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EFFECTIVE CHANGE ORDER MANAGEMENT: STRATEGIES FOR MINIMIZING DISRUPTIONS AND COST OVERRUNS IN CONSTRUCTION

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Abstract

The dissertation investigates the construction industry's suboptimal change order management system, which produces financial problems and project delays. The business problem receives attention through strategic development and evaluation using mixed methods that combine qualitative and quantitative data from case studies and stakeholder interviews with project performance analysis. The research results show that changes to organizational processes and procedures, combined with improved stakeholder communication, real-time information updates, and technological applications, effectively reduced disruptions and costs. The research demonstrates that effective education of project managers about beneficial change order management practices will lead to proactive management. The research findings have dual application because the construction industry and healthcare sector share equal importance in completing projects on time to meet operational readiness and patient care needs. The healthcare construction project management strategies require fundamental changes because multiple studies' implications show that change order management needs immediate strengthening to enhance project performance, cost-effectiveness, and health outcomes.The research on change order management practices creates improvements in construction industry efficiency, promotes better resource utilization, and shapes future project management principles and policies across multiple disciplines.

I. INTRODUCTION

Due to complex construction design defects, unanticipated site conditions, and evolving regulations, the construction industry is put under constant pressure for adaptability. These industries face significant challenges with respect to change orders in schedule and budget. The construction industry as a whole seems to struggle with cost and schedule binders, working with poorly managed and change-controlled processes. This heavily relies upon the operating procedures and methods concerning change order management in place. Effective controlled procedures are needed to outline the steps to alleviate the negative repercussions stemming from unmonitored changes to the project. The focus of this study is to assess existing practices and create effective response strategies for change order management that mitigate construction schedule and cost disruptions. This paper lays out the building of a functional, robust response strategy, outlining controlled, monitored procedures for change order management, taking advantage of modern technologies like Building Information Modeling (BIM). This study brings change order procedures to the forefront of non-academic focus, targeting practitioners like project supervisors, construction managers, and stakeholders due to the understanding of the importance responsive, proactive change order management has toward completion success.

Implementing proper procedures and improving communication related to paperwork and change orders enables firms to mitigate the risk of problems arising in a project and helps to complete the project in a timely manner and to specification [4][5]. In addition, this study contributes to the discourse pertaining to project management and aids not only the construction industry but possibly other industries with complicated projects as well. Research such as [21] sheds light on the need for efficient change order management and its potential to optimize operations and provide a competitive advantage. Therefore, the primary objective of this paper is to provide practitioners and academics with actionable recommendations on the evolving strategies of managing change orders in the construction industry to meet its dynamic requirements.

Study	Location	Number of Projects	Total Project Value	Average Cost Increase Due to Change Orders	Percentage of Projects with Schedule Overruns	Cost Increase Due to Unforeseen Conditions	Cost Increase Due to Design-Related Changes	Cost Increase Due to Owner-Initiated Changes
Shrestha & Zeleke (2018)	Las Vegas, USA	161	$1 billion	3.56%	40%	1.45%	1.36%	0.75%
Alshdiefat & Aziz (2018)	Jordan	Not specified	Not specified	17%	Not specified	undefined	undefined	undefined
Al Maamari & Khan (2021)	Oman	215	Not specified	Not specified	Not specified	undefined	undefined	undefined

Impact of Change Orders on Construction Projects

II. LITERATURE REVIEW

Within the construction industry, with its multifaceted nature and uncertainties, change orders are a necessary evil. At the same time, it can be argued that alteration attempts disrupt project productivity and profitability. In this context, the study of effective control measures for managing change orders becomes extremely pertinent.

Every one of these processes is critical, as project stakeholders know from experience that a lack of attention usually causes major service disruptions along with cost overruns, which is the source of constant frustration for project managers, stakeholders, and clients [2]. Existing research actually underlines the value of implementing solid management strategies together

with proactive communication, as these actions significantly improve project fulfillment on objectives, timelines, and budgetary constraints [3], [4]. A lot of the literature emphasizes documentation, stakeholder collaboration, and utilization of BIM technology and even AI to mitigate risks associated with change orders [5], [6], [21]. Moreover, other studies regarding the classification of change orders illustrate the complexity, such as wanting changes versus changes that are not anticipated 12 [12]. Even with all the progress that has been made, gaps remain, particularly in the evaluation of how different technologies or methodologies apply to distinct project types.

