A REVIEW ON CHANGE ORDER AND ASSESSINGCAUSES AFFECTING CHANGE ORDER IN CONSTRUCTION

ARTICLE · JANUARY 2015

READS
54

3 AUTHORS, INCLUDING:

Dr. Jayeshkumar Pitroda
Birla Vishvakarma Mahavidyalaya Engineerin…

193 PUBLICATIONS **129** CITATIONS

SEE PROFILE

JOURNAL OF INTERNATIONAL ACADEMIC RESEARCH FOR MULTIDISCIPLINARY
Impact Factor 1.625, ISSN: 2320-5083, Volume 2, Issue 12, January 2015

A REVIEW ON CHANGE ORDER AND ASSESSINGCAUSES AFFECTING CHANGE ORDER IN CONSTRUCTION

JAYDEEP N. DESAI*
JAYESHKUMAR PITRODA**
PROF. JAYDEV J. BHAVSAR***

*Student of Final Year, M.E.(Construction Engineering& Management), B.V.M. Engineering College, Vallabh Vidyanagar, Gujarat, India
**Assistant Professor & Research Scholar, Civil Engineering Dept., B.V.M. Engineering College, Vallabh Vidyanagar, Gujarat, India
***Associate Professor, P.G. Coordinator of Construction Engineering Management, B.V.M Engineering College, Vallabh Vidyanagar -Gujarat-India

ABSTRACT

The construction process is a complex one and is associated with various changes. These changes usually lead to issuance of change orders. Change orders are usually issued to cover variations in scope of work, material quantities, design errors, and unit rate changes. Change Orders in construction often have a serious impact on the quality, time, and cost of projects. Hence, Change Orders require proper analysis and action to measure the causes and effects of change orders. It is difficult and risky to manage them, but it is required to manage change order in construction projects. However, past research has been done on Change order are mostly qualitative and there is a lack of quantitative research. Due to this lack of quantitative research, there is no good-developed framework for causes and effects of Change order in the construction industry. This paper deals with identification of causes and effects of change order and developing a framework for assessing the causes of Change Order. In the end, a framework has been developed which can be used for the future research in this area.

KEY WORDS: Change, Change order in Construction, Causes, Effects, Framework.

INTRODUCTION

Change order on a construction project is a work that added to or deleted from the original scope of work of a contract which alters the original contract amount or completion date, unavoidably a change order represents a problem on the project in terms of additional cost, or additional time or both. Change orders play a significant role in construction because they have a great impact on cost, schedule, quality, safety, and productivity. So, they are one of the major causes of project failure.

Approximately every construction project throughout its lifecycle confronts with numerous changes which frequently bring about cost and schedule overruns quality defects along with various unfavourable impacts. Actually changes happen due to the uniqueness of each

construction project as well as restricted resources available for planning such as time, money and manpower. The formal way of implementing of changes in the project is by the Change Order which authorizes the contractor to execute defined changes in the project. These changes are often the origin of project disputes and future claims.

Change order is the most critical part in any construction project, as they are occurring by any parties which involved in it. Therefore, causes which influence change order and its effects on construction project are very much critical for any construction firms. Impact of change order on construction projects and effective management of change order is required to be done. They may change from project to project, place to place, time to time and also with respect to the type of work.

PREVIOUS RESEARCH REVIEW BASED ON CHANGE ORDER AND ASSESSING CAUSES AFFECTING CHANGE ORDER IN CONSTRUCTION

Diekmann et al. (1985) examined the cost of change orders on 22 federal construction projects and found that change orders on these projects averaged 5.5% of the contract value. [5]

Fleming et al. (1990) found in his study that changes in construction project can cost between 10-15% of a contract's value. Fleming also developed Framework, which aims to provide the management of project change with a tool that will enable construction professionals to consider and analyze the changes that occur on projects from cause to consequence. To determine whether a change is feasible and to provide a result that is favorable to all parties. [6]

Thomas et al. (1995) causes for change orders vary greatly, thus making the task of change management difficult for most clients. He reviewed 522 days' work on three different projects. This analysis showed that on many days (fewer than half) it was possible to incorporate change orders into the project without hurting labour productivity. However, the average impact of all changes was a 30% loss of productivity, indicating that when the impact is negative, it is substantial. The analysis concluded that the timing of change was a key variable affecting productivity. [29]

