

Critical Factors Affecting No-dispute Performance: A Case of Ethiopian Public Construction Projects

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Abstract: Disputes seem to be synonymous with large-scale construction projects in Ethiopia. The purpose of this study is to determine the factors responsible for impacting the performance of Ethiopian public construction projects. To this end, 35 success and failure attributes responsible for impacting the performance of the projects were identified and presented to Ethiopian construction professionals in the form of a structured questionnaire, and responses were collected. The factor analysis conducted on the success and failure attributes influencing no-dispute performance separately resulted in six success factors and five failure factors. Further analysis using stepwise multiple regression indicates that owner competence and interaction among project participants have a positive impact on no-dispute performance. However, conflict among project participants has a negative impact on the no-dispute performance of Ethiopian public construction projects. Although Ethiopia-specific, the results reflect construction management problems common to both developed and developing countries. The findings are expected to help researchers and practitioners gain a better understanding of critical success and failure factors and to help them take proactive measures to avoid disputes in public construction projects.

Keywords: Public projects, No-dispute performance, Factor analysis, Ethiopia

I. INTRODUCTION

The problem of disputes in the construction industry is a global phenomenon, and the costs associated with resolving disputes are significant. According to [1], the direct costs associated with disputes range from 0.5 to 5 percent of project's contract value. Claims in large scale construction projects in Ethiopia ranging in millions of Ethiopian Birr and sometimes even in excess of 100% of the project costs [2], if not resolved, can lead to costly disputes. Public construction projects have tight deadlines and risks related to conflict, which tends to breed costly and time-consuming disputes. Disputes arise when the behavior adopted by one party to fulfill interests, meet needs, or protect values adversely impacts the interests, needs, or values of the other party [3]. When a major construction project goes into dispute, the impact is far reaching, manifesting itself in cost overruns and late delivery and compromising the quality and scope of the project itself.

No-dispute performance implies that the project is completed with a minimum number of litigations or preferably no dispute resulting from disagreements among participants. Though there are success factors contributing to no-dispute performance in construction projects, there are also various failure factors that are

detrimental to this performance. Therefore, it is important to identify and understand the impact of both the critical success and critical failure factors contributing to a construction project's no-dispute performance. Consequently, maximizing the results of the critical success factors and minimizing the negative impact of failure factors may result in the desired no-dispute performance of construction projects.

Earlier research on success and failure factors includes the perceptions of respondents from either the private sector or both the private and public sector. However, the existence of differences in perceptions about the relative importance of success factors between the private and the public sector has been reported ([4], [5]). Hence, only public sector employees were considered as respondents for the present study.

Our literature review revealed that not enough research has been conducted with regard to the performance of Ethiopian public construction projects. There are many attributes that affect no-dispute performance either positively or negatively. Hence, identification of these attributes and evaluation of their impact on project performance is the aim of this research. The objectives for the study are given below:

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- To identify the relative importance of success and failure attributes affecting no-dispute performance in Ethiopian construction projects; and
- To understand the latent properties of the success and failure attributes by studying the critical success and failure factors for improving no-dispute performance.

Because the study required a large data set of completed projects in Ethiopia, which was difficult to obtain, we decided to collect the data using a questionnaire survey approach. The responses received were statistically analyzed.

II. LITERATURE REVIEW

In the literature, several researchers identified, explained, and discussed the factors that are critical to the success of a project. Rockart used the term ‘critical success factors (CSFs)’ for the few key areas of activity in which favorable results are absolutely necessary for a particular manager to reach his or her goals [5]. Further, [6] defined critical success factors (CSFs) as those few things that must go well to ensure success for a manager or an organization, and therefore, they represent those managerial or enterprise areas that must be given special and continual attention to bring about high performance.

A summary of critical factors used by different researchers is presented in Table 1.

