases of inability to complete and hand over project works as agreed initially at the commencement of the work (Chan and Yeong 1995). The issue of variation orders is unavoidable due to the complex nature of construction projects. Ssegawa et al. (2002) explained that, in order to finish a construction project, changes to plan or construction process itself must be expected. In general, even if the project is carefully planned, it is likely that there will be changes to the scope of the contract as work progresses (Harbans, 2003).

Previous research. Various previous studies were dedicated to finding the origin of the variation orders in construction projects. An investigation of the consequences of variation orders on institutional building projects showed they resulted into a substantial increment in amount of funding budgeted for construction works (Arian and Pheng, 2005). Hanna et al. (2002) used a statistical regression and fuzzy logic approach to quantify the impact of change orders on construction projects. Much research works developed systems and models to

manage variations and variation orders. Al-Sedairy (2001) developed a change management model for analyzing managing and optimizing the organization's productive performance. Yitmen and soujeri (2010) developed an artificial neural network model to manage change orders through all phases of project. Stare (2011) developed a project risk and change management model. Ibbs et al. (2001) proposed a comprehensive project change management system for managing project change.

RESEARCH PLAN AND METHODOLOGY

For the purpose of achieving research objectives the following methodology was followed:

Historical data. The study included the collection of 640 change cases from 58 contracts implemented (between 2010 & 2013). The kinds of these contracts were general buildings and civil engineering works.
The nature of the data was a comparison between the final measurements and contract awarded schedules. Results were categorized in accordance of the following: Changes (increase or decrease) in quantities within the rate of 20%, Changes (increase or decrease) in quantities more than the rate of 20%, addition of works or clauses to the contract, omission of works or clauses from the contract, change of the quality of works, and others.

The questionnaire. Questionnaire was adopted as another major source of data required to accomplish the research. The questionnaire form was designed based on the theoretical study and site visits to selected construction projects.
Prior to the final formulation of the questionnaire form, a pilot survey which included 5 engineers with experience of more than 20 years, was conducted. The purpose was to check the clarity and feasibility assurance. The form was revised in accordance of the notes received.

The questionnaire form was divided into three sections: **Section 1**, included personal and general questions (name of establishment, positions, years of experience, etc.). **Section 2**: the same classification used in the historical data collection was used in questionnaire to discover the opinion of the three parties (Client, Consultant, and Contractor) about the percentage of occurrence of each class of variation and to find how these percentages complying with those from historical data collection.The expected answers were "very high", "high", "medium", "low", and "not" occurrence. **Section 3**: Forty reasons were collected from previous research works. These were presented to the five experts in order to select the most important. Twenty five reasons were selected for the questionnaire form. The forms distributed to engineering staff representing the three parties (Clients, Consultants, and contractors). The respondents score given ranges from 1 to 5 in which (1) is not significant and (5) is extremely significant.

The forms were distributed and collected personally. Numbers of sets distributed and received are shown in Table 1. The five point scale used to calculate the mean score factor by assessing ranking to mean score, with low mean score assigned low ranks and high scores allocated high ranks. The mean score for each factor computed by using the following formula: Mean=$\sum$a(n/N) / 5

Where (**a)** is the constant expressing weighting given to each response (range from 1 to 5), **n** is the frequency of the response, and **n** is the total number of responses.

Table 1. Number of questionnaire sets

	Clients	Consultants	Contractors	Total
number distributed	65	65	65	195
number received	43	46	41	130
response rate	65%	70%	63%	67%

ANALYSIS OF THE RESULTS

Analysis of the nature of change occurrence – the historical data. The results of the field study concerning the nature of the occurrence of 640 changes in 58 contracts are shown in table (2) below. The results showed the variation in quantities is the most important reason (with more than two thirds of the results). This reason is distributed to those within 20% with a percentage of 42% and above 20% with a value of 28%. The other causes (additional works, deleting works, and change of quality) occur in lower frequency.

Table 2 – Final results of historical data regarding the causes of variations

	The nature of variations	Number of Occurrence	The relative importance %)
1	Variations in quantities within 20%	269	42
2	Variations in quantities in more than 20%	179	28
3	Additional works	86	13.5
4	Deleting of works	48	7.5
5	Change of quality of works	38	6
6	Others	20	3
	Total	640	100

Analysis of change occurrence –the questionnaire. Table (3) presents the results of the questionnaire form concerning the amount of occurrence of each kind of variation from the point of view of the parties involve in the construction process. The resulted answers (for each party) were calculated using the "weighted average" through giving weight for each answer from 5 to 1 (5 for "very high", 4 for "high", 3 for "medium", 2 for "low", and 1 for "not".