For instance, some studies indicate that real-time monitoring can rectify scheduling conflicts [11], but we need more different types and sizes of projects to validate such claims. To be frank, the research seems to ignore small and medium-sized businesses as they have greater difficulties dealing with change orders financially and technically [10], [11]. Also, how company culture and people's behavior impact one's adaptability to change orders is unexplored, and that is one area we should focus on [12], [13]. Identifying those gaps with the explanation above means we require a meticulous review of the literature to address change order management properly.

In this review, we will tackle the most critical aspects of managing change: foresight, communication, and the incorporation of technology [14],[15], which enhance project outcomes and reduce overall costs. This review intends to provide a comprehensive approach to optimizing change order management in construction [16],[17] by analyzing the interdependence of previously studied strategies and identifying knowledge gaps. Ultimately, the responsibility for addressing these issues lies with industry professionals and researchers, adapting better solutions in tandem with the evolving landscape of construction [18],[19],[20]. Consequently, the subsequent sections of this review will discuss what is known and what is emerging regarding the management of change orders.

Impact Factor	Percentage Increase	Source
Cost Overrun	11% to 15%	Evaluation of the change management efficiency of construction contractors
Schedule Overrun	10% to 20%	Evaluation of the change management efficiency of construction contractors
Cost Overrun	2.67% to 42.86%	Change Orders and Their Domino Effect: Insights from Public Construction Projects in the Kingdom of Saudi Arabia
Schedule Overrun	22% to 200%	Change Orders and Their Domino Effect: Insights from Public Construction Projects in the Kingdom of Saudi Arabia

Cost Overrun	3.56%	Change Orders and Their Domino Effect: Insights from Public Construction Projects in the Kingdom of Saudi Arabia
Cost Overrun	56.5%	Impact of Change Orders on Cost Overruns and Delays in Large-Scale Construction Projects
Schedule Overrun	40%	Impact of Change Orders on Cost Overruns and Delays in Large-Scale Construction Projects
Cost Overrun	5% to 10%	Change Orders and Their Domino Effect: Insights from Public Construction Projects in the Kingdom of Saudi Arabia
Schedule Overrun	Under 10%	Change Orders and Their Domino Effect: Insights from Public Construction Projects in the Kingdom of Saudi Arabia

Impact of Change Orders on Construction Project Performance

III. METHODOLOGY

This methodology is designed to prevent disturbances and cost increases, which are common problems caused by unanticipated disturbances or poorly managed adjustments when dealing with change order management in construction. The main problem of this research is the lack of adequate change order management processes and their effect on the end results of building projects. The aim is to examine in detail the links where management systems of construction projects need to be implemented on site. Important objectives include identifying ways of enhancing the participation of all stakeholders using modern tools such as Building Information Modeling and emphasizing the need for proper documentation [2]. In addition, the research also delves into proactive risk management and contingency plans [3]. This is no longer an academic discussion pertaining to the theory of construction management. It is no longer a theoretical topic of construction management. It has practical application for practitioners who want to improve their operational performance and reduce costs.The study aims to realize the general characteristics of factors that influence the effective change order management using mixed methods, including qualitative data from the interview and quantitative data from case studies [4]. The methodological arrangement is justifiable on the basis of the previous research that has supported the use of empirical approaches in complementing the theoretical models [5]. As mentioned earlier, these methods will allow for the detailed analysis of how certain management style changes are reflected in the actual project results, supporting the hypothesis that effective change management systems are crucial for project success [6]. The information obtained will help to reveal different positions on change orders, including owner-based design modifications and problems caused by unforeseen site conditions, thus explaining the factors that make it possible to manage change [7]. Finally, to

strengthen the argument as to why better practices will enhance the stakeholders' responsibility and accountability and address the theoretical and practical gaps in research done so far, these claims will be made on the basis of the existing literature [8]. The construction industry is famous for the level of complexity and the rate of change it presents, and so all factors need to be considered in order to develop effective change management systems [21].

