

# Approaches on Mitigating Variation Orders in Road Construction Industry in Kenya: The Case of Kenya National Highways Authority (KeNHA)

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**Abstract**—Variation orders have been globally identified as a significant reason for poor performance of construction projects. Several variation orders have been identified in the Kenyan construction industry, however, there is a paucity of information on the approaches to minimize their occurrence. The aim of this study is to identify the practices for variation order mitigation in the public road construction sector in Kenya. This is a cross-sectional study that was carried out among the stakeholders (clients, consultants, and contractors) involved in road construction projects. The study used the purposive sampling technique whereby the data were collected with the use of distributed questionnaires among clients, consultants, and contractors' staff with a technical background in civil engineering. The Relative Importance Index (RII) was used for data analysis. According to the findings of the study, the top five recommended approaches for minimizing variation orders include the provision of adequate planning before the initiation of road construction projects, understanding of the contract provisions by all the parties before project implementation, solving of land disputes before the project tender awards, provision of complete project designs, and provision of a brief project scope during the tendering process. This research, therefore, contributes to a pool of knowledge that will enable practitioners and researchers in the construction industry to develop effective models for minimizing variation orders.

**Keywords**—variation orders; relative importance index

## I. INTRODUCTION

Road infrastructure in Kenya plays an instrumental role in economic development. Road network development has experienced a steadfast growth, in line with the government agenda [1]. High quality road network positively impacts the Gross Domestic Product (GDP) of a country [2]. High quality of road connectivity results in reduction of transportation costs

and increased profitability of investments [3-8]. Despite the recognized benefits of road network development, the majority of road construction projects in Kenya is neither completed on time nor is its construction cost within the stipulated budgetary allocation. It has been reported that delays in completion time and increased cost occur in over 70% of the road construction projects in Kenya [8]. This has been highly attributed to variation orders occurring during the project lifecycle [8].

Variation orders encompass modifications introduced to the original contractual agreement made among the parties involved in the construction project [9, 10]. Variations in road construction production predominantly emanate from clients, consultants, and contractors [9, 10]. Some of the causes of variation orders that have been reported in construction industry include communication gaps between the stakeholders, delays in the design process, errors and discrepancies in design documents, limited project details, complexity in the nature of the project, insufficient site survey, poor coordination among the involved parties, limited financial resources, lack of qualified personnel, weather conditions, change in economic conditions, change of government policies, technological changes, and lack of knowledge in the availability of construction materials and equipment [11-18]. These factors consequently lead to poor project performance, which unfavorably affects completion time, cost, and the quality of the project [19, 20]. It has been reported that most variation orders are likely to impact construction works adversely [21-23]. Variations in road construction works can result in a substantial alteration of the contract terms, quality of the construction projects, and duration and cost of the project implementation [13, 22]. Therefore, identification of ways to resolve and minimize variation orders may enhance the ability of the project team to improve project performance [11, 24].

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Acquiring knowledge on the approaches to reduce variation orders can help the stakeholders to plan effectively before commencement of construction works [25, 26]. A systematic approach to the handling of variation orders in construction projects can effectively minimize cost overruns and time delays [27]. Variation management models can be incorporated into project management systems to facilitate the process of handling variations that have occurred or are due to occur [28].

Various studies have suggested several recommendations to minimize and handle variation orders [29-31], however, road construction industry has been unable to effectively eliminate them [2]. The complexity of road construction works suggests that it is unlikely to deliver projects without making changes during their lifecycle [30, 32]. Liability to variations is a feature that generally embodies nearly all construction projects, although the use of a change management system in construction works can reduce variation orders effectively, however, such systems are yet to be established for use in most construction works [11, 31]. Effective change management systems can be developed by recognizing the ways to minimize variation orders [29]. Such strategies have been identified, however, none is specific to the Kenyan road construction perspective. Several variation orders are similar in many construction industries globally, however, some are project and country-specific [33]. The local construction industry is overwhelmed by variation orders which are detrimental to project delivery resulting in unachieved schedules and cost performance. Information on the ways that can be utilized to minimize variation orders in the Kenyan road construction industry is scarce. This study therefore aims to identify the potential approaches to minimize variation orders in Kenya.

