Change Orders in International Construction Projects: Causes, Effects, and Solutions

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Introduction

Change orders during construction projects are a particularly irritating and costly problem for clients and contractors and a time-consuming effort for project managers. In the past few years, governmental construction projects in Kuwait have been characterized by change orders and monetary volume. A construction project that starts with five million Kuwaiti Dinars and ends up with twenty is really worth investigating. The prime concern of the government agencies that are involved in projects is to minimize the change orders in projects. The problem is: how?

It is recognized that some changes are necessary and inevitable; however, they are also time-consuming and expensive compared to the cost of the original scope of work for a construction project. International contractors working with different governmental clients need to recognize the principle causes to changes and why there is a lack of understanding about the effect of these changes on a project's cost and schedule. This paper lists the objectives of identifying and establishing the causes of change orders and their effects to major construction projects. The paper also establishes the guidelines that can act as a methodology to minimize the effects of changes to the original scope of a construction project.

The data for this study was extracted from a survey conducted among governmental client agencies, which included thirty project engineers (managers) with experience in managing and supervising governmental projects in Kuwait. The participating governmental agencies are involved in large-scale infrastructure construction projects and usually assign international project management firms to mange their projects. The management of these projects is usually handled through a joint relationship between the staff of the governmental agencies and international project firms, while the construction-site supervision of these projects is usually done through the staff of architectural/engineering consultants.

The objectives of conducting this study are to take a close look at the change orders practice in Kuwait, its effects, and implications and to provide a means of minimizing their effects and minimizing the issuance of change orders. This will then lead to the following:

- Reduce claims by contractors
- Delivery projects at their planned end dates
- Have firm control of the cost during and after construction phase
- Fulfill end-user requirements without overruns of budgets
- Optimize use of supervision and management staff.

The research methodology of the study has been done through submitting a structured questionnaire to introduce opinions of experienced project managers. The questionnaire is divided into three major parts. The first part identifies the causes and their relative importance of change orders in construction projects from a list of causes. These causes are categorized into four major areas, such as client-related cause, project-related causes, organizational-related causes, and so on. The survey participants can identify other changes that are not mentioned in the list. The second part of the survey establishes the advantages and disadvantages of change orders, while the third part of the survey provides the chance to the survey respondent to comment on the best approach to utilize in order to minimize the effect of changes. The findings of the survey are of importance to the construction industry participants and to the project management profession. The results categorize the principle causes to change orders and their relative importance using the Relative Importance Index.

Literature Review

A change order is a written agreement to modify, add to, or otherwise alter the work from that originally set forth in the contract documents at the time of opening bids, provided that such alteration can be considered to be within the scope of the original project; otherwise, a contract modification may be required (Barie and Paulson 1992). It is the only legal means available to change the contract provisions after the award of the contract. A change order is the formal document that alters some condition of the contract documents. The change order may alter the contract price, schedule of payments, completion date, or the plans and specifications. A price change is not necessarily always in the contractor's favor, however, as it could also be in the form

Proceedings of the 30th Annual Project Management Institute 1999 Seminars & Symposium
Philadelphia, Pennsylvania, USA: Papers Presented October 10 to 16, 1999

of a cash credit to the owner, or it may involve no price change at all.

Types of Change Orders

There are two basic types of change: directed and constructive. A directed change is easy to identify. The owner directs the contractor to perform work that differs from that specified in the contract or is in addition to the specified work. A directed change may 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. A constructive change, which is a major source of construction disputes, is an informal act authorizing or directing a modification to the contract caused by an act or failure to act. A constructive change arises when the contractor alleges that something that the owner has done, or failed to do, has resulted in a de facto change in the contract requirements. The argument, of course, is that the contractor is entitled to extra compensation for performing the work. The contractor must claim constructive change in writing—within the time specified in the contract documents in order to be considered. The owner should evaluate a change order proposal based on such a claim and can use the same reasoning process as any other proposal. Most constructive change disputes center around the interpretation of the plans and specifications.

Causes of Changes

Following a literature review, there are four major categories of change orders that were identified: client-related characteristics, project–related, project organization, and environmental factors.

