Project Conveyance Strategies Change Request types and Extents Experienced in Expressway Development

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Abstract

Transportation authorities might have a problem with construction modification orders and the rise in costs that come with them. Practitioners and academics alike are interested in discussing this topic. Because of the difficulties involved in resolving this issue, the management of modification orders in alternate delivery methods is even more important. Change orders and project delivery techniques are rarely studied together. despite the fact that this issue is significant. This study demonstrated a connection between delivery methods and highway construction modification orders. This study only includes the kinds of change orders that have been studied in the business and literature. Data from 162 US road projects completed between 2004 and 2015 were included in the study. Interviews with representatives of the many organizations involved in the various initiatives studied complemented the quantitative data. According to the data, agency-directed modification orders are followed by unanticipated conditions in increasing overall costs. There was evidence that owner agencies frequently added value through agency-directed modification orders when they took advantage of an initial contract excess, which is more prevalent in design-build delivery. The findings of this study may assist agencies and researchers in developing efficient mitigation strategies and gaining a deeper comprehension of the factors that lead to change orders in various delivery systems

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1. INTRODUCTION

Transportation authorities rarely achieve their goal of avoiding changes after construction, despite their best efforts. Due to their uniqueness and complexity, construction project scope development may be challenging. Since scope revisions, errors, and unplanned scenarios are common in most projects, owners must issue change orders. According to the most recent US highway construction

literature, transportation agencies in the United States receive $4 billion in annual modification requests. Due to their significance to both individual projects and the industry as a whole, scholars have examined change orders from a variety of angles. For instance, previous research has examined the frequency of modification orders and their effect on project costs.

Change orders can have a big effect on how well the project works, but they can also cause disputes or claims that take a lot of time and hurt how well all stakeholders' programming works. This study used five previous studies to help define the change-order categories that have been observed in the transportation sector in the United States in order to support a claim. Diekmann and Nelson (1985) examined 22 federal projects from 1979 to 1985 and discovered that the most common causes of change orders were plan omissions, agency-directed adjustments, and unanticipated circumstances. Bordat and others 2004) looked at almost 800 Indiana Department of Transportation projects, whereas Jacoby (2001) looked at 74 state Department of Transportation projects. This is in line with what Diekmann and Nelson (1985) did, but they also added a new category for differentiating reasons for change orders that don't happen as often. From 2005 to 2008, 610 projects were examined by researchers from the Kentucky Department of Transportation (Kentucky DOT). They discovered a number of similarities as well as plan quantity adjustments, the majority of which were applicable to unit pricing contracts. Additionally, the researchers gathered information on damage claims related to 40 prior DOT projects located in all 50 states prior to 2018. This information was gathered in spite of the fact that similar language has been used in previous studies. Mehany et al.'s investigation (2018) found no connection between delivery methods and change order categories. The following is a summary of these findings based on these findings (note that these bullets represent the number, type, and number of projects analyzed, followed by the types of modification orders resulting in cost escalation, ranked from greatest to least impact):

From 1979 to 1983, agencies ordered plans, omissions, and adjustments for 22 federal projects. Between 1996 and 1999, 822 Indiana DOT projects were plagued by plan omissions, agency-directed adjustments, unanticipated situations, and other issues.

Seventy-four state DOT projects completed prior to 2001 experienced difficulties as a result of unanticipated circumstances, agency-mandated adjustments, and plan errors and omissions. 610 projects from 2005 to 2008 by the Kentucky Department of Transportation (KDOT): unforeseen circumstances, plan quantity changes, agency-directed changes, and plan errors and omissions Prior to 2018, the DOT completed 40 projects, including claims for damages, unexpected events, plan errors and omissions, agency-directed adjustments, plan quantity changes, and more. On the basis of this research, the category definitions and characteristics discussed in this study are presented in Table 1. Since this study focuses on federal highway construction, it makes use of FAR

terminology whenever possible. Creedy, Parikh, and Riley (2005) and Riley and Parikh (2019) conducted a second study on change-order categories.

Under the most prevalent delivery models for highway projects, the contractor and the government share the risk to varying degrees: CM/GC, DBB, and DB It is common knowledge that project hazards and cost overruns go hand in hand. The following examples demonstrate how a project delivery method's risk distribution results in a variety of modification orders.