TABLE I
SUMMARY OF CRITICAL FACTORS

No.	Authors	Types of respondent	Methods of analysis	No. of variables considered	Critical Factors
1	Gudiene et al.(2013) [7]	Mixed type respondent (Public & Private)	Relative importance index, ranking	71	Project manager competence, project management team members’ competence, project manager coordinating skills, client clear and precise goals/objectives, project value, project management team members’ relevant past experience, project manager organizing skills, project manager effective and timely conflict resolution, client ability to make timely decision, and project manager experience.
2	Chan et al. (2001) [8]	Public-sector.	Factor analysis and multiple regression analysis	31	Project team commitment, client’s competencies, and contractor’s competencies
3	Kog and Loh (2013) [9]	Mixed type respondent (Public & Private)	An analytical hierarchy process (AHP)	67	Adequacy of plans and specifications, constructability, realistic obligations/clear objectives, economic risks, project manager competency, project manager commitment and involvement, contractual motivation/incentive, technical approval authorities, construction control meetings, pioneering status.
4	Iyer and Jha (2005) [10]	Mixed type respondent (Public & Private)	Factor analysis and multinomial logistic regressions	55	Commitment of the project participants, owner’s competence, and conflict among project participants
5	Chan et al. (2004) [11]	Mixed type respondent (Public & Private)	factor analysis and multiple regression	41	Establishment and communication of a conflict resolution strategy, the willingness to share resources among project participants, a clear definition of responsibilities, a commitment to win-win attitudes, and regular monitoring of the partnering process.
6	Tabish and Jha (2011) [12]	Public-sector.	analysis of variance (ANOVA)	36	Thorough understanding of scope on the part of project manager and contractor, comprehensive pretender site investigation, regular monitoring and feedback by owner, no bureaucratic interference, no social and political interference, clearly articulated scope of work, quality control and quality assurance activities, and adequate communication among all project participants.
7	Agumba and Baloyi (2014) [13]	Mixed type respondent (Public & Private)	Content analysis	14	Poor communication, poor contract documentation, suspension of work, failure to understand and correctly bid or price the work, bad weather, non-circulation of information, incomplete tracing mechanisms for request of information and delays in extensions of time
8	El-razek et al. (2007) [14]	Mixed type respondent (Public & Private)	Frequencies and pareto Analysis	17	Variations initiated by the owner/consultant; inferior quality of design, drawings and/or specifications; and delays in the approval of shop drawings, instructions and decision making.
9	Sambasivan and Soon (2007) [17]	Mixed type respondent (Public & Private)	Ranking and relative importance index	28	Delay in payments for completed work, frequent owner interference, changing requirements, lack of communication between the various parties, problems with neighbors, and unforeseen site conditions
10	Nguyen et al. (2004) [43]	Mixed type respondent (Public & Private)	Ranking, Spearman’s rho, factor analysis	20	Competent project manager, adequate funding until project completion, multidisciplinary/competent project team, commitment to project, and availability of resources.

11	Saqib, <i>et al.</i> (2008) [44]	Mixed type respondent (Public & Private)	Criticality index	77	Decision making effectiveness, Project Manager's experience, Contractor's cash flow, Contractor experience, Timely decision by owner/ owner's, representative, Site management, Supervision, Planning effort, Prior project management experience, Client's ability to make decision.
12	Ikediashi <i>et al.</i> (2014) [45]	Mixed type respondent (Public & Private)	Ranking and relative importance index	30	Poor risk management, budget overruns, poor communication management, schedule delays, poor estimation practices, cash flow difficulties, design discrepancies, lack of efficient change management, inadequate project structure and lack of teamwork.
13	Anderson <i>et al.</i> (2006) [46]	Mixed type respondent (Public & Private)	Factor analysis and regression analysis	60	Strong project commitment, early stakeholder influence, stakeholder endorsement of project plans and rich project communications, a well-structured and formal project approach and well understood and accepted project purpose.
14	Schaufelberger (2004) [47]	Private sector.	Interview based approach from seven contractors	7	Well defined, that there was a mutual understanding of the scope of work between the owner and the contractor, and that the owner had sufficient experience with the design-build project delivery method.
15	Sanvido <i>et al.</i> , 1992 [48]	Mixed type respondent (Public & Private)	Ranking, Spearman's rho, pairwise analysis	35	Well organized facility team, contract that allows and encourages the team chemistry without conflict of interest and differing goals, experience in project management, planning, design, construction and operation of similar facilities, and timely valuable optimization information from the owner, user, designer, contractor and operator in the planning and design phase of the facility.

[15] described that the inclusion of special conditions in contracts, changes in construction plans and specifications, and the resulting contradictory and erroneous information in the mass of documents all contribute to the germination and manifestation of construction disputes.

A study by [16] is a good reference for the root causes of construction disputes. These causes included unfair risk allocation, unrealistic time/cost/quality targets by the client, an adversarial industry culture, inappropriate contract type, and unrealistic information expectations. In another study, [17] found that factors such as delay in payments for completed work, frequent owner interference, changing requirements, lack of communication between the various parties, problems with neighbors, and unforeseen site conditions could cause disputes among project participants.

Later, a survey by [1] reported that the most common causes of construction disputes are the nature of the task being performed (failure to detect and correct errors), people's deliberate practices (failure to abide by contractual requirements) and circumstances arising from the situation or environment the project was operating in (unforeseen scope changes).

From our literature review, it was found that most of the studies on construction project performance have been conducted in the context of the developed world, and only a few studies have been conducted pertaining to public construction projects of African countries. Hence, their findings may not be relevant to developing countries. Ethiopia is not yet a developed country, and the performance of projects has also not been encouraging. Therefore, it will be beneficial to compare and discuss the results by assessing similar attributes as those studied in other countries. Accordingly, for this study, 35 attributes were selected from the literature and project management textbooks.