Client-Related Factors

The end-user in governmental projects is the agency commissioning a project and possessing limited knowledge of construction. The end-user decisions or actions are simply the routine process of refining the project once it begins to take shape. The owner will realize during the course of construction that some items should be added, moved, or removed. Budget considerations may dictate changes during the course of the work. The owner may desire to occupy a part of the facility early and, as a consequence, change the contractor's sequence of work. When an owner initiates an action that requires performance different from what was specified, a change occurs.

Organizational Factors

The organization of the construction process is dynamic in nature, involving different disciplines with different objectives and generating different contract strategies and organizational structures as well as styles of management. This can often create problems of coordination and communication, affecting variations in terms of number, agreement of cost/value, and, if disputes arise, how they are resolved. These factors include method of procurement, type of contract, method of tendering, adequacy of information, and number of subcontractors used.

Project-Related Factors

Construction projects are generally unique, accommodating different designs, sites, and construction methods. Each has different characteristics influencing how the project is initiated, designed, organized, and managed. One example of this category is change order due to Differing Site Conditions.

The Environmental Factors

This includes all external influences of the construction process. These influences include the economy of the country, social, political, and technology elements.

Questionnaire Development

The questionnaire that was submitted to thirty project managers is divided into three parts.

Part A

This part identifies the major causes of change orders; seventeen causes are listed, and the project managers are asked to estimate on the level of influence of each cause to change orders. The project manager then is asked to give the reason for each cause. The author adopted a scale of 1 to 5 to assess the effect of each factor on the project change order, where "1" represented the "lowest" level of effect and "5" the "highest" level of effect. In this part, the following is a list of the major causes that were given to the project managers.

The Client-Related Factors

- End-user requirements (EUR)
- Client's changes (CC)
- Clients interference (CI)
- Contractor's interference (COI)

Project Organization Factors

- Design duration (DD)
- Contract type (CT)
- Adequacy of information (AI)
- Number of subcontractors (NS)

Project-Related Factors

- Design mistakes or discrepancies (DMD)
- Incomplete design documents (IDD)
- Field conditions (FC)
- Project type (PT)
- Project size (PS)
- Project complexity (PC)
- Project duration (PD)

The Environmental Factors

- Governmental Funding
- Social Interference

The purpose of this part is dedicated to finding major reasons for change orders, for which the project manager provides his rating.

Part B

This part is considering the advantages and disadvantages of change orders. The project managers can give more choices other than the ones indicated. The rating follows the same procedures as in part A.

Advantages of Change Orders

- Improve quality
- Improve performance
- Improve safety
- Improve reliability
- Improve maintenance
- Improve design function
- Improve end-users satisfaction
- Improve service
- Improve clients attitude

Disadvantages of Change Orders

- Delay the works
- Waste money
- Disturb the works
- Lead to disputes
- Lead to claims

Part C

This part addresses the issues that can reduce the number and the effect of change orders. The purpose is to identify ways to minimize change orders. A list of the following issues was identified.

- Value engineering during design stage
- Proper review of design documents
- Update design before tendering
- Get end-user approval on tender drawings
- Have end-users handle legal legislation issues for change orders initiated by them
- Have end-users get approvals for additional budget for change orders initiated by them
- Allow tenderers more time to submit bids
- Allow consultants to revise tender documents based on feedback from bidders and issue detailed addendum
- Allow negotiations with low bidders to clear discrepancies in design documents prior to award of contract

As in part A, the five-point scale is used to rate these issues.

Data Analysis and Results

The Data Analysis method was implemented using the relative importance index (Kometa, Olomolaiye, and Harris 1994). The relative importance index method is used for the analysis of the data collected from the current questionnaire survey. The five-point scale mentioned earlier was transformed to relative importance indices for each factor to determine the ranks of the different causes. These rankings made it possible to cross-compare the relative importance of the factors as perceived by the project manager's responses. The mean and standard deviation of each factor are suitable statistics to assess the overall rankings because they do not reflect any relationship between them. Hence, all numerical scores of each of the identified factors were transformed to relative importance indices to determine the relative ranking of the factors. The relative importance index (RI) was evaluated using the following equation.

$$RI = \frac{\sum w}{A * N} \qquad (0 \text{ RI } 1)$$

Where w = weighting given to each factor by the respondents and ranges from 1 to 5 where "1" is "not significant" and "5" is "extremely significant," A = highest weight (i.e., 5 in this case), and N = total number of respondents.