Ibbs et al. (1997) in his study found that the amount of change is negatively correlated with productivity and total installed project cost, whether within the design phase or construction phase, or between them. He also found that the greater the amount of change, the more productivity and costs are degraded. He also analyzed that if some small fraction of the $60 billion spent annually on change were invested in research and development, the construction industry would be a much more cost-effective business. [12]

Aldubaisi et al. (2000) described that changing the plans by the owners is the main source of change orders, change in mind, substituting materials and/or procedures is the second source of change orders and errors and omissions in design are another source. Increase in project cost and duration were founded as the main two effects of change orders. [3]

Johnson et al. (2000) said that significant change conditions resulting in change orders to a construction contract are generally due to one of four situations: underground conditions different from those identified in the contract document, differing existing conditions often associated with remodeling work on an existing building, owner request and changes, and regulatory review. [18]

Hanna et al. (2004) showed that the most common reasons for change orders are additions, design changes, and design errors, all of which can theoretically be eliminated in the design stage. Recommend that the time between the initiation of the change order and its approval should be kept as short as possible because they found that the project is more likely to see a smaller productivity loss if the processing time of change orders is shortened. [8]

Hsieh et al. (2004) reviewed recorded change orders in 90 effective metropolitan public work projects completed before the year 2000 in Taipei, Taiwan. The study categorized causes for change orders in a detailed hierarchy that divides the causes into two main dimensions, i.e., technical and administrative, which in turn are also divided into nine categories. Thirty-five causes among nine categories are ranked according to their contribution level to seven indices representing the impact or effect of change orders.[11]

Ssegwa et al. (2004) described that the major cost due to change is the cost of rework or revision of work which in construction projects can be as high as 10-15% of contract value. Rework is an example of a direct effect of the project change. In addition to direct effects, project changes can also bring some indirect effects, which will ultimately have an impact on project cost and schedule. [27]

Love et al. (2004) presented a number of recommendations to reduce rework such as: understanding and identifying client and end-user requirements and implementing techniques for mitigating change; auditing contract documentation and providing a risk assessment for the potential of change and errors; implementation of training programs to enhance skills and knowledge.[19]

Osama et al. (2005) carried a study conducted to investigate the impact of change orders on construction productivity and introduces a new neural network model for quantifying this impact. A prototype software system is developed to estimate the percentage loss of labour

productivity due to change orders. The developed software provides a user-friendly interface to facilitate data entry and to assist users in generating a response to a number of what-if scenarios. The results of the analyses indicated that the present neural network model provides, in comparison to the other models, more accurate estimates of the impact of change orders on productivity. [22]

Ibbs et al. (2007) used the methods available for quantifying lost productivity to visualize relationships among uncertainty, effort and expertise to use, and the level of contemporaneous project documentation required of these methods. He also stated that the keys to successfully achieve cumulative impact claims are Credibility of analysts, explicit connections between damages and causes, and an acceptable level of accuracy for measuring lost labor productivity. [14]

Gerald et al. (2007) described a quantified investigation of the effects of changes on labor productivity. The study was based on a detailed review of 90 claims, each from a separate contract. The cases were divided into two groups: civil/architectural and mechanical/electrical. The percentage loss of productivity was shown as a function of the percentage of the total work hours spent on changes. A four or fivefold increase in the percentage of work hours spent on changes lead to 10-20% loss of productivity. [7]

Oladapo et al. (2007) explored the significance of variation as a cause of cost and time overruns explored. The study displayed that changes in specification and scope initiated mostly by project owners and their consultants are the most sources of variation. [21]

Perkins et al. (2007) examined the causes for construction phase changes in 23 private design/build and 20 government design/build construction projects in the United States. He found that changes might arise from: owner-requested additions/deletions to the work; the action of third parties beyond the control of the owner or contractor; delays in owner-supplied access or equipment; differing site conditions; and discrepancies in the original design specifications. He reported that the number of changes due to design error in design/ build construction is statistically significantly lower than that of the design-bid-build construction. [23]