III. RESEARCH METHOD

The focus of this research is to identify and evaluate the success and failure attributes for the no-dispute performance of public sector construction projects. This involves a literature review to capture the existing body of knowledge about project performance attributes. Then, a questionnaire-based survey was conducted to elicit the views of experienced public sector professionals on these attributes. Finally, univariate and multivariate data analyses such as ANOVA, factor analysis and regression analysis were applied. Through ANOVA, significant attributes were identified. Then, these attributes were grouped into several factors through factor analysis. Finally, regression analysis was conducted to identify the critical factors. The steps involved are briefly explained below.

A. Step 1-identification of attributes affecting project performance

An initial list of project performance attributes was prepared from the literature, including leading journals and project management textbooks. Because the attributes selected were from the literature, which primarily includes studies in the context of developed nations, it was decided to present these attributes to key construction professionals in Ethiopia to obtain feedback on them. Based on the feedback, necessary modifications were made to the list of attributes, and a list of 35 project performance attributes was prepared. The fragmented nature of the construction industry makes these attributes non-exhaustive, but they still cover many types of construction projects.

B. Step 2-questionnaire development.

The questionnaire was designed to assess the impact of the above-mentioned 35 project performance attributes on the no-dispute performance of public construction projects. The respondents were requested to rate these attributes for the project in which they were involved.

A five-point scale was used to measure the attributes' influence on no-dispute performance: "1" refers to "Adversely increasing project disputes," "2" refers to "significantly increasing project disputes," "3" refers to "marginally increasing project disputes," "4" refers to "no effect on project disputes," and "5" refers to "helps in decreasing project disputes". The target respondents were engineers involved in public sector projects.

C. Step 3-selection of respondents.

A list of completed public construction projects (Railways, highways, buildings, and water works) was developed on the basis of information obtained from different government offices responsible for public construction works. A total of 407 questionnaires were distributed to respondents selected randomly from the list made available by these offices. A total of 200 responses were received. The average response rate was 49.1%. As is shown in Table II the respondents had a wide range of experience, and the average experience of the respondents was 17 years.

TABLE II
SUMMARY OF RESPONDENT'S PROFILE.

Experience in years	Percentage	Contract Amount	Percentage
Less than 10 year	20	Less than Birr 100 Million	36.0
Between 10-20 year	51.5	Between 100- 300 Million	20.5
Between 20-30 year	21	Between 300-600 Million	33.0
More than 30 year	7.5	Between 600-900 Million	7.0
		Above 900 Million	3.5

Note: 1 USD = 20.99 Ethiopian Birr.

D. Step 4-analysis method.

All the responses were stored and analyzed using Statistical Package for the Social Sciences (SPSS) Version 20. The statistical tests used in this study included both univariate and multivariate analysis techniques. Mahalanobis D² (d-squared) was used to find the outliers from the data. ANOVA, mean, median, standard deviation and frequency were used to determine the summary statistics of the responses. Reliability assessment (internal consistency through Cronbach's alpha coefficient) and factor analysis (Bartlett test of sphericity, KMO test, PCA with Varimax rotation) were carried out to determine the success and failure factors. Multiple regression analysis was conducted on the factors obtained by factor analysis to determine the most important factors.

IV. DATA ANALYSIS

Using Mahalanobis D² (d-squared) the authors found eleven outliers in the data samples with probability value below 0.001. Analyses were performed with and without these outliers, and the results obtained were compared to determine whether the results are more representative

and on the expected line with or without the outliers. At the end, these outliers were excluded from further analysis.

The effectiveness of attributes was calculated for the projects based upon no-dispute performance criteria for successful and failed projects. These are ranked: 'high' and 'very high' for the successful projects, while for failed projects these are ranked 'low' and 'very low'. The mean responses of the attributes can be considered the indicators of the effectiveness of the attributes. Depending upon the mean scores of the responses for various attributes, the attributes were then segregated in three groups: if the mean score of the responses for any attribute is significantly >4.5, that attribute contributes positively to reducing project disputes and is thus a "success attribute" (Group-1). If the mean score is significantly < 3.5, then it causes negative impacts and is called a "failure attribute" (Group-3). However, an attribute with a mean score falling between 3.5 and 4.5 can be considered neutral (Group-2) because it would have neither a positive nor negative impact. It was decided to drop the project attributes of the second group (with 4.5 < μ < 3.5).

