The Impact of Change Orders on Construction Projects Sports Facilities Case Study

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Abstract: Change Orders in construction often have a serious impact on the quality, time, and cost of projects. Hence, Change Orders require proper analysisand action to measure the reasons and effects of change orders. This paper presents the most important factors considered to have impact on the time, and the cost of the project during its life cycle stages forsportsfacility projects in Egypt.These two dimensions of change order are applied to specific factors (Owner, Consultant, Contractor, Project Management, Local Authorities, Stakeholder, etc.).
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1. Introduction

Change is an event that results in any modification of the original scope. For example: prolongation of the time of execution and change in cost of work etc. Construction Change Orders are one of the most widely experienced Change Orders. However, many projects are plagued by severe construction disputes triggered by such changes. For a project to run its entire life without a single change orderwould mean that the design, execution, coordination, and communication on the project have to be almost perfect. But this is simply impossible. The words "Change Order" conjure strong feelings of negativity for all involved in construction projects. Owners do not like them because they generally feel they are paying for other's mistakes. Contractors believe thatChange Orders disrupt workflow and require additional paperwork and time. Engineers, contractors, and owners agree that projects would be better without change orders. Change Orders strain the relationships of the owners, engineer, contractors, subcontractors, and others involved in the construction process as well as add cost and schedule delay. Changes on one project can also affect other unrelated projects by trying up resources that are committed elsewhere. Negative relationships between the parties are another by-product of changes on a project. Not only is workflow disrupted, but also trying to get quick responses quotes, shop drawings, and many other things required to get back schedule causes a strain on working relationships.

Literature review:

A Change Order is the way used to compensate a contractor for additional costs or time on a construction project. A Change Order is an instrument prepared by the Engineer and signed by the owner, contractor, and engineer, each stating their agreement to any/all of the following: change(s) in work; the amount of the adjustment, if any, in the contract sum; and the extent of the adjustment, if any, in the contract time (AIA, 1997). There are two types of changes identified by A201 which include Change Orders and minor changes. The Engineer's authority to order a change is limited to minor changes which by definition do not have any impact on price or time.All changes under the A201 process begin with Construction Change directives (CCD's) which may be used to direct the contractor to execute a change in the project. The contractor must perform the directed work under this process even if there is disagreement on price or time. Upon full agreement between the owner, contractor, and architect as evidenced by their signing, the CCD is converted to a change order. Aggregate changes require supplemental documents such as bulletins describing the project change, subcontractor quotes and negotiation to obtain agreement between the parties.A change order may also be viewed as procurement without competitive bid (Wall Work, 2001). In some instances an owner at bidding may choose to defer a planned item until later in the project when confidence in project cost and progress is gained. A change may be executed to increase the scope of project at this time.

Change Order Causes:

Changes can originate from a number of sources, including the Owner, Architect, or the Contractor, as well as from the project itself. Complexity of construction project, a lack of coordination between design professionals, and misinterpreted design programs are the leading causes of change orders.Numerous authors have also identified and categorized potential causes of Change Orders.Jacobs and Richter (1978) Diekmann, Nelson (1985), and Clark (1990) classified Change Orders into three main categories: design errors and omissions, scope changes and unforeseen conditions. They have also suggested

that design errors and omissions is responsible for 65% of changes, design changes (scope changes) account for 30% and unforeseen conditions account for 5% (Ibbs, 1997). Civetello, in his book "Contractor's Guide Orders", identified many detailed causes of Change Orders and dedicates an entire chapter to "prospecting" for Change Orders (Civetello, 2002).According to Fayek, the majority of Change Orders result from errors or omissions in original contract documents (Fayek, 2002). Sufficient time is not often given to Engineers and Architects to review historical data and develop construction documents, and therefore often resulting in errors and/or omissions. Although human error cannot be eliminated from the process, significant reductions of the same are possible. Changes made on the drawing board and in the design office are a lot cheaper and less time consuming to implement than those made in the field (Ehrenreich, 1994).Owners often issue bid package addenda when responding to formal questions from bidders (McCally, 1997). Current practice is to address or resolve issues with addenda or during the construction phase in lieu of the design phase. This slows the project down and distracts the parties from concentrating on the end goal.This forces them to deal with the changes at hand, which are commonly referred to as "putting out fires". Contractors and designers are so preoccupied with making corrections and tweaking designs; they spend much of their time concentrating on certain part of the project and lose sight of project as a whole.In current practice, architects and engineers rely on general notes in the contract documents to cover unanticipated changes which may lead to damages or delays sustained by the contractor. Subsequently the controller may misinterpret the documents (Kirsch, 2000).