## II. METHODOLOGY

The study was a cross-sectional descriptive survey. The target population was clients, consultants and contractors' staff with a technical background in civil engineering that were working in ongoing road construction projects under Kenya National Highways Authority (KeNHA) during the period of this study. A sample population of 80 participants was selected by purposive sampling technique. Questionnaires were used to gather information related to recommendations on the reduction of variation orders in the road construction industry. The considered variables included, among others, adequate planning, identification, and understanding of contract terms before commencement of projects, resolution of land ownership disputes before awarding of project tenders, and the availability of complete designs at the project tendering stage. The variables were rated on a Likert scale having values ranging between very important, less important, and not important. Relative Importance Index (RII) was used to rank the importance of each recommendation provided by the respondents. The Likert scale was converted into a four-point ranking scale ranging from 1 (not important) to 4 (very important) which was then used to calculate RII as follows:

$$RII = \frac{\sum W}{A \cdot N} \quad (1)$$

where W is the converted weight of Likert scale response of the participants (ranging from 1 to 4), A is the highest weight (4 in

this case), and N is the number of respondents. A high RII value indicates the importance of the recommendation [30].

## III. RESULTS AND DISCUSSION

Responses were received from 70 out of a total of 80 distributed questionnaires, thus achieving a response rate of 87.5%. The responses were distributed among the stakeholders as shown in Figure 1.

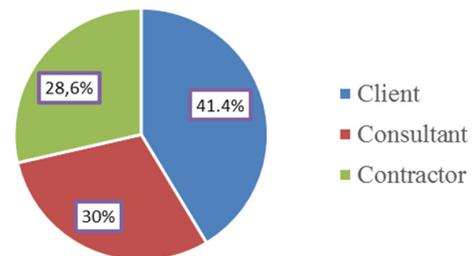


Fig. 1. Participant distribution.

The findings of the study on the recommendations to reduce variation orders in road construction industry are shown in Table I. The results indicated that 85.7% of the participants recommended that sufficient planning before beginning the road construction project is very important. Further, 74.3% recommended that identification and understanding of contract terms before commencement of road construction project is very important. A 74.3% of the study participants indicated that resolving land ownership issues before the project tendering stage is very important in the resolution of variation orders. It was also recommended by the majority (55.7%) of the respondents that it is very important to provide complete designs of the project during the tendering stage of the construction works. The approach of having a consultant to closely coordinate the project design stage was considered very important by the 64.3% of the respondents. The majority of the respondents (61.4%) also indicated that it is very important for experienced supervisors to manage construction works in order to minimize variation orders in road construction works. Further, 67.1% of the respondents recommended that provision of a brief description of the project at the tendering stage is very important. Communication and cooperation among project team members were indicated to be very important by the 52.9% of the respondents. Additionally, most of the respondents (71.4%), recommended that the provision of a detailed description of the construction project is very important. The 45.7% of the respondents recommended that placement of experienced and knowledgeable executives in project planning is very important whereas 5.7% of the participants considered it less important. The results also showed that 44.3% of the respondent reported that it is very important the costing of construction projects to remain within the stipulated budget whereas 45.7% and 10.0% of the participants indicated that it was important and less important respectively. The provision of accurate details on the procurement procedure and the availability of resources was recommended to be a very important approach to resolve variation orders by 31(44.3%) of the respondents.

Further analysis based on RII indicated that the respondents ranked adequate planning before commencement of projects (RII=0.771) as the leading approach in reduction of variation orders in road construction projects. Identification and

understanding of contractual terms before project implementation (RII=0.749) was ranked second, followed by the resolution of land ownership issues before the project tender awards (R=0.749).