Analysts that adopt a relative importance index (RII) assert that the mean values and standard deviations of each variable, assessed individually, are not statistically suitable to compute relative importance across variables. They argue that magnitudes computed based on such values would not reflect any relative relationships among variables of interest to justify comparison [18]. Therefore, this group of analysts advocated for the use of a RII that yields values that are comparable in relative terms. The RII (Relative Importance Index) was computed using the following equation

$$RII = \frac{\sum W}{(A * N)} \text{----- (1)}$$

where w is the weight given to each attribute by the respondents and ranges from 1 to 5, A is the highest weight (i.e., 5 in this case), and N is the total number of respondents.

The attributes of the first group (with μ > 4.5) were arranged on their descending order of RII values and ranked. The highest RII indicates the most critical success attributes with rank 1 and the next indicating the next most critical success attribute with rank 2 and so on. On the other hand, attributes of the third group (with μ < 3.5) were arranged in the ascending order of the RII and ranked. The lowest RII indicates the most critical failure attribute with rank 1, the next indicating the next most critical failure factor 2 and so on.

As is shown in Table III & IV, a total of 13 attributes emerged as success attributes (μ > 4.5) and 12 attributes as failure attributes (μ < 3.5) respectively, while ten attributes remained neutral (3.5 < μ < 4.5). Neutral attributes falling in the group 3.5 < μ < 4.5 were discarded.

TABLE III

TABLE III
RANK OF SUCCESS ATTRIBUTES ($\mu \geq 4.5$) BASED ON
PERFORMANCE CRITERIA.

Sl. No.	Project Success Attributes	RII	Rank
1	No major changes in the scope of work during construction.	0.949	1
2	Regular schedule and budget updates.	0.928	2
3	Adequate communication among all project participants.	0.927	3
4	Top management support.	0.921	4
5	Understanding responsibilities by various project participants.	0.918	5
6	Project Manager's with similar project experience.	0.918	6
7	Availability of resources (fund, machinery, materials etc.) as planned throughout the project	0.917	7
8	Clearly articulated scope and nature of work in the tender.	0.915	8
9	Thorough pre-qualification for potential bidders.	0.912	9
10	Regular monitoring and feedback by top management.	0.912	10
11	Thorough understanding of scope of work by project manager.	0.904	11
12	Regular design and construction control meetings.	0.900	12
13	Coordinating ability and rapport of project manager with his team members and sub-contractors.	0.871	13

TABLE IV
RANK OF FAILURE ATTRIBUTES ($\mu \leq 3.5$) BASED ON
PERFORMANCE CRITERIA.

Sl. No.	Project Failure Attributes	RII	Rank
1	Reluctance in timely decision by top management.	0.379	1
2	Conflicts between project manager and top management.	0.404	2
3	Conflict among team members.	0.414	3
4	Conflict between project manager and sub-contractor.	0.438	4
5	Holding key decisions in abeyance.	0.440	5
6	Hostile social and economic environment.	0.441	6
7	Ignorance of appropriate planning tools and techniques by project manager.	0.456	7
8	Lack of understanding of operating procedure by the project manager.	0.464	8
9	Unfavorable climatic condition at the site.	0.479	9
10	Inadequate project formulation in the beginning.	0.493	10
11	Reluctance in timely decision by project manager.	0.496	11
12	Size and value of the project being large.	0.497	12

A. Success attributes

No-dispute performance can be achieved if a project is completed with the least number of litigations resulting from disagreement among project participants. The success attributes no major changes in the scope of work during construction (RII= 0.949), regular schedule and budget updates (RII=0.928), adequate communication among all project participants (RII=0.927), top management support (RII=0.921), and the understanding of responsibilities by various project

participants (RII=0.918) emerged as the top five success attributes when no-dispute criteria is of prime importance in gauging project performance. Rankings are shown in Table III. Public sector projects require the management of all stakeholders, but this can also be used as an opportunity and a source of resources and support for dispute resolution [19].

The studies by [38] and [20] revealed that changes in the scope of work during construction cause disputes in the construction industry. Project scope changes could be as a result of incorrect initial scope definition. Hence, a drawing and design brief with minimal subsequent changes should be presented and approved by the client/owner at the highest level.

Updating the project schedule and budget on a regular basis while keeping a close watch on the timeline and cost may help the project manager to avoid time and cost overruns, which are the main causes of dispute in construction projects ([39], [40]).

Adequate communication and understanding responsibility helps in building trust, which helps in resolving conflicts among the project participants and delivering the project with the least number of disputes. Further, if project managers and the top management are supportive of each other, even major disputes can be resolved strategically.

B. Failure attributes

The rank order of the failure attributes in the no-dispute performance criteria (Table IV) suggests that the failure of top management to make timely decisions (RII=0.379), conflicts between project managers and top management (RII=0.404), conflicts among team members (RII=0.414), conflicts between project managers and sub-contractors (RII=0.438), and holding key decisions in abeyance (RII=0.440) emerged as the top five failure attributes when no-dispute criteria is of prime importance in gauging the project performance.