Hao et al. (2008) stated that effectively managing change orders in construction processes is not trivial because change orders are a part of the contract and they need to be strictly traced in terms of contracts. He developed a generic change process model is proposed having five stages in a sequence: identify, evaluate & propose, approve, implement and review. [9]

Homaid et al. (2009) investigated 21 causes and 11 potential impacts of change orders. Also, nine practices reported to management and control of change orders. The study identified eleven important causes and seven important impacts. It is further concluded that the

consultant is the most responsible party for the change orders. The overall average increase in total cost of construction projects due to change orders was found to be 11.3%. The research concluded that change of project scope due to owner requirements is the most important cause and cost overruns are the most important impacts of change orders in those projects. [10]

Jawad et al. (2009) presented causes, effect, and controls of variation orders in large building construction. The study concluded that the owner is the major source of variation and that most variation is civil and structural. [17]

Alnuaimi et al. (2010) investigated the causes, effects, benefits and remedies of change orders on public construction projects in Oman, they divided the causes of change order into client related, consultant related, contractor related and others. They concluded that client's additional works and modification to the design were the most important factors causing change orders, followed by non-availability of construction manuals and procedures. The most important effects of change orders on the project were found to be the schedule delays, disputes, and cost overruns. The contractor was found to be the party most benefiting from the change orders followed by the consultant and then the client. [4]

Ross et al. (2010) presented causes of variation and change orders in group as owner-related variations; consultant related variations; contractor-related variations; and other variations. He found various causes of variations through case study: errors and omissions, ambiguous design details, poor design, poor working drawing details, change in specifications by owner, poor coordination. Additionally, causes of variations through questionnaire survey findings are: conflicts between contract documents, lack of involvement in design. Andrew David Ross also recommended that Variations can be avoided or minimized through successful contract preparation and execution phases, successful project management, and sustainability in the parties' relationships and emergence of variations and change orders can also be minimized through the contractor's involvement at the design stage.[25]

Sunday et al. (2010) identified 53 causes of variation orders for the formulation of the questionnaire. 58 questionnaires were distributed to the in-house construction professionals, consultants and contractors involve in handling government projects. 30 in house staff responded to the questionnaire and 18 responded by both the consultants and contractors who were involved in government construction projects. Through the analysis of the data it was discovered that the projects handled by the consultants are more prone to variation orders than projects handled by the in-house professionals. Aside the study also discovered that the percentage difference in the initial contract sums and final sums was significant both for the

projects managed by the in-house project staff and the consultants but higher in the consultants managed projects. The study concluded that the projects handled by the consultants suffered both cost and time overruns than the projects handled by the in-house staff. [28]

Wambeke et al. (2011) examined the similarities and differences between craft workers, foremen, and project managers in terms of starting time and task duration variation. He summarized the causes of variation, which account for a total of over 19 hours of variation per week. [30]

Ibbs et al. (2012) in his research examined 226 projects in an attempt to better quantify patterns. He developed a set of curves and reference points that contrast the amount and likelihood of change with the amount and nature of its impact. He also find out major finding of this study is that the ratio of final project costs with estimated project costs is substantially higher than conventionally thought. Approximately 40% of all projects in this study experienced more than 10% change. He also stated that even when a project has little or no change, costs, schedules, and labour productivity can vary considerably from the plan. Thus, minimizing change is important for realizing good cost, schedule, and productivity performance. [13]

Ijaola et al. (2012) indicated in his study that the "clients' additional works and modification to design" were the most important causes of change order in both Nigeria and Oman, the most important effects of change order are "variations result in claims and disputes" in Nigeria while "delay in the completion date of the project and cost overruns" were the most important effects in Oman. He also identified the contractor as the most benefiting parties in change order. He determined certain points that are: Implementation of National Building Code, Review of contractor's/ consultant's registration should be carried out periodically to ascertain their professional competency, the Client should carry out proper feasibility study and survey before the design stage. [15]

Jawead et al. (2012) identified that there is not only a need to apply an appropriate variation order management system to Saudi public sector construction project at the design stage, but it also present participant's suggestions are invited. [16]

