Evaluating the Causes and Effects of Change Order in Assosa Zone Building Construction Projects

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Abstract - Changes in building construction projects are very common and likely to occur from various sources at any stage of the project. This study evaluates the causes and effects of change orders in public building construction projects in Assosa zone, Benshangul-Gumuz, Ethiopia. Tasks included conducting a field survey by a questionnaire. In order to obtain reliable source from construction parties' players such as clients, consultants and contractors in the industry, a survey questionnaire was conducted. Using previous accomplish literature works in this study, twenty-one factors responsible for causes and twelve factors responsible for the effect of change orders were taken. The most five causes of change orders were owner's additional works, error and omissions in design, change of plans by owner, change in design and owner financial difficulties. Whereas, the most five effect of change orders were increase in project cost, delay completion schedule, rework and demolition, increase in overhead expenses and dispute between owner and contractor.

Keywords: Change order; causes; effects; importance index; prevalence index; building construction projects

1. INTRODUCTION

The greatest unavoidable situation in building construction projects is change order. It is available in all kind of building construction projects and have great influence in budget and duration of the construction projects. Therefore, it is a common incident in building construction projects. The change order includes a modification of the scope of work. The origins of this change orders are characterized under client, consultant or contractor related. The drawback of change order results economic cost, lengthening time schedule, causes disagreement and claims among construction stakeholders (Gobana and Thakur, 2017). Building construction projects are open to a high level of change. Changes normally occur to modify or correct the scope or design of work. Based on previous studies, for successful completion projects three main criteria should be meet i.e., completed within budget, time and quality (Shoar and Chileshe, 2021). The complex nature of building construction projects it hard to finish any the projects without changing in plans or in the construction process itself (Staiti et al., 2016). Change orders is not only to correct a mistake instead contract terms modifications must be memorialized by change order. The change order may be due to owner changes to the project, unforeseen conditions, weather condition, contractual issues. Mainly changes in construction industry originate from the client/owner side (Muhamad and Mohammad, 2018).

Gokulkarthi and Gowrishankar (2015) conducted a study to investigate the impacts of change order in building construction projects and concluded that change of plans by owner, substitution of materials and procedures, errors and omissions in design, owner's financial problems and change in design by consultant are the main source of change orders. Oladiran et al. (2018) evaluated the cause change orders on construction and found that the major cause of change orders in projects is scope of works. Khalifa and Mahamid (2019) also investigated the causes of change orders in construction projects. Conclude that the top five causes of change orders from contractors' point of view are; owner's additional works, error and omissions in design, lack of coordination, defective workmanship and owner financial difficulties. The top five causes of change orders from consultants' point of views were; owner's additional works, error and omissions in design, lack of coordination, owner financial difficulties and differing site conditions.

Mohammed and Chambrelin (2020) studied the causes and effects of change orders in construction sites. Found that in construction sites change in project scope by owner and financial problems are the two main causes for change orders. Oladiran et al. (2018) conducted a study to investigate the impact of change orders in construction industry and found that cost overrun is the major impact of change orders on construction projects. Also Mohammed and Chambrelin (2020) found that in construction sites cost overrun and increase in project duration are the two main effects of change orders.

2. METHODOLOGY

2.1. Introduction

This study is a case study for which the data was collected in Assosa Zone. A quantitative survey questionnaire was used to evaluate the cause and effect of change orders in building construction projects. The methodology of this study was categorized into three main steps: the first was

questionnaire design, the second was data collection and the third was data analysis. In order to determine and analyze the cause and effects of change orders in public building construction projects of Assosa zone, Benshangul-Gumuz region, Ethiopia. A wide range of personnel selected from clients, consultants and contractors were targeted and involved in building construction projects of Assosa zone.