Research Scopeand objectives:

The study is undertaken in Egypt, a developing country; where the construction industry is has its unique challenges. The construction industry is faces high demand due to the need for development of an array of projects. The approach of this research was aimed to determine the impact and main causes which lead to Change Orders occurrence in Sports facility projects during construction.

2. ResearchMethodology:

The research methodology selected for this purpose comprised an extensive literature review, a questionnaire with a list of factors that were considered to have effects on Change Orders during all project life cycle stages of the sportsfacilities projects, and a statistical analysis of the data. The questionnaire consisted of two sections; Section (1) solicited general information about the respondents,while Section (2) carried a total of 36causes impacting change associated with Sports construction facilities.The likelihood of occurrence of these causes and the level of impact on each project objective was then determined. The survey was performed overtwenty weeks. The questionnaire was distributed to 65 construction practitioners in Egypt, out of which 33 responded.

Change Orders Identification and Assessment:

To develop the questionnaire;several interviews were conducted with twenty experts in the construction field to comply the general causes for nearly the most changes which effect on the cost and time. The general causes were covered in the questionnaire are listed and described below:

A - Changes attributed to the owner

1- Additional client request during the course of the project.
2- Stopped, disrupted or interrupted work.
3- Owner Financial difficulties.
4- Accelerated performance requested by the owner.
5- Delays from the owner's acts.
6- Initiated value engineering change.

B - Changes attributed to the designer/ Consultant

1- Design revisions (change).
2- Design errors or omissions.
3- Design deficiency.
4- Unanticipated works.
5- Discrepancies in the contract drawings.
6- Unavailable specified products.
7- Incomplete scope definitions.
8- Over inspection.
9- Differing site conditions.
10- Work method restrictions.

C - Changes attributed to the Contractor

1- Construction errors.
2- Construction omissions.
3- Remedial work.
4- Work out of sequence.
5- Material & equipment late delivery.
6- Following new or different schedule.
7- Contractor Financial Difficulties.
8- Lack of skilled labor.
9- Increased Risks.

D - Changes attributed to Project Management

1- Lack of Coordination.
2- Difference in contract interpretation.
3- Errors in contract documents.

E - Changes attributed to Local Authorities

1- Third party permits.
2- Governmental actions.
3- Restrictions in site access.
4- Utility relocation.

F - Changes attributed to Stakeholders

Impact scope changes definitions

G - Changes attributed to Force Majeure

1- Unexpected Events.
2- Acts of God.

Data analysis method:

The survey feedback includes two groups of data; the likelihood of occurrence of each cause of change order and its level of impact on project objectives in terms of cost, and time. The risk significant index developed by Shen*et al.* (2001) was used in this research. With respect to the impact on a particular project objective, the significance score for each cause of change order assessed by each respondent can be calculated through Equation (1).

Sij = αijßij …….(1)

Where

Sij is the significance score for cause of change order i as acknowledged by respondent j

αij is the probability of occurrence for cause of change order i, as acknowledged by respondent j

ßij is the level of contractors' potential loss (degree of impact) for cause of change order i, as acknowledged by respondent j (Shen, 2001).

Thus the

RSISi = (Σ Sij) / N…….(2)

Where

RSISi is the relative significance index score for cause of change order i Sij is the significance score for cause of change order i as acknowledged by respondent j

N is the number of respondents. (Shen, 2001).

The three-point scales for α (high likely, moderate likely, or low likely) andthe five-point scales for α ß (very high, high, moderate, low or very low) need to be converted into numerical scales, According to Shen*et al.* (2001). The matrix presented in Table 1 shows the calculation of the cause of change order significance index.