Results and Discussion

Exhibit 1 shows the relative importance indices of the top-fourteen factors. It was observed that the five most significant factors as perceived by the project managers were 1) End-user Requirements, 2) Client's Changes, 3) Design Duration, 4) Project Duration, and 5) Adequacy of Information.

The Client-Related Factors

Lack of studying the end-user requirements was a main initiator of change orders; sixty percent of the respondents have indicated that this has (61 to 100 percent) influence

Exhibit 1. Relative Importance of Causes to Change Orders

Cause	Percentage of respondents			Importance	Rank
	≥ 4	3	≤ 2		
End-user Requirements	60	17	23	0.71	1
Client's Changes	30	27	43	0.56	2
Design Duration	17	27	57	0.49	3
Project Duration	30	10	60	0.48	4
Adequacy of Information	13	20	67	0.48	5
Project Complexity	23	27	63	0.47	6
Number of Sub-Contractors	13	20	67	0.41	7
Contract Type	10	23	67	0.41	8
Incomplete Design Documents	10	10	80	0.38	9
Project Size	13	10	77	0.38	10
Project Type	7	17	77	0.37	11
Design Mistakes	7	13	80	0.36	12
Client's Interference	7	17	77	0.35	13
Field Conditions	0	0	100	0.27	14

on change orders. It is extremely important to find a solution to this problem, as it agreeably emphasized project managers. "Client's changes" are a very noticeable factor, which ranked second. The client here is meant to be the government or the ministry in charge of executing the project, such as the Ministry of Public Works (MPW), on behalf of the end-user. These changes are generally requested by the chief engineer of the client based on the reports given by the site staff. Other client-related changes are not considered significant as compared to these two.

Project-Organization Factors

The design duration is a very important factor, which is ranked third here, simply because during that phase, the preparatory work for the construction is done. If the designer is not given enough time to do a professional job, you can expect all kinds of trouble during the next phases as the results agree to this perception. Adequacy of information is ranked fifth; on many occasions, contractors send RFIs (request for information) to the client asking about unclear clauses or section of drawing and so on. If information is not adequate, this leads to ambiguity and could lead to change orders. The other significant factor is the number of subcontractors. The more subcontractors on a certain job, the more chances of having change orders. The main contractors might make a change that suits them and neglect their subs. Subcontractors then will react, and the client will end up changing twice during the same project.

Project-Related Factors

This category is of factors that scored less than the first two categories. The only significant factor is the effects of project duration, which is ranked fourth, as a major cause that influences the issuance of change orders. Project complexity is considered a significant factor that could affect the chances of having change orders. The more complex the project, the more chance of having a change order. Incomplete information of design drawings is a factor that should be considered. Incomplete design is probably due

Exhibit 2. Advantages of Change Orders

Advantage	Percentage of respondents			Importance Index	Rank
	≥ 4	3	≤ 2		
Improve End-user Requirements	50	17	33	0.66	1
Improve Quality	27	27	47	0.55	2
Improve Performance	23	23	53	0.52	3
Improve Design Function	17	33	50	0.52	4
Improve Reliability	17	17	67	0.49	5
Improve Maintenance	3	30	67	0.46	6
Improve Safety	13	13	73	0.44	7
Improve Service	3	23	73	0.44	8
Improve Client's Attitude	3	40	57	0.44	9

Exhibit 3. Disadvantages of Change Orders

Disadvantage	Percentage of respondents			Importance Index	Rank
	≥ 4	3	≤ 2		
Delay the Works	43	37	20	0.67	1
Disturb the Work	37	37	27	0.65	2
Waste Money	40	23	37	0.59	3
Lead to Claims	23	43	33	0.57	4
Lead to Dispute	23	37	40	0.55	5

to the fact that consultants in Kuwait try to establish a continuation of their services with the client during the construction phase under a supervision agreement. Incomplete design will always increase the need for the same designer to be at the site during the contractor presence. The other four elements of this category are not performing as major reasons for change orders.