Moghaddam et al. (2012) formulated 8 open-ended and 16 close-ended questions. He showed that there is not a change management procedure available in the Iranian construction industry; therefore, the existence of such procedure is vital in order to achieve the contractual obligations of time, cost and quality. [20]

Rashid et al. (2012) said that 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 in one project can also affect other unrelated projects by tying 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.[24]

Soares et al. (2012) in his study concluded that the best way to manage change orders is to reach a negotiated solution between the different parties. The initiation of change orders in a construction project correlated with the level of integration of the services of design and construction. [26]

Albalushi et al. (2013) investigated the cost overrun in public construction projects in Oman. He also identified the average change in budgets during the design period was 257.6 %; while in construction period was 11.4 %. This indicates that cost overrun initiates at design stage. Accordingly, the review of design systems is very essential to avoid the problem. [2]

Alaryan et al. (2014) investigated the change orders in construction projects in Kuwait by conducting a questionnaire surveying of the owners, contractors and consultants to identify the major causes of change orders, their effects on projects and controls measures. The most five common causes of change orders can be identified as: change of plans by owner, change of project scope by owner, problems on site, errors and omission in design, poor working drawing details. The five most common effects of change order are increasing the project's cost, increasing the duration of individual activities, delaying in completion schedule, additional money for the contractor, and delaying in payment. Finally, the most six common control measures are: checking and reviewing the contract documents, reviewing design before change approval, the change order must be negotiated by knowledgeable persons, the scope of change orders must be clearly made, appropriate approval in writing must be

Handed, and best tools to control the occurrence of change, including the areas of concern in monthly reports and meetings. [1]

Based on the literatures studied, the following figure 1 has been shown, describing the studied papers published till the year stated and indicating the key findings till this year.

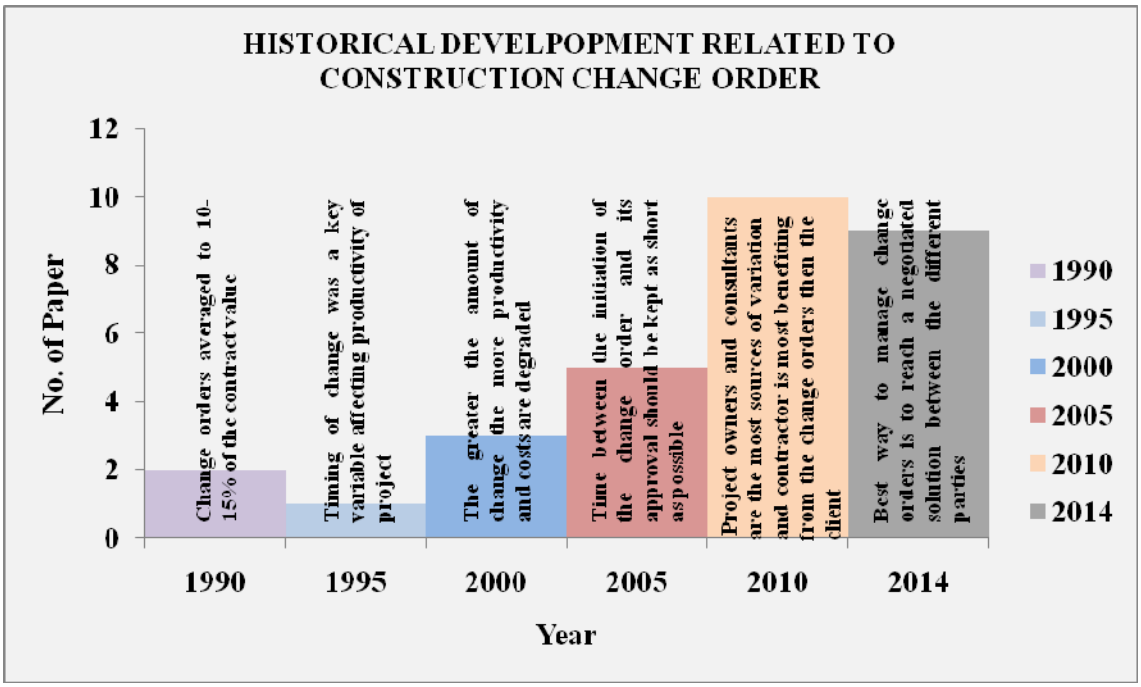

Figure 1: Historical Development of Causes of Change Order

CONCLUSION

This review research investigated the causes and impacts of change orders in construction projects are as follows:

1. Change orders on construction projects averaged 10-15% of the contract value. [5,6]
2. The greater the amount of change, the more productivity and costs are degraded. [12]
3. Change in plans by the owners is the main source of change orders, change in mind, substituting materials and/or procedures is the second source of change orders and errors and omissions in design is another source. Increase in project cost and duration were founded as the main two effects of change orders.[3]
4. The most common reasons for change orders are additions, design changes, and design errors, all of which can be removed from the design stage. The time between the initiation of the change order and its approval should be kept as less as possible.[8]
5. Percentage of work hours spent on changes lead to 10-20% loss of productivity. [7]
6. Changes in specification and scope initiated mostly by project owners and their consultants are the most sources of variation.[21]
7. The consultant is the most responsible party for the change orders. The research concluded that change of project scope due to owner requirements is the most important cause and cost overruns are the most important impacts of change orders in those projects. [10]

8. Client's additional works and modification to the design were the most important factors causing change orders. The most important effects of change orders on the project were found to be the schedule delays, disputes, and cost overruns. [4]
9. Minimizing change is important for realizing good cost, schedule, and productivity performance. [13]
10. 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. [24]
11. The average change in budgets during the design period was very more; while in construction period was very less. [2]

After identifying these causes and impacts of change orders, an integrated framework for assessing the causes and impacts of change orders in construction projects was developed, which contained main 4 groups containing different 22 causes and impacts of change orders. This framework, shown in figure 2 (See Annexure), shall be used for future research work.

ACKNOWLEDGMENT

The Authors thankfully acknowledge to Dr. C. L. Patel, Chairman, Charutar Vidya Mandal, Er. V.M.Patel, Hon.Jt. Secretary, Charutar Vidya Mandal, Mr. Yatinbhai Desai, Jay Maharaj construction, Dr. F.S.Umrigar, Principal, B.V.M. Engineering College, Dr. L.B.Zala, Headand Professor, Civil Engineering Department, Prof. J. J. Bhavsar, Associate Professor, Civil Engineering Department, B.V.M. Engineering College, Vallabh Vidyanagar, Gujarat, India for their motivations and infrastructural support to carry out this research.

REFERENCES

1. Alia Alaryan et al Int. Journal of Engineering Research and Applications, ISSN : 2248-9622, Vol. 4, Issue 7(Version 2), July 2014, pp.01-08.
2. Albalushi I.,Fathoni Usman and Ali S. Alnuaimi, "Construction Cost Overrun and Variations: Investigation on Its Causes and Consequences", Australian Journal of Basic and Applied Sciences, 7(14) December 2013, Pages: 311-323.
3. Al-Dubaisi, A.H. (2000). „Change Orders in Construction Projects in Saudi Arabia'. M.Sc. Thesis, Faculty of college of graduate studies, king Fahad University of Petroleum and Minerals, Saudi Arabia.
4. Alnuaimi, A., Taha, R., Mohsin, M. and Alharthi, A. (2010), „Causes, Effects, Benefits, and Remedies of Change Order on Public Construction Projects in Oman', Journal of Construction Engineering and Management, 136(5), 615–622.
5. Diekmann, J. & Nelson, M. (1985). Construction claims: frequency and severity. Journal of Construction Engineering and Management, March, 111: 74-81.
6. Fleming A, S. Senaratne, M. Sexton, M. Sun*, G. Aouad, "Managing Project Change in Construction:The Dependency Framework"
7. Gerald McEniry,Published by Revay and Associates Limited Volume 26 Number 1 May 2007
8. Hanna, A., Camlic, R., Peterson, P., and Lee, M. (2004). "Cumulative effect of project changes for electrical and mechanical construction." J. Constr. Eng. Manage., 130(6), 762–771.
9. Hao, Weiming Shen, Joseph Neelamkavil, Russ Thomas, "CHANGE MANAGEMENT IN

CONSTRUCTION PROJECTS" CIB W78 (2008) International Conference on Information Technology in Construction Santiago, Chile.