Table 1: Matrix for the calculation of the risk significance index

α \ ß	Very high(1)	High(0.8)	Moderate(0.6)	Low(0.4)	Very low(0.2)
Highly likely (0.1)	0.1	0.08	0.06	0.04	0.02
Moderate likely (0.5)	0.5	0.4	0.3	0.2	0.1
Low likely (1)	1	0.8	0.6	0.4	0.2

3. Survey Results:

The main purpose of this investigation is not to identify a list of causes of change order but to determine the effect of each reason during all project lifecycles. Change Order probability occurrence may be described in quantitative terms such as low, moderate, and high. The degree of its cost impact probability is the effect on project objectives if the Change Order event occurs and also can be described in quantitative terms such as very low, low, moderate, high and very high. These two dimensions of change order are applied to specific factors (Owner, consultant, Contractor, Project Management, Local Authorities, Stakeholder and Force Majeure) not to the overall project. Analysis of Change Order using probability and consequences helps identify those Change Orders that should be managed aggressively. Hence, only the top twenty ranked ones are chosen as significance causes of change order. The result of the previous survey is presented in Table 2.

Table 2 the list of the 20 reason of change order and which project phase can give great cost impact on the construction project

No.	Project Phase	Change Order Factor
1	Direct and Manage project Execution	Additional client request during the course of the project by the owner
2	Perform Integrated Change Control	Contractor Financial Difficulties
3	Direct and Manage project Execution	Unanticipated works by designer/ Consultant
4	Perform Integrated Change Control	Stakeholders
5	Direct and Manage project Execution	Design revisions (change) by designer/ Consultant
6	Direct and Manage project Execution	Owner Financial difficulties
7	Perform Integrated Change Control	Accelerated performance requested by the owner
8	Direct and Manage project Execution	Following new or different schedule by the Contractor
9	Perform Integrated Change Control	Following new or different schedule by the Contractor
10	Direct and Manage project Execution	Unavailable specified products by the designer/ Consultant
11	Direct and Manage project Execution	Stakeholders
12	Monitor and Control Project Work	Stakeholders
13	Direct and Manage project Execution	Initiated value engineering change by the owner
14	Monitor and Control Project Work	Initiated value engineering change by the owner
15	Direct and Manage project Execution	Stopped, disrupted or interrupted work by the owner
16	Monitor and Control Project Work	Unavailable specified products by the designer/ Consultant
17	Direct and Manage project Execution	Design deficiency by the designer/ Consultant
18	Perform Integrated Change Control	Lack of skilled labor
19	Direct and Manage project Execution	Third party permits
20	Monitor and Control Project Work	Third party permits

The most frequently and costly Change Orders were generated due to changes attributed to the owner 31%, while the second cause was changes attributed to the Designer/ Consultant by 25%, the third cause in order was changes attributed to the Contractor by 20%, the forth cause was changes attributed to Stakeholders by 15%, the fifth cause was changes attributed to Local Authorities by 9%, and no impact from the Project management or Force Majeure on the original cost or duration of the project.The Changes attributed to the Owner was considered to have the greatest impact on sports facilities construction project,as shown in Figure 1.

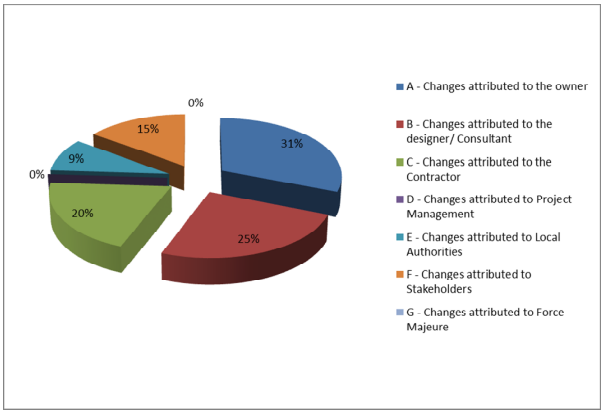

Fig.1 Percentage of frequency for the causes which gives great impact on the project

Conclusions:

The most frequent five reasons for Change Orders which have the greatest impact on projects are; additional client request during the project execution phase by the Owner, Contractor Financial Difficulties, Unanticipated works by designer/Consultant during project Execution phase, Stakeholders during Perform Integrated Change Control phase and Design revisions by designer/consultant during project Execution phase.The Owner was responsible for the most great impact change order on the construction project.

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