In DBB, the owner designs the project or designer in-house and hires a general contractor for the job through a separate contract. This indicates that the agency is accountable for ensuring that the design work is completed, regardless of who performed it—an in-house team or a third party. For the bearer of this risk, every error, omission, and change in amount represents a possible change order. Numerous studies indicate that in the highway industry, DBB is more susceptible to order changes than other methods.

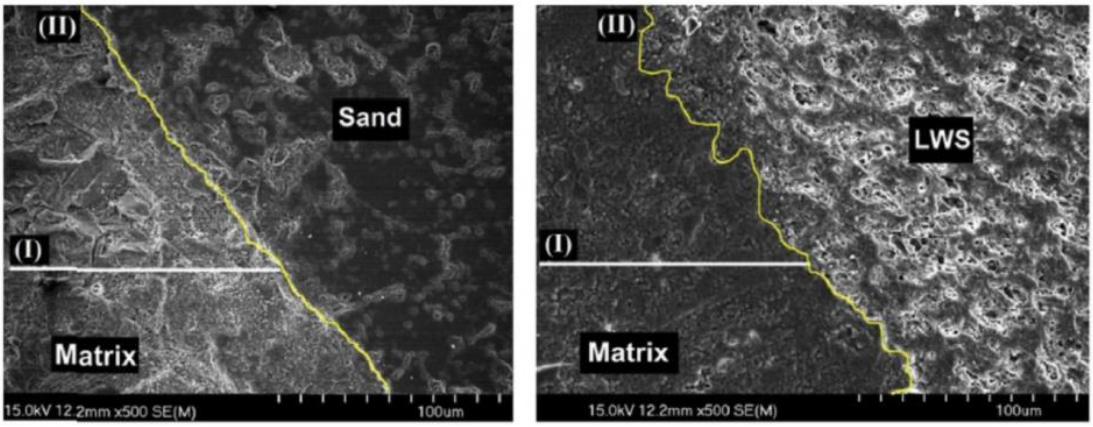

Fig.1 copyrighted photographs

2. LITERATURE REVIEW

The owner contracts with a construction manager (CM) early in the design process for advice on construction feasibility and scheduling. The design process is entirely under the agency's control, just like it is with DBB. Construction services are priced out with the CM once the design is approved. Consequently, in this context, the CM is referred to as the "general contractor." Like DBB, the agency considers any design error or change to be a change order. On the other hand, it has been demonstrated that contractor participation in the design process early on improves constructability. The use of constructability has been found to reduce disputes and change orders in contracts. These results indicate that the size of change outcomes would also be reduced by CM/GC and DB taking a more collaborative approach. To put it another way, working together early on in the design phase might help catch mistakes early on, which could cut down on the need for

construction changes. Last but not least, CM design support services add an extra layer of quality control to the design process, making it more accurate.

A single design-builder is in charge of both designing and building the final product with the DB delivery method. Most of the time, a design-build company has to pay for mistakes. The transfer of risk is one of the benefits of DB that is frequently cited. Therefore, the design-builder's sole responsibility should not be the sole basis for modification orders. If the DB request for proposal (RFP) contains errors or omissions, this is the only exception to the rule.

Mehany and others 2018) found that there was no significant correlation between the method of dissemination and the type of claim. As a result, in order to make up for the lack of statistical data and fill this void, the authors decided to incorporate the results of qualitative agency interviews, quantitative project performance evaluations, and literature research. Triangulation is a better assessment technique than quantitative analysis because it takes into account both subjective and objective factors as well as the inherent complexity and irregularity of construction management. The researchers obtained data from state and federal highway transportation agencies, and they used triangulation to support their findings in the construction management literature. The research team sought information on completed highway construction projects, hoping to find projects using DBB, DB, and CM/GC. The data for each project were obtained by distributing a questionnaire to representatives of the project in order to collect additional empirical evidence on the performance of the project in addition to data extraction from preexisting agency construction contract cost and schedule data sets. The final FHWA Project Report contains all of the data collected, but this release focuses on the data collected for this particular project. The accuracy of the cost data was ensured in two steps, and project staff were encouraged to respond to any questions that were not already answered in the contractual databases. To ensure quality control and fill in any data gaps, phone calls were made as needed.