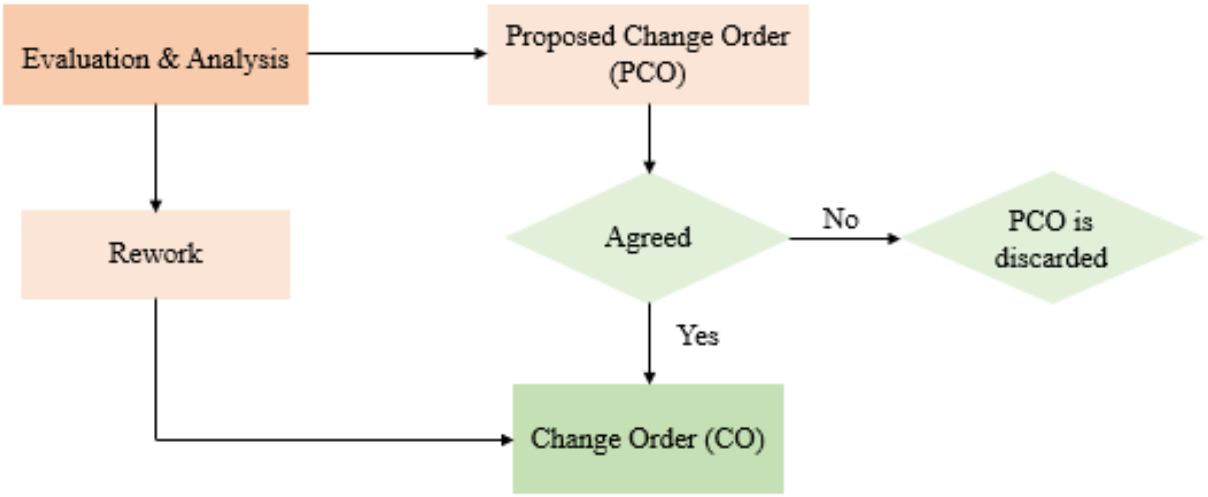

Figure 2-1 Change Orders Flow Charts

2.2. Questionnaire Design

The questionnaire design was divided into three main sections. The first section contains general information about the respondent's general information. The second section addresses the causes leads to change orders. The third section examines the possible effects of change orders. A questionnaire was carefully designed from previous preliminary investigations conducted in building construction projects. It was organized in the form of a priority scaling (100% is for very often, 75% is for often, 50% is for sometimes, 25% is for seldom, 0% is for never).

Causes of Change Order: this factor of list was developed from the literature review. The possible causes of change orders in building construction of projects are shown in Table 2-1.

TABLE 2-1 LIST OF CHANGE ORDER CAUSES

S.N	Cause of change orders	S.N	Cause of change orders
1.	Change in design	12.	Owner change of schedule
2.	Change of plans by owner	13.	Owner financial difficulties
3.	Conflict between contract and document	14.	Owner's additional works
4.	Contractor desire to improve his financial conditions	15.	Safety considerations
5.	Contractor financial difficulties	16.	Substitution of material or procedures
6.	Defective workmanship	17.	Technology changes
7.	Defined project objective	18.	Unavailability of equipment
8.	Differing site conditions	19.	Unavailability of skill
9.	Error and omissions in design	20.	Value engineering
10.	Lack of coordination	21.	Weather conditions
11	New government regulations		

Effects of Change Orders: this factor of list was also developed from the literature review. The effects of change orders that are usually encountered are shown in Table 2-2 below

TABLE 2-2 LIST OF CHANGE ORDER EFFECTS

S.N	Effect of change orders	S.N	Effect of change orders
1.	Additional money for contractor	7.	Dispute between owner and contractor
2.	Decrease in productivity	8.	Increase in duration of individual activities
3.	Decrease in quality	9.	Increase in overhead expenses
4.	Delay completion schedule	10.	Increase in project cost
5.	Delay in payment	11.	Rework and Demolition
6.	Delay of material and tools	12	Work on hold in other areas

2.3. Data Collection

The sources of data collection in this study questionnaire surveys. The questionnaire was distributed to the selected three main construction parties i.e., clients, consultants and contractors. The participant clients, consultants and contractors were requested for response to questions with respect to their experience in the building construction industry and their opinions about the cause and effect of change orders.