10. Homaid, N., Eldosouky, A. and AlGhmdi, M. (2009), „Change Orders in Saudi Linear Construction Projects'.Emirates Journal for Engineering Research, 16(1), 33-42.
11. Wu, C., Hsieh, T. and Cheng, W. (2005), 'Statistical analysis of causes for design change in highway construction on Taiwan'. International Journal of Project Management, 23, 554–563.
12. Ibbs William (1997)." Quantitative Impacts of Change on Project Cost & Schedule". ASCE Journal of Construction Engineering andManagement. 123(3). September 1997.123 (3) 8- 011.
13. Ibbs William (2012).Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, Vol. 4, No. 3, August 1, 2012. ©ASCE, ISSN 1943-4162/2012/3-67–73/$25.00.
14. Ibbs William (2007).Journal of Professional Issues in Engineering Education and Practice, Vol. 133, No. 1, January 1, 2007. ©ASCE, ISSN 1052- 3928/2007/1-45–52
15. Ijaola, I.A and Iyagba R.O, "A Comparative Study of Causes of Change Orders in Public Construction Project in Nigeria and Oman", Journal of Emerging Trends in Economics and Management Sciences (JETEMS) 3(5): 495-501 © Scholarlink Research Institute Journals, 2012 (ISSN: 2141-7024 jetems.scholarlinkresearch.org
16. Jawead A; Bowles G and Chen Z (2012) Current practice of variation order management in the Saudi construction industry In: Smith, S.D (Ed) Procs 28th Annual ARCOM Conference, 3-5 September 2012, Edinburgh, UK, Association of Researchers in Construction Management, 1003-1012
17. Jawad, R., Abdulkader, R. and Ali, A. (2009), 'Variation Orders in Construction Projects'. Journal of Engineering and Applied Sciences, 4(3), 170-176.
18. Johnson J. (2000), "Practitioner's Forum: Construction Quality Assurance under Change Conditions", Journal of Architectural Engineering, 6(4), 103-104.
19. Love P., Irani Z. and Edwards D. (2004), "A Rework Reduction Model for Construction Projects", IEEE Transactions on Engineering Management, 51(4), 426-440.
20. Moghaddam G A., Change Management and Change Process Model for the Iranian Construction IndustryInt. J. Manag. Bus. Res., 2 (2), 85- 94, Spring 2012 © IAU
21. Oladapo, A. (2007), 'A quantitative assessment of the cost and time impact of variation orders on construction projects', Journal of Engineering, Design and Technology, 5(1), 35 – 48.
22. Osama, M., Assem, I., and El-Rayes, K. (2005). "Change order impacts on labor productivity." J. Constr. Eng. Manage., 13(3), 354–359.
23. Perkins, R. A. (2009). "Sources of changes in design/build contracts for a governmental owner, management of engineering and technology." Portland International Centre for Publication, 5–9, 2148–2153.
24. Rashid, I., Elmikawi, M. and Saleh, A. (2012), 'The Impact of Change Orders on construction projects Sports Facilities Case Study'. Journal of American Science, 8(8), 628-631
25. Keane, P., Sertyesilisik, B. and Ross, A. (2010), 'Variations and Change Orders on Construction Projects'. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 2(2), 89-96.
26. Soares, R. (2012), 'Change Orders: the Output of Project Disintegration'. International Journal of Business, Humanities and Technology, 2(1), 65-69.
27. Ssegwa (2004) The Engineering and Physical Sciences Research Council, "Managing Changes in Construction Projects", Industrial Report written and compiled by the research team.
28. Sunday, O A (2010) Impact of variation orders on public construction projects. In: Egbu, C. (Ed) Procs 26th Annual ARCOM Conference, 6-8 September 2010, Leeds, UK, Association of Researchers in Construction Management, 101-110
29. Thomas, H. R., and Napolitan, C. L. (1995). "Quantitative effects of construction changes on labor productivity." J. Constr. Eng. Manage., 121(3), 290–296.
30. Wambeke, B., Hsiang, S. and Lie, M. (2011), 'Causes of Variation in Construction Project Task Starting Times and Duration'. Journal of Construction Engineering and Management, 137(9), 663-677.