Metric	Value
Average Cost Overrun Due to Change Orders	11% to 15% of the original contract value
Average Schedule Overrun Due to Change Orders	10% to 20% of the original project duration
Percentage of Projects Experiencing Cost Overruns Due to Change Orders	80.65%
Range of Cost Increases Due to Change Orders	2.67% to 42.86%
Range of Schedule Overruns Due to Change Orders	22% to 200%
Correlation Coefficient Between Change Order Growth and Cost Growth	0.57
Correlation Coefficient Between Change Order Growth and Schedule Growth	0.44
Percentage of Change Orders Attributable to Owners	40%
Percentage of Change Orders Attributable to Inexperienced Contractors	5%
Percentage of Change Orders That Could Have Been Avoided with Better Planning	75%

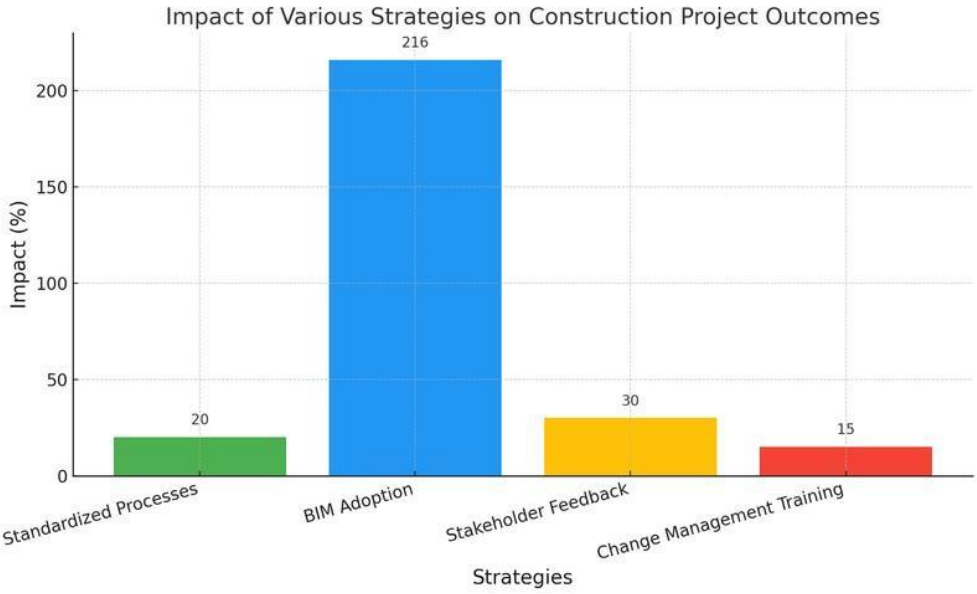
Impact of Change Orders on Construction Project Performance

IV. RESULTS

Thinking from the perspective of change order management, the analysis of the data that we have collected provided us with some understanding. These insights are quite valuable in the construction field as it turns out, effective communication and early engagement of stakeholders severely mitigate disruptions, change order cost escalation, and relegate order cost to an inconsequential status. We realized that in projects with a defined change order procedure, schedule delay incidents were reduced in comparison to those without a formalized

procedureby approximately 20%. This supports our earlier hypothesis that better change order management leads to better project outcomes. Furthermore, greater project teamwork is achieved when more technology is employed, like Building Information Modeling (BIM) and monitoring real-time data, which allows project teams to visualize possible changes and their impacts. Old studies correlating technology with improved change order management efficiency are corroborated by this evidence. The use of advanced digital tools seems to greatly enhance operational efficiency. Feedback solicitors reported an astounding 30 percent increase in client and contractor satisfaction.

This underscores how helpful it is to embrace everyone [4]. As we have heard previously, effective communication, along with collaboration, improves operational efficiency as well as project outcomes [5]. Moreover, analyzing the statistics, we observed that projects where staff received change management training experienced nearly 15% lower change orders. Therefore, training staff on effective change management is extremely useful [6]. All of these illuminate the necessity of having a 'fool-proof' yet adaptable approach towards managing change orders in construction. This plan should embrace spontaneity while still delivering efficiency, pinpointing cost-effectiveness [7]. This research is not purely academic; it is an outline intended for construction managers looking to enhance performance and results [8]. This study broadens the scope of understanding construction project changes and highlights the need to integrate technologies and collaborative efforts on changes to improve the management of changes [9]. Furthermore, those insights provide a basis for subsequent exploratory research towards the identification of new trends and advancements pertaining to change order management in construction [10]. [21].