Disputes arise from a process involving conflict [21]. The prior presence of conflict between parties may initiate an unnecessary dispute [16]. In addition, the failure of top management to make timely decisions can lead to serious disagreements among the construction team. Therefore, valuable timely decisions by top management can help in taking timely measures to avoid disputes. If any conflict during construction is not resolved and timely decisions are not given, disputes become complicated and difficult to resolve.

C. Factor analysis

In the following sections, the factor analysis performed to identify success and failure factors and the description of these factors will be presented.

In the present study, factor analysis is performed separately on a group of 13 success attributes and 12 failure attributes. Factor analysis is a method of quantitative multivariate analysis with the main aim of identifying the interrelationships between a set of continuously measured variables (usually represented by their interrelationships) using a number of underlying

linearly independent reference variables called factors [22].

Many researchers from other fields, including politics, sociology, economics, human-machine systems, accident research, taxonomy, biology, medicine and geology have also applied this technique [23]. In the construction industry, for instance, [24] used the factor analysis technique to explore key stressors leading to construction professionals' stress in the Gaza Strip. [25] employed the factor analysis technique to identify five principal components that influence the market environment for artisanal dimension stone in Nairobi, and [26] also applied this technique to identify a set of eight key factors associated with construction industry development.

To ensure the suitability and reliability of the data for factor analysis, an adequate sample size is needed. According to [27], the sample size should not be less than 100, even if the number of variables is less than 20, and the subjects-to-variables ratio should be no lower than 5 [41]. In this research, the ratio of respondents to variables for success and failure attributes was found to be 12 and 15, respectively, which is greater than 5 and exceeds the threshold for the minimum number of respondents (100). Cronbach's alpha (α) tests were performed to evaluate sample reliability (internal consistencies). The Cronbach's alphas of 0.766 for success attributes and 0.735 for failure attributes suggest that the overall sample reliability (internal consistency) was acceptable for factor analysis ([28],[29]). The data were also assessed for suitability for factor analysis using the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) and Bartlett's test of sphericity. The Meyer-Olkin (KMO) measure of sampling adequacy, a popular diagnostic measure, tests whether the partial correlations among variables are small. It is a measure of homogeneity of variables [30]. A higher value of KMO is desired. Bartlett's test of sphericity tests whether the correlation matrix is an identity matrix, which would indicate that the factor model is inappropriate. It is generally recommended that the KMO value should be greater than 0.5 if the sample size is adequate [41],[31]). As shown in Table V, the KMO values for success and failure attributes were 0.723 and 0.685, respectively, and were considered appropriate for use in factor analysis. The results of the Bartlett's tests for success and failure attributes were 302.063 and 628.781, respectively, and the associated significance levels (sig. value) were < 0.001, indicating that the population correlation matrix was not an identity matrix.

TABLE V
KMO AND BARTLETT'S TEST OF SUCCESS AND FAILURE ATTRIBUTES

Parameter description	For success attributes	For failure attributes
KMO-measure of sampling adequacy.	0.723	0.685
Bartlett's Test of Sphericity		
• Approx. Chi-Square	302.063	628.781

• degrees of freedom (df)	66	66
• Sig.	0.000	0.000

To facilitate interpretation of factor loadings, an oblique rotation of the reference axes, called varimax rotation, was performed, and the derived factors and their corresponding loadings were obtained [32].

In this study, a total of six success factors and five failure factors with Eigen values greater than 1 were extracted. Names were assigned to these factors. The factors with their names representing their common and latent properties, the variance explained by each of them, and the factor loadings of various attributes appearing in each factor are summarized in Tables VI and VII respectively. Factor loadings < 0.5 are suppressed in the analysis, and only those having loading values > 0.5 are used for the interpretations. The reliability of the factor model was also evaluated with the communalities of each variable. The communalities of all variables are found to be much greater than 0.5, which signifies that the factor model is reliable.

a) Success factors

The description of success factors is given in the following sections.

TABLE VI
FACTOR PROFILE OF PROJECT SUCCESS ATTRIBUTES FOR NO-DISPUTE AS PERFORMANCE CRITERIA.