TABLE I. RECOMMENDATIONS OF REDUCING VARIATION ORDERS

Recommended strategies to minimize variation orders	Not important	Less important	Important	Very important	RII	Rank (R)
Adequate planning before starting construction	0	0	10(14.3)	60(85.7)	0.771	1
Identification and understanding of contract terms before the project starts	0	0	18(25.7)	52(74.3)	0.749	2
Settle land ownership issues before awarding the tender	0	0	18(25.7)	52(74.3)	0.749	3
Complete design provision during tendering	0	9(12.9)	22(31.4)	39(55.7)	0.743	4
The client should provide a brief scope of works during tendering	0	3(4.3)	20(28.6)	47(67.1)	0.726	5
The consultant should closely coordinate the project designing stage	0	1(1.4)	24(34.3)	45(64.3)	0.726	6
An experienced supervisor should manage the construction works	0	3(4.3)	24(34.3)	43(61.4)	0.703	7
Communication and cooperation among project team members	0	3(4.3)	30(42.9)	37(52.9)	0.697	8
Provide detailed site description during tendering (e.g. soil profile)	0	0	20(28.6)	50(71.4)	0.686	9
Experienced and knowledgeable executives in the project planning department	0	4(5.7)	34(48.6)	32(45.7)	0.680	10
Sufficient time required for pre-tender planning phase	0	8(11.4)	25(35.7)	37(52.9)	0.674	11
The costing of the project should be within the approved budget	0	7(10.0)	32(45.7)	31(44.3)	0.666	12
Accurate information on the procurement procedure and availability of material during tendering process	0	11(15.7)	28(40.0)	31(44.3)	0.657	13

Other authors have reported several recommendations to reduce variation orders in construction industry. According to [34, 35], provision of sufficient site conditions with complete design would help reducing variation orders in construction industry. Authors in [36] indicate that incomplete project design is the most significant cause of variation orders in Pakistan, hence the provision of complete designs would significantly minimize variation orders. A similar study reported that adequate allocation of funds to construction works, adequate planning for controlling floods during rainy seasons and the utilization of skilled labor are potential approaches that can mitigate variation orders [18]. Additionally, provision of adequate funds, correction of errors at the project designs stage and elimination of delay in award of tender were reported as probable strategies for elimination of variation orders in construction industry in Ghana [37]. The findings of this study concur with the observation (in Vietnam construction industry) that adequate planning of the construction project and clear understanding of the responsibilities of the parties in detailed contract terms are major practices that can minimize variation orders [38]. In Gaza strip, it was reported that adequate planning before implementation of construction works and understanding of contract terms by the parties involved are key factors in elimination of variation orders [39]. Authors in [17] state that provision of an accurate brief document about the requirements of the project before the design stage by the client would significantly reduce variation orders in Saudi Arabia construction industry. Additionally, as was also observed in the present study, authors in [10] suggested that communication among parties involved in the construction works is paramount to project delivery, hence its enhancement during the project cycle could potentially minimize the occurrences of variation orders.

It has been previously reported that incompetent and inexperienced project teams (clients, consultants, and contractors) are responsible for variation orders in construction works [38, 39]. Authors in [38] provide a recommendation for the necessity of competent technical staff and executive personnel for effective project management. They also reported that recruiting highly experienced consultants and contractors is necessary in the reduction of variation orders in Pakistan construction industry. A study conducted in Saudi Arabia also reported that hiring of experienced technical staff members would significantly decrease variation orders [17]. Clients, consultants, and contractors should, therefore, ensure that their personnel are qualified with pertinent experience to minimize variation orders in construction industries [40, 41]. Whereas this study concurs with other studies on the remedies for variation orders, it adds land issues as yet another important factor in resolution of variation orders. It should be noted that none of the studies done elsewhere found land to be a major issue. This seems to be a Kenyan specific issue underscoring the point raised earlier that context matter [33] when providing solutions to mitigate variation orders. Although this might be context-specific to Kenya it might also be a challenge in other countries and it has yet to be researched. In this regard, this study provides a novel contribution to the body of knowledge of the remedies of variation orders.

#### IV. CONCLUSIONS AND RECOMMENDATIONS

Variation orders occur in construction industries worldwide. This study investigated probable preventive measures to reduce variation orders that are prevalent in road construction industry. From this report findings, it has been established that adequate planning before commencement of the project, identification and understanding of contractual terms before project implementation, resolution of land ownership issues before awarding of construction tenders,

availability of complete project design during tendering, and provision of brief project scope during tendering could effectively minimize variation orders in the construction industry. The local and global construction industry can consider the factors presented herein as insights in the development of effective models that can mitigate variation orders during construction projects. In line with its findings, this study recommends that project implementers should:

- ensure adequate planning before commencement of construction works,
- prioritize land issues in planning stages and making resolution of all land issues as a key pre-requisite before project commencement,
- re-design the tendering process so that tender documents have a brief scope of the project, and
- ensure the capability of their staff through training in project planning and management

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