2.4. Data Analysis

The information collected from the questionnaire survey was analyzed statistically in excel. Causes and effects are scored as follows to come up with an index to indicate its importance or prevalence: very often (100%), often (75%), sometimes (50%), seldom (25%) and never = 0%. The relative importance index and relative prevalence index of causes and effects are calculated as follows:

$$RII \quad or \quad RPI = \quad C\sum_{i=1}^{5}(i-1)N_i \Big/ \sum_{i=1}^{5} N_i$$

Where:

- ⇒ RII is the relative importance index
- ⇒ RPI is the relative prevalence index
- ⇒ C is constant numerical factor 25
- ⇒ N_i is the number of respondents for each weight
  - → $N_1$is for never,
  - → N_2 is for seldom,
  - → N_3 is for sometimes,
  - → N_4 is for often and
  - → N_5 is for very open

3. RESULTS AND DISCUSSIONS

A total of 105 questionnaire was distributed to three main construction parties (25 for clients, 40 for consultants and 40 for contractors). The participating two contractors and consultants have more than 5 years of experience. A total of 95 persons filled the questionnaire with response rates of 100%.

The measure of rates of causes and effect of change order have different criteria and the categorization for each of them are as follows:

- ⇨ Data analysis about causes are categorized by relative importance index (RII)
- ⇨ Data analysis about effects are categorized by relative prevalence index (RPI)

3.1. Causes of Change Orders

The causes of change orders are analyzed and ranked by the measurement of relative important index according to Khalifa and Mahamid (2019). The relative important value index and ranking of causes of change orders for building construction projects in Assosa Zone from are evaluated and listed in Table 3 1. The results indicates that the overall ranking of the top five causes of change orders in descending order are as follows: -

1. Owner's additional works
2. Error and omissions in design
3. Change of plans by owner
4. Change in design
5. Owner financial difficulties

TABLE 3-1 CAUSES OF CHANGE ORDERS IN TERMS OF RELATIVE IMPORTANCE INDEX

S.N	Cause of change orders	N	N_1	N_2	N_3	N_4	N_5	RII	Rank
1	Change in design	95	0	5	16	35	39	78.42	4
2	Change of plans by owner	95	0	3	12	36	44	81.84	3
3	Conflict between contract and document	95	2	7	31	29	26	68.42	10
4	Contractor desire to improve his financial conditions	95	22	25	24	18	6	39.74	18
5	Contractor financial difficulties	95	6	22	35	22	15	57.37	14
6	Defective workmanship	95	7	6	15	36	31	70.53	9
7	Defined project objective	95	7	11	24	33	20	62.63	12
8	Differing site conditions	95	20	24	25	19	7	41.84	17
9	Error and omissions in design	95	0	0	11	37	47	84.47	2
10	Lack of coordination	95	2	7	20	35	31	72.63	7
11	New government regulations	95	5	7	17	35	31	71.05	8
12	Owner change of schedule	95	7	9	25	32	22	63.95	11
13	Owner financial difficulties	95	0	7	16	38	34	76.05	5
14	Owner's additional works	95	0	0	1	39	55	89.21	1
15	Safety considerations	95	21	29	27	15	3	36.84	19
16	Substitution of material or procedures	95	0	6	23	37	31	75.53	6
17	Technology changes	95	29	37	26	3	0	25.79	21
18	Unavailability of equipment	95	11	7	26	32	19	60.79	13
19	Unavailability of skill	95	13	9	32	21	12	48.42	16
20	Value engineering	95	25	36	27	6	0	28.42	20
21	Weather conditions	95	10	24	26	21	14	51.32	15

Note: N is total number of respondents, N_1 is never, N_2 is seldom, N_3 is sometimes, N_4 is often, N_5 is very often

Figure 3-1 Relative importance index vs causes of change order chart

3.2. Effects of Change Orders

The effects of change orders are analyzed and ranked by the measurement of relative prevalence index is also according to Khalifa and Mahamid (2019). The relative prevalence value index and ranking of effects of change orders on building construction projects in Assosa Zone from are evaluated and listed in Table 3-2. The results show that the overall ranking of the top five causes of change orders in descending order are as follows: -

1. Increase in project cost
2. Delay completion schedule
3. Rework and Demolition
4. Increase in overhead expenses
5. Dispute between owner and contractor