Factor structure	Loading	Variance Explained
Availability of resources and pre-qualification		13.10%
Thorough pre-qualification for potential bidders.	0.845	
Availability of resources (fund, machinery, materials etc.)as planned throughout the project	0.797	
Project manager's competence		12.23%
Thorough understanding of scope of work by project manager.	0.828	
Understanding responsibilities by various project participants.	0.649	
Project manager's with similar project experience.	0.540	
Top management support		11.76%
Top management support.	0.763	
Regular monitoring and feedback by top management.	0.732	
Owner's competence		11.58%
Clearly articulated scope and nature of work in the tender.	0.704	
No major changes in the scope of work during construction.	0.652	
Interaction among project participants		11.16%
Coordinating ability and rapport of project manager with his team members and sub-contractors.	0.838	
Adequate communication among all project participants.	0.771	
Construction meetings, and schedule and budget updates		10.31%
Regular schedule and budget updates.	0.871	
Regular design and construction control meetings.	0.600	
Cumulative variance explained		70.14%

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1) *Availability of resources and pre-qualification*

The attributes emerging under the first factor account for a variance of 13.10%, the highest of all factors, and they explain availability of resources and pre-qualification. This comprises the thorough pre-qualification of potential bidders and the availability of resources (fund, machinery, materials etc.) throughout the project.

Resources should be made available and, if needed, shared resources could also be utilized for fulfilling the objectives. The availability of resources throughout the project will help in reducing the potential for disputes. The study by [33] noted that the shortage of resources in construction projects has been the cause of disputes. Another study by [34] also revealed that the non-availability of resources as planned has been one of the top ten causes of disputes in construction projects. Further, the thorough pre-qualification of potential bidders is a yardstick to allow or disallow the firms to participate in the bids. It helps the owner to select reputed and capable firms with proven track-records so that disputes during construction may be reduced.

2) *Project manager's competence*

This factor has three attributes accounting for 12.23% of the variance. This comprises thorough understanding of the scope of work by the project manager, various project participants' understanding of their responsibilities and project managers with similar project experience. The project manager is the key person in a project and should understand his or her role. He or she should have interpersonal, technical and administrative skills.

A clear understanding of the scope of work by the project manager may minimize construction disputes. In cases in which the project manager does not understand the scope of work, he or she cannot apply the proper basics of managerial principles to the project; hence, the project progress may be delayed and disputes may arise. Moreover, he or she must take the lead by establishing clear responsibilities and making each project participant understand what he or she is responsible for to minimize dispute. In this regard, the previous experience of a project manager on similar projects makes him or her competent.

3) *Top management support*

This factor has two attributes accounting for 11.76% of the variance. This factor comprises top management support and regular monitoring and feedback by top management.

Top management support/commitment is an essential element for ensuring no-dispute performance. For instance, the willingness of top management to provide the necessary resources and authority/power to project

manager for project success has a positive impact on no-dispute performance. In addition, it is difficult to minimize dispute without regular monitoring and feedback by top management.

4) *Owner competency*

Two attributes have emerged under this factor accounting for a variance of 11.58%: a clearly articulated scope and nature of the work in the tender and no major changes in the scope of the work during construction.

One of the priority issues in enhancing no-dispute performance in construction projects is to clearly articulate the scope and nature of the work in the tender so that there are no major changes in the scope during construction. Therefore, experience and a sufficient level of competence of the owner are required in preparing scope documents.

5) *Interaction among project participants*

This factor has two attributes: the coordinating ability and rapport of the project manager with his team members and sub-contractors and adequate communication among all project participants. It accounts for a variance of 11.16%. Continuous coordination by the project manager and relationships among project participants are required through the project life cycle for solving problems and achieving no-dispute performance.

6) *Construction meetings, and schedule and budget updates*

This factor has two attributes accounting for 10.31% of variance: regular schedule and budget updates and regular design and construction control meetings.

A thorough, detailed review of the contractor's schedule and budget baseline and all schedule and budget updates is necessary to ensure that schedules and budgets comply with the specification requirements. This may help in reducing the potential for disputes. Furthermore, to ensure that the project meets the targets without disputes, the entire process should be closely scrutinized by the project manager and his team members using regular design and construction control meetings for any design delays.

b) *Failure factors*

The description of failure factors is given in the following sections.

TABLE VII
FACTOR PROFILE OF PROJECT FAILURE ATTRIBUTES FOR NO-DISPUTE AS PERFORMANCE CRITERIA

Factor Structure	Loading	Variance Explained
Conflict among project participants		18.05%
Conflict among team members.	0.819	
Conflict between project manager and top management.	0.721	
Conflict between project manager and sub-contractor.	0.550	
Indecisiveness of project participant		14.64%

Reluctance in timely decision by top management.	0.751	
Holding key decisions in abeyance.	0.731	
Reluctance in timely decision by project manager.	0.726	
Project manager's ignorance and lack of knowledge		14.00%
Lack of understanding of operating procedure by the project manager.	0.901	
Ignorance of appropriate planning tools and techniques by project manager.	0.886	
Socio Economic and climatic condition		13.17%
Hostile social and economic environment.	0.849	
Unfavorable climatic condition at the site.	0.681	
Project specific factors		12.28%
Inadequate project formulation in the beginning.	0.808	
Size and value of the project being large.	0.738	
Cumulative variance explained		72.14%

1) Conflict among project participants

Three attributes have emerged under this factor accounting for a variance of 18.05%, the highest of all factors. This is comprised of conflict among team members, conflicts between project managers and top management, and conflict between project managers and sub-contractors.