From 2004 to 2015, this study included 162 highway projects completed by state DOTs and the FHWA Office of Federal Lands Roadway. The authors focused on projects from businesses that have used DB and CM/GC delivery methods in the past. They had to be awarded within two years of each other, be of the same kind, in the same location, and be CM/GC and DB projects that were comparable in terms of cost and size (within 25% of the award cost). With 21 DBB/LB projects, 56 DBB projects, and 19 CM/GC projects rounding out the top five, DBB projects comprised 65% of the entire sample. Given the overall number of CM/GC initiatives in the United States, it is appropriate that this study included as many as it did. Only a few CM/GC projects were built in the United States from 2004 to 2015. Table 2 displays the statistics.

AgencyInterviews Interviews were conducted with employees of the agency to complete and

contextualize the project data's findings. Researchers wanted to find projects with high and low cost increases within each category of change orders and delivery mode. To better comprehend survey results, projects with the greatest cost reductions and increases can be used as examples.

Twelve projects were selected for further investigation when agency officials from all over the country were interviewed. Meetings with representatives from Virginia to Florida resulted from this. The aggregate results are presented to safeguard the participants' privacy. The study was based on the project, but the people questioned worked as resident engineers, project managers, or construction managers for their respective transportation departments. The number of agency representatives who were interviewed for each project is shown in Table 3

3. PROPOSED SYSTEM

Unexpected occurrences make up 2% of the total cost increase, according to Table 4, followed by agency-directed (15%), plan quantity (6%), and plan defects or omissions (6%). Mehany et al.'s research as well as Jacoby (2001) 2018), as well as Taylor et al.'s findings (2017) are in agreement with this study's findings. Bordat et al. and Diekmann and Nelson (1985) two decades ago (1991) have previously examined change-order categories, and the conclusions of this paper do not match their findings. This disparity may indicate that agencies are more adept at managing design risk through a variety of delivery methods. Diekmann and Nelson wrote a paper in 1985, and Bordat et al. did the same in 2004. published one, both 34 and 15 years before DB and CM/GC were widely used. Taylor and colleagues (2012), Jacoby (2001), Mehany et al. 2018) all came to similar conclusions from their own investigations. The conclusions of this paper are strengthened by this.

Due to the widespread nature of change orders across all delivery methods, it is extremely challenging to reduce them. Due to the difficulty of mitigating them, they may have a greater impact than other categories. One official stated, "I don't see how we could have discovered the problem if we hadn't started the project." One representative, on the other hand, attributes the high frequency of unanticipated conditions to the fact that agencies typically rush through the preconstruction period, shortening the amount of time needed for soil borings and thus increasing the risk.

Change orders gave by the client's organization come in runner up as far as effect on the undertakings analyzed in this examination. The literature suggests that this result may also indicate that agencies aren't planning ahead enough or aren't speeding up the process of developing the scope. However, half of the projects had initial contract surplus savings greater than the value of their change orders, according to a database of agency-ordered change orders. According to interviews, adjustments directed by the agency are frequently beneficial. That's what one worker said, adding that with "more money," they were looking into "things we can do to improve the

project in the region."

Plan mistakes and omissions had the least impact on the combined projects in this analysis. According to this finding, agencies may be able to achieve their theoretical goal of reducing these kinds of modification orders with the assistance of alternative project delivery methods. Agencies are familiar with the effect that DB has on shifting design risks to the design builder. A spokesperson for DB stated that when the design-builder is in charge of creating the blueprints, there is very little room for errors and omissions in the modification orders. Agencies also acknowledge the impact of CM/GC on design quality (since early contractor engagement may result in better design). According to the DOT, "CM/GC allows them to conduct a comprehensive site inspection that optimizes the design and minimizes risks, ultimately reducing errors and omissions modification orders," as stated by another spokesperson.

According to Table 4, DB/BV projects came in first and second, with DB/LB and DBB rounding out the top three. The most agency-ordered changes, surveys, and interviews were found to be in DB, according to the current analysis. When the DBB and CM/GC results were compared, there was no consensus. Agency-directed modification orders have been observed when DB's lack of design completeness at the proposal stage or a hasty RFP preparation were the culprits. Agency-directed modification orders in DB are more prevalent in agencies that spend their initial contract excess than in other de-delivery approaches, according to the findings of the interviews. One participant asserted, "We had more money to spend." We thought about how we could improve the project's neighborhood impact. The group came up with about 16 or 20 ideas for our brainstorming session. Due to budget constraints, five out of eight project managers claimed that their agency-ordered modifications were value-added and integrated. The remaining 39 of the 57 DB projects experienced cost overruns as a result of agency modification orders over time. Consequently, it is safe to assume that the majority of DB initiatives dealt with change orders. Instead, four representatives from each delivery option might be working on the project. They said they had to deal with negative agency-directed modification requests. Typically, the causes of their failures were more complex than a single agency error. DBB claims that: The initial bid amount, not the anticipated cost, serves as the foundation for the budget. "DBB projects": "The award savings are lower because the scope is better understood at the time of bid due to the use of 100 percent drawings." "We take into account the initial offer amount, not the buyout." Depending on the DBB or DB, engineers' estimates frequently rise by 3 percent or 6 percent; This was demonstrated in previous studies. DBB projects typically have a larger scope at procurement than other types of projects. It seems reasonable to prioritize value-adding change orders over database changes.