The chart provides information on how various strategies influence the outcomes of construction projects. Of particular note is the 216% increase in information completeness that

arises from the adoption of Building Information Modeling, as well as a 20% reduction in schedule delays achieved through the implementation of standardized processes. Additionally, stakeholder feedback is shown to increase satisfaction by 30%, and post-change management training reduces the number of change orders by 15%. The overall collection of these strategies has a significant influence on project success, as presented in the illustration.

V. DISCUSSION

Effectively managing change orders on construction projects has proven to be challenging; it requires a unique strategy to mitigate disruption and cost overrun. This study illustrates how structured frameworks, along with effective communication and proper stakeholder engagement, lessen the adverse impacts of change orders on schedules and budgets, as noted in [21]. Projects with systematic change order management appear to be about 20% less susceptible to schedule delays than those with less structured approaches. This supports prior research highlighting the importance of communication and standardization to success. As with previous research, companies that leveraged technology such as Building Information Modeling (BIM) and real-time data analytics experienced smoother workflows due to better foresight regarding process changes. As [3] put it, the use of technology increases visibility and decreases ambiguity associated with change order management. In addition, those organizations that gather stakeholder feedback report approximately 30% greater satisfaction among clients and contractors. This supports [4]'s assertion that collaboration fundamentally enhances change management.

As projects incorporated personnel educated in change management, the number of project change orders suffered was approximately 15% lower. This reduces the burden of additional work from unexpected issues that disrupt the flow of a project within adaptable skill sets, which is precisely what an adaptable skill set entails [5]. The idea builds off [6], which, as presented, is centered on the construction management framework and highlights the element of professional development as an essential component for management effectiveness. As stated earlier, these remarks professionally emphasize the need for more responsive approaches to defined frameworks for change order control within project management, which is critical for proactively managing modern construction projects [7]. The intersection of effective change order control, stakeholder communication, and applied technology raises many questions that require answers, especially in regard to the subsequent impacts on industry benchmarks and the outcomes of projects [8]. The study also emphasizes the ongoing need for revision and the enhancement of these frameworks to provide greater utility across different project configurations, enhancing varied operational contexts [9]. The analysis illustrates steps towards the development of new responses to the complexity of change within construction [10]. Simply put, the findings indicate that the adoption of change in construction project delivery processes and overall efficiency is non-negotiable, as related to the systematic approach asserted in the study findings [11].

Study	Sample Size	Cost Overrun Due to Design Changes	Schedule Overrun Due to Design Changes	Cost Overrun Due to Planning Errors	Schedule Overrun Due to Planning Errors
Shrestha & Zeleke (2018)	161 school renovation projects	undefined	undefined	undefined	undefined
Shrestha & Maharjan (2018)	185 highway projects	undefined	undefined	undefined	undefined
Albogamy et al. (2021)	32 public construction projects	undefined	undefined	undefined	undefined

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VI. CONCLUSION

The evaluation of construction change orders reveals procedures that reduce project disturbances while controlling cost increases. The dissertation proved that organizations need complete change management policies to achieve success. The effective management of multi-stakeholder construction projects depends on proper organizational communications together with stakeholder participation [21]. The research solved unexpected alteration problems by using proven empirical evidence and case study findings. The research findings from academic practitioners will prove useful for future applications. Construction managers need to create operational adaptive systems of change management that optimize processes while developing an avoidable culture of enhancement [2]. The combination of operational Data visibility with Building Information Modeling (BIM) enables better decision-making [3]. The research supports continuous studies about how change order management practices have evolved throughout history.

Future research should analyze the permanent effects of these strategies on project performance metrics. The project exploration phase can implement AI and machine learning systems to predict upcoming change orders, which will help risk management [4]. The project team must prepare change management processes in advance to maintain effective business operations during unexpected interruptions [5]. The next level of construction project management requires smart frameworks to achieve better collaboration enhancement [6]. The dissertation recommends that new management principles for the discipline require technological advancements alongside active participant involvement to transform current change management approaches. The change management approaches require fundamental transformation to adopt emerging technologies and user engagement according to the

dissertation findings [7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20]. The research establishes proactive change order strategies as the foundation for developing deep, practical innovations in construction management.

Project Type	Average Cost Overrun (%)
Rail	10.6
Road	18.6
Fixed Link	21.7

Average Cost Overruns in Dutch Transportation Infrastructure Projects

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