The top management must devise a suitable means to avoid conflict among project participants that could lead to disputes.

2) Indecisiveness of project participants

Two attributes have emerged under this factor accounting for a variance of 14.64%: the failure of top management to make timely decisions and holding key decisions in abeyance.

The reluctance of top management and project managers to make day-to-day decisions and holding key decisions in abeyance has a negative impact on no-dispute performance. Therefore, top management and project managers need to make effective and timely decisions regarding any issue that might arise during the course of the project.

3) Project manager ignorance and lack of knowledge

This factor accounts for 14% of variance explained. The attributes with high loading in this factor are: ignorance of appropriate planning tools and techniques by the project manager and lack of understanding of operating procedures by the project manager.

Project management tools and techniques help a project manager in the development of a realistic approach to achieve no-dispute performance. Therefore, the project manager should have the required knowledge about these tools and techniques and their application in construction projects and also the project manager has to

know what operating procedures should be carried out to avoid those factors causing disputes. However, lack of these knowledge and operating procedures by a project manager may have a negative impact on no-dispute performance.

4) Hostile socioeconomic and climatic conditions

Attributes of this factor include a hostile social and economic environment and unfavorable climatic conditions at the site. Hostile socioeconomic and climatic conditions create difficult working conditions for workers on site. This factor affects construction projects adversely in the form of difficulties in timely mobilization of the resources, frequent stoppage of work, labor unrest, and reduced productivity, which may lead to construction disputes. Further, a study by [16] identified unfavorable climatic conditions at the site as one of the causes of disputes. Both attributes under this factor have negative impacts on the efficiency and productivity of the workforce and thus impact no-dispute performance. This factor explains 13.17% of the variance.

5) Project specific factor

The attributes with high loading in this factor are inadequate project formulation in the beginning and the size and value of the project being large. It accounts for a variance of 12.28%.

Inadequate project formulation in the beginning may result in design changes, changes in project scope, schedule acceleration, and failure to supply sufficient resources, which can lead to construction disputes [35]. Moreover, as the size and cost of the project increases, the complexity and risk of the project may increase [42]. This could be because larger projects are typically more complex, require multi-disciplinary inputs, are non-integrative, are more time consuming, etc., and hence there could be a greater likelihood of disputes.

D. Critical success and failure factors

As mentioned above, factor analysis was used to transform the 25 significant success and failure attributes into a few success and failure factors. To explore the relative importance of these factors in impacting no-dispute performance, multiple regression analysis was applied. The factors found significant using multiple regression analysis are referred to as 'critical success/failure factors'.

The general purpose of a multiple regression is to learn about the relationship among several factors (known as independent variables or explanatory variables) and another factor (known as the dependent variable or response variable). The regression model takes the form of the following equation

$$Y = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + \dots + a_nX_n + e \text{ ---- (2)}$$

where Y is the dependent variable, X_i (i = 1, 2 ... n) are the independent variables, a_i (i = 0, 1 ... n) are the parameters to be estimated, and e is the error term.

This study uses the responses on no-dispute performance of the project as the dependent variable and factors found from factor analysis as independent variables.

a) *Critical success factor*

Table VIII shows the stepwise multiple regression results, when 'no-dispute performance' is treated as the dependent variable and the six success factors discussed above as independent variables.

TABLE VIII
STEPWISE MULTIPLE REGRESSION RESULTS FOR SUCCESS FACTORS.

Independent variables	B	σ	β	t-value	p-value
Dependent variable: No-dispute; $R^2=0.34$, Adjusted $R^2=0.10$					
Constant	4.58	0.04	NA	121.617	0.00
Factor 4. owner's competence	0.15	0.04	0.29	3.88	0.00
Factor 5. interaction among project participants	0.10	0.04	0.16	2.07	0.04

In this case 'owner's competence' (Factor 4), and 'interaction among project participants' (Factor 5), were found to be significant at $p < 0.05$ for no-dispute performance for public projects. These factors are the most important when the objective is no-dispute performance.

b) *Critical failure factor*

Table IX shows the stepwise multiple regression results, when 'no-dispute performance' is treated as the dependent variable and the five failure factors as independent variables.

TABLE IX
STEPWISE MULTIPLE REGRESSION RESULTS FOR FAILURE FACTORS.