According to the research, the lowest proportion of CM/changes are government-mandated

revisions. GC's Both the owner and the contractor have agreed on the project's scope and price. To put it another way, "CM/GC gave us the chance to look at a number of options and work with the contractor to find the best solution for the project," a company official said. Choosing construction management and general contracting (CM/GC) over traditional CM/GC has a number of advantages. The initial contract surplus can also be spent by a CM/GC agency like DB. Consequently, officials at the agency hypothesized that CM/GC was more receptive than DBB to changes to agency orders. In a CM/GC project, "the objective was always to extend project limits as far north as we could, with the purpose of spending all the money provided to date," there was "a large volume of owner-directed change orders."

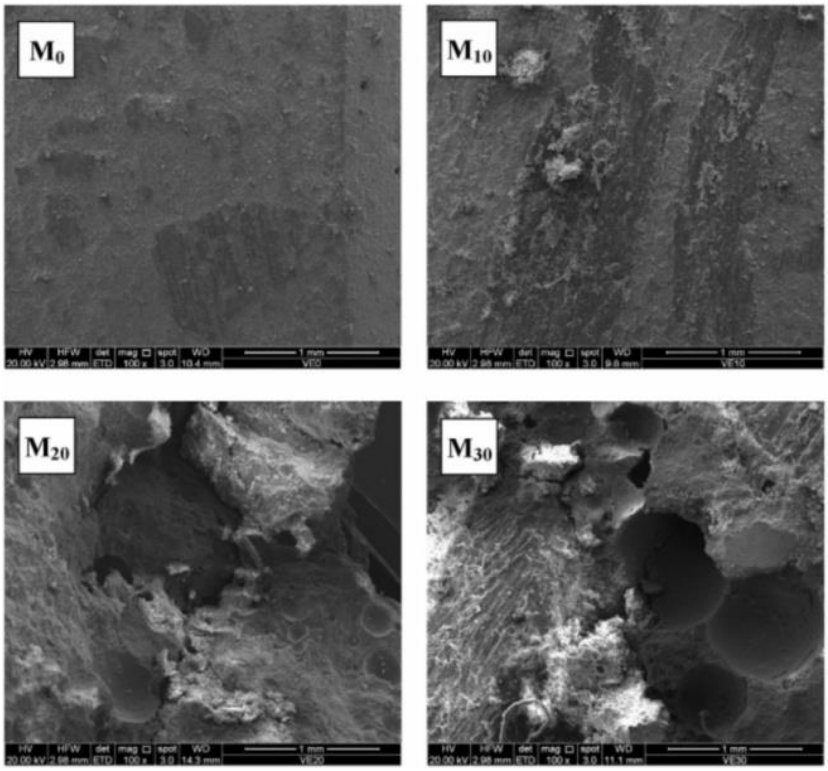

Fig.3 SEM Images

4.CONCLUSION

Steel cutting is yet another underutilized resource. El-Sayed studied the reuse of waste from industrial lathes. These lathe wastes were used instead of steel fibers because they were cheap and easy to get. Lo et al. used furnace bottom ash and high-carbon fly ash as LWA following sintering. and Zhang et al., LWAC must be made with the right proportions and the right production method in order to have the same compressive strength and workability as NWC. It was stated that the LWAC had a significant advantage over the NWC if the raw materials were chosen correctly. The LWA selection criteria, the mixture design policy, and curing conditions have had a significant impact on the strength and durability of LWAC. The primary challenge of LWAC constructions

continues to be the conflict between the bulk density and mechanical characteristics, despite recent research demonstrating that LWAC can meet the strength criteria and be utilized in structural applications.

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