ANNEXURE

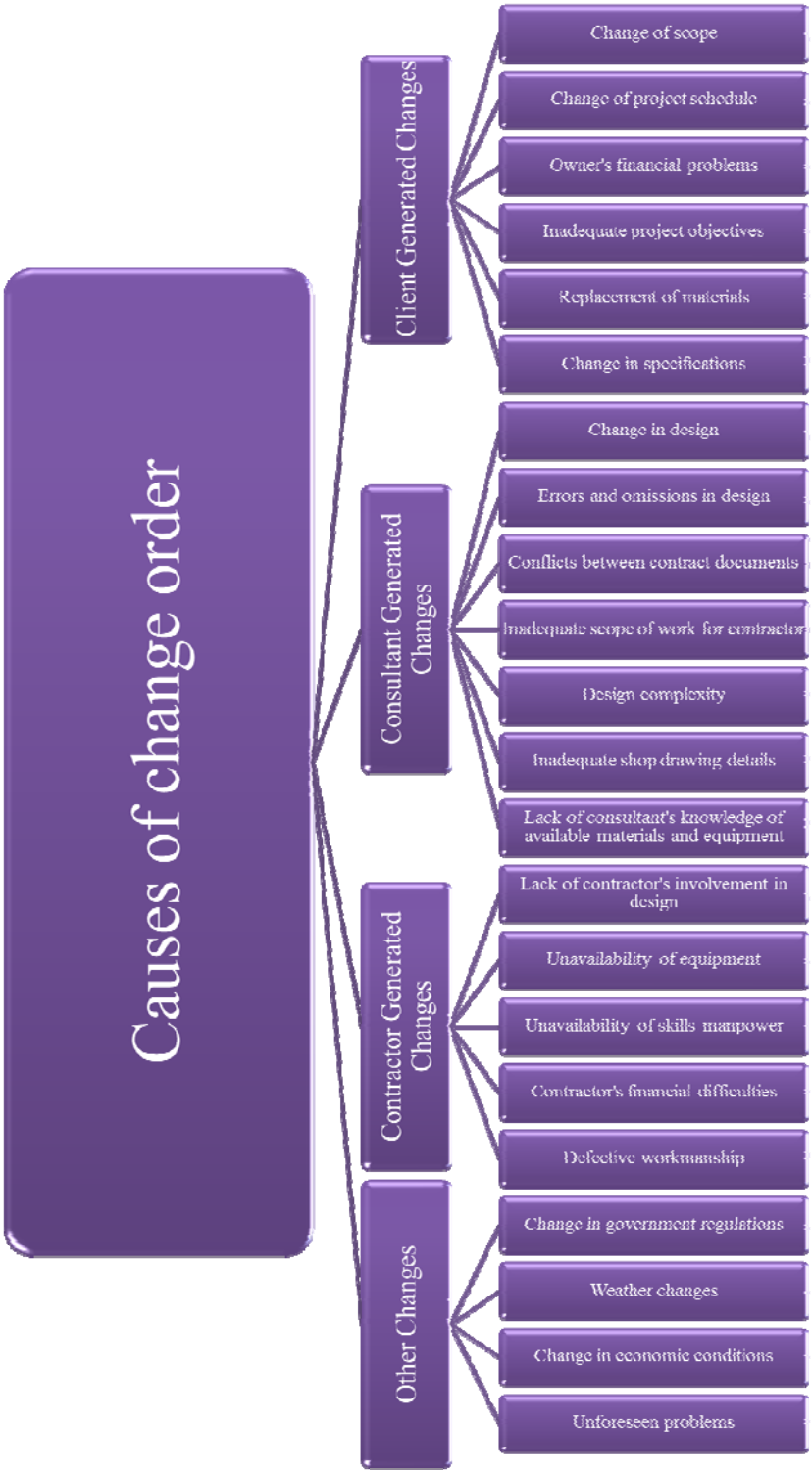

Figure 2: Framework for Assessing Causes of Change Order