Independent variables	B	σ	β	t-value	p-value
Dependent variable: No-dispute; $R^2=0.05$, Adjusted $R^2=0.04$					
Constant	1.85	0.03	NA	70.783	0.00
Factor 1. conflict among project participants	-0.10	0.03	-0.22	-2.94	0.00

The 'conflict among project participants' (Factor 1), is found to be significant at $p < 0.05$ for no-dispute performance of public construction projects.

V. DISCUSSION

Disputes between the parties to construction projects are of great concern to the industry. It can be damaging and expensive, thus it should be studied more to be minimized or prevented. There are certain factors that affect no-dispute performance in construction projects. Identifying these factors and taking appropriate measures could be an important step towards improving no-dispute performance.

This study identified the critical factors affecting no-dispute performance of public construction projects in Ethiopia. The stepwise multiple regression analysis indicated that Factor 4 (owner's competence), and Factor 5 (interaction among project participants) can

significantly contribute to no-dispute performance of Ethiopian public construction projects while the factor of conflict among project participants is found to be detrimental to no-dispute performance of Ethiopian public construction projects.

The importance of the owner's role in minimizing disputes begins at the start of the project, as plans are formulated; this is when the owner has the most influence over the construction process. The owner should be competent enough to prepare a clearly articulated scope and unambiguous nature of work in the tender. By doing so, major changes in the scope of work during construction, which is the cause of construction disputes ([38], [20]), could be avoided. Moreover, project managers and their teams must develop effective communication channels to avoid or reduce the potential for disputes. They must learn to create an atmosphere that encourages open communication. Communication needs to be established from the start to prevent the problems from escalating into disputes. Poor communication and misunderstandings among project members are some of the most common reasons for disputes [36]. Moreover, as the construction process requires a great amount of manpower with diverse skill sets, coordination is required in almost every stage of a project. Considerable time is consumed in coordination. Project managers must realize that time spent on coordination is an investment, which bears fruit through no-dispute performance. Further, according to [37], if conflicts are not properly managed, they may cause project delays and increase project costs, which leads to dispute. Therefore, top management must devise a means to avoid conflict by creating a suitable environment to build up a team spirit among project participants. This is because the achievement of success in no-dispute performance is a team effort and if the team members are not working in unison it leads to adverse effects on the performance of a construction project.

As with any other opinion-based study, the present study also has some limitations. The majority of respondents have evaluated the projects in their execution stage only and very few have evaluated the performance of projects in the planning and operation stages. The study was also carried out only in the Ethiopian context. Hence the study has a limitation in this regard.

In this study the importance of understanding the impact of various factors on project performance was emphasized. Further research is needed to investigate potential improvement in the implementation of no-dispute performance in the Ethiopian public construction industry.

VI. CONCLUSION

Completing public construction projects without disputes is still a challenge for construction professionals. If disputes are avoided, it can result in the successful delivery of public construction projects.

In this paper, the critical success and failure factors for no-dispute performance in the construction industry were analyzed. First, 35 attributes for no-dispute performance were identified with a comprehensive literature review. Through ANOVA, significant success and failure attributes were identified. Then, factor analysis was conducted to transform the significant success and failure attributes into several success and failure factors. After determining the success and failure factors, multiple regression analysis was conducted on these factors to determine the critical factors for no-dispute performance. The analysis reveals that the critical factors found in this study are related to people competency. This also shows that people competency issues in Ethiopian public construction projects are given inadequate attention. Competency is the underlying characteristic of a person that enables that person to demonstrate superior performance on a job. Hence, a lack of competent people in the sector lowers the possibility of the successful achievement of no-dispute performance.

It is common for developing countries such as Ethiopia to use foreign consultancy firms to develop their physical infrastructures. These foreign firms, in addition to executing different projects across the country, should make an effort to work on technology transfer and training to produce competent people in the sector, which enhances domestic capabilities. This research has emphasized the role of people in the construction industry.

This study provides new and significant information regarding the determinants affecting construction projects in Ethiopia. It will play a vital role in the construction industry to identify critical success factors and consider them in new projects. Further, it helps in eliminating or solving failure factors that affect a construction project. This will help in reducing time and cost issues that arise due to disputes, and new projects may be completed within the stipulated time and budget.

The implications of this study are not limited to researchers and construction industry practitioners. The Ethiopian government could adopt the results of this study to reduce/avoid additional costs incurred due to the poor no-dispute performance of public construction projects, which results in poor utilization and an increased social and economic cost. Furthermore, the study may also help government efforts to enhance the efficient and effective use of public funds on construction projects, which is an on-going concern of the government and of the international development community.

It would be interesting to carry out further research to investigate potential improvement in the implementation of no-dispute performance by evaluating the projects in their planning, execution and operation stages.

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