TABLE 3-2 EFFECTS OF CHANGE ORDERS IN TERMS OF RELATIVE IMPORTANCE INDEX

S.N	Effect of Change Order	N	N_1	N_2	N_3	N_4	N_5	RPI	Rank
1	Additional money for contractor	95	7	39	47	2	0	36.58	11
2	Decrease in productivity	95	2	21	32	24	16	58.16	10
3	Decrease in quality	95	15	37	43	0	0	32.37	12
4	Delay completion schedule	95	0	0	9	36	50	85.79	2
5	Delay in payment	95	0	8	27	31	29	71.32	7
6	Delay of material and tools	95	0	7	21	37	30	73.68	6
7	Dispute between owner and contractor	95	0	4	19	41	31	76.05	5
8	Increase in duration of individual activities	95	0	15	20	36	24	68.16	8
9	Increase in overhead expenses	95	0	0	17	43	35	79.74	4
10	Increase in project cost	95	0	0	2	37	56	89.21	1
11	Rework and Demolition	95	0	0	11	45	39	82.37	3
12	Work on hold in other areas	95	3	17	29	28	19	61.84	9

Note: N is total number of respondents, N_1 is never, N_2 is seldom, N_3 is sometimes, N_4 is often, N_5 is very often

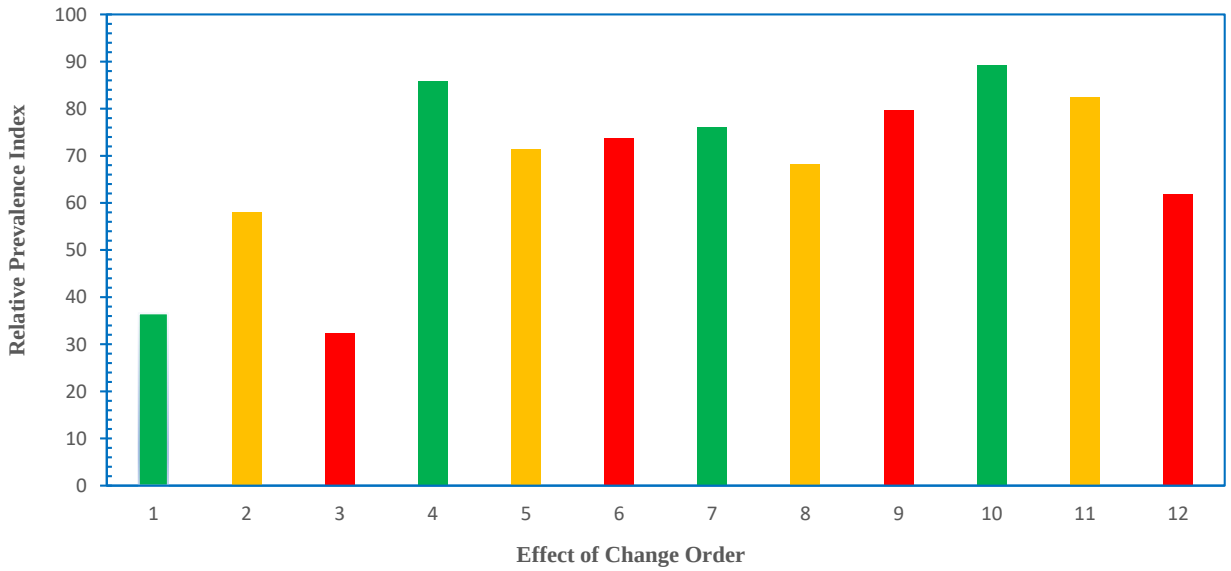

Figure 3-2 Relative importance index vs causes of change order chart

4. CONCLUSIONS

This study evaluated the cause and effect of change orders for building construction projects in Assosa zone, Benshangul-Gumuz region, Ethiopia. The questionnaire survey was addressed the three main parties of construction industry i.e., the client, consultants and contractors. Finally, based on the limited study in this research work the following conclusions are drawn:

1. The most five causes of change orders were owner's additional works, error and omissions in design, change of plans by owner, change in design and owner financial difficulties.
2. The most five effect of change orders were increase in project cost, delay completion schedule, rework and Demolition, increase in overhead expenses and dispute between owner and contractor.

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