Causes of changes occurrence. The participants responses (in terms of numbers and percentages) to the significance of the variation reasons, the mean, and ranking of these reasons are shown in Table 4.

Table 3 –Parties answers about types of variations

	Occurrence	client	Consl	Contr.	Av.
1	Variations in quantities within 20%	33	35	37	35
2	Variations in quantities in more than	19.5	23.5	22.5	21.8
3	Additional works	15.2	12	15	14.1
4	Deleting of works	12.8	14.3	13.6	13.6
5	Change of quality of works	10.5	10.0	8	9.5
6	Others	9.0	5.2	3.9	6.0
	Total	100	100	100	100

Table 4 Detailed causes of variations

No.	Variation order factor	Number of respondents = 130					mean	rank
		5	4	3	2	1		
1	Design by consultant	32 25%	42 32%	22 17%	18 14%	16 12%	3.43	1
2	Owner's financial problems	36 28%	30 23%	27 21%	20 15%	17 13%	3.37	2
3	Inadequate scope of work for contractor	15 12%	20 15%	32 25%	40 31%	23 18%	3.27	3
4	Conflict between contract documents	33 25%	30 23%	25 19%	22 17%	20 15%	3.26	4
5	Change of specifications by the client	31 24%	28 21%	25 19%	27 21%	19 15%	3.19	5
6	Contractor's financial difficulties	21 16%	31 24%	43 33%	18 14%	17 13%	3.16	6
7	Change of schedule by the client	20 16%	38 29%	30 2%3	25 19%	17 13%	3.15	7
8	Defective workmanship	13 10%	30 23%	58 45%	18 14%	11 8%	3.12	8
9	Client's delay, responding to other parties requirements	17 13%	36 28%	38 29%	20 15%	19 15%	3.09	9
10	Change in government regulations	10 8%	30 23%	47 36%	35 27%	8 6%	2.99	10
11	Errors and omission in design	19 15%	22 17%	43 33%	27 21%	19 15%	2.96	11
12	Change of scope by the client	15 12%	28 22%	37 28%	26 20%	24 18%	2.88	12
13	Unavailability of skilled manpower	12 9%	22 17%	45 35%	32 25%	18 14%	2.85	13
14	Design complexity	13 10%	25 19%	40 31%	31 24%	21 16%	2.83	14
15	Change in economic conditions	9 7%	25 19%	44 34%	35 27%	17 13%	2.80	15
16	Delay caused by sub-contractors	12 9%	18 14%	33 25%	46 35%	21 16%	2.65	16
17	Lack of consultant's knowledge of materials and equipments.	10 8%	22 17%	30 23%	44 34%	24 18%	2.62	17
18	Lack of coordination between contractor and others	12 9%	18 14%	30 23%	39 30%	31 24%	2.55	18
19	Inadequate shop drawings details	7 5%	25 19%	20 15%	43 33%	35 27%	2.43	19
20	Unclear contract language and translation	7 5%	20 15%	23 18%	42 32%	38 29%	2.35	20
21	Variations in the method of construction	8 6%	13 10%	27 21%	43 33%	39 30%	2.29	21
22	Unforeseen problems	3 2%	17 13%	33 25%	37 28%	40 31%	2.28	22
23	Unavailability of equipment	6 5%	12 9%	28 22%	40 31%	44 34%	2.20	23
24	Weather Changes	1 1%	17 13%	30 23%	40 31%	42 32%	2.19	24
25	Lack of contractor's involvement in the design	3 2%	17 13%	22 17%	45 35%	43 33%	2.17 %	25

CONCLUSIONS

The following conclusions were obtained based on site visits and interviews, historical data analysis and questionnaire results. The most important conclusions are:

a. Through historical data analysis for 640 change cases occurred in 58 construction contract and comparing results to questionnaire results; it is shown clear mutual agreement among the three parties about the most common changes occurred in construction projects. This agreement is to some extent approaching the historical data analysis results according the occurrence rate and as shown in Table 5.
b. The study revealed that the most significant reasons for variations are: changes in design by consultant, owner's and contractor's financial problems, inadequate scope of work for contractor, conflict between contract documents, client's change to specifications and schedule, defective workmanship, etc.
c. The study revealed that the three parties involve in the construction process share responsibility for variations.

Table 5. causes of variations- historical data vs. questionnaire

No	Occurrence	Av. historical data	Av. Questionnaire
1	Variations in quantities within 20%	42	35
2	Variations in quantities in more than 20%	28	21.8
3	Additional works	13.5	14.1
4	Deleting of works	7.5	13.6
5	Change of quality of works	6	9.5
6	Others	3	6.0
	Total	100	100

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