Environmental Factors

Factors that are related to this category have scored enough to be considered as major causes to the issuance of change orders. Exhibits 2 and 3 list the advantages and disadvantages of change orders, as suggested by the thirty project engineers who responded to the survey, while Exhibit 4 lists the issues that have to be implemented in order to minimize change orders. All issues in the three Exhibits are ranked using the relative importance index, and the percentage of respondent is also illustrated for each issue.

The major factor that needs to be considered in reducing change orders is design updating. If for any reason, old designs are used for the projects or are kept pending due to budget constraints, then a full update

Exhibit 4. Issues to Reduce the Effects of Change Orders

	Percentage of respondents			Importance Index	Rank
	≥ 4	3	≤ 2		
Update Design before Tendering	80	10	10	0.84	1
Review of Design Documents	67	23	10	0.82	2
Obtain Tender Drawing Approvals by the end-user	70	23	7	0.79	3
Get Additional Budget Approval	70	17	13	0.79	4
Value Engineering	67	17	13	0.78	5
Allow Consultants to Revise Tender Documents	37	40	20	0.65	6
Allow Negotiations with Low Bidders	47	20	33	0.61	7
Allow more Time for tenderers	43	7	50	0.55	8
End-users Legal Legislation	33	20	47	0.53	9

should be implemented before tendering so that any market changes can be considered before commitments with the contractors. The second-ranked issue is reviewing design documents. Proper design review is extremely important and is supported by the participants. A strong professional team of reviewers is needed to give valid comments during the design phases. Also, a suggested independent consultant is recommended for review of drawings and documents prior to tendering, to ensure completeness and minimum mistakes or discrepancies. The third issue is obtaining the end-user approval on Tender Drawings. About 70 percent of the project engineers (61-percent-and-above range) support the need for obtaining the end-users approval on tender documents before tendering. This will close the chances on them for requests of changes during construction. The fourth-ranked issue is obtaining additional budgets for any changes initiated by end-users. This should be handled by the end-users and also have them appreciate the difficulty of consequences of any request for changes. This point is supported by the participants and could be the key toward minimizing changes. The fifth-ranked issue is the implementation of the Value Engineering (VE) program in the governmental construction projects. A very huge support of VE during the early stages of the design is due to the fact that VE deals with the optimum functions and its worth values, and it evaluates the design from a different perspective. The sixth-ranked issue is the allowance of consultants to revise tender documents. The seventh-ranked issue is the negotiation with the winner (contractor) prior to signing. Although negotiations with the winner prior to signing the contract may resolve any discrepancies and could decrease the chances of disputes and changes during construction, this issue did not attract the participants' attention. The eighth issue is the allowance of enough time for tenderers (contractors) to price their bids. This may decrease the risks and make the tenderers feel more comfortable with their prices. This issue is not supported heavily by the participants, which could indicate its low relation to change orders.

Conclusion

The data was collected from questionnaires sent to project engineers that are responsible in the management and supervision of large government-construction projects. The data, which was analyzed using a statistical-ranking formula called the Relative Importance Index, indicates the following points that have to be highlighted.

- End-users are the main initiators of change orders (due to either lack of experience or awareness).
- Considerable mistakes, discrepancies, or incompleteness are found in the design drawings, documents, and specifications.

In order to correct the situation in the proper way, the following suggestions are extremely helpful in reducing the issuance of change orders.

- Minimize the interference by the end-users during the construction phase of the project.
- Make a complete and thorough study of the design drawings, specifications, and documents before signing the contract.
- Conduct Value Engineering workshops during the early design stage.
- Apply cost control methods before, during, and after the construction phase of the project.
- Make sure you have satisfied the end-user needs without exceeding the approved budget before commitment with contractors.
- Update the design, if for any reason a delay has occurred in the pre-tendering period.
- Have the end-users approvals on tender documents before tendering.
- Allow the end-users to handle additional budget approvals for changes initiated by them.

References

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