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Contractors' Competitiveness Measurement in International Competitive Bid of Ethiopian Road Projects

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Abstract*: *The competitiveness of organizations and the development of competitive strategies have become important issues in the construction industry. Therefore, this research aimed to develop a statistical model framework to enhance the competitiveness of domestic road contractors when bidding for international competitive bids in Ethiopia. This has been addressed by studying the challenges faced by domestic contractors in International competitive bids. The study employed structured questionnaires, interviews, and case studies to collect data. To measure the level of competitiveness, a statistical model was developed using factor analysis and multiple regression analysis in a software program. It has been found that challenges related to core competency, owners' strict requirements, public construction policies, and others are critical factors that construction stakeholders need to prioritise.

Keywords*: *Competitiveness, Construction-Procurement, Domestic-Contractors.

I. INTRODUCTION

The construction industry is vital for the development of any nation. In many ways, the pace of economic growth of any country can be measured by the development of physical infrastructures, such as buildings, roads, railways, hydropower stations, and bridges [20]. Construction project development involves numerous parties, various processes, different phases and stages of work, and numerous inputs from both the public and private sectors, with the primary aim of bringing the project to a successful conclusion. The procurement system and tendering process are how it goes about acquiring the Goods, Services, and Works with the competitive Contractor [19].

In most cases, Construction Work is awarded mainly through competitive bidding. Under this system, the project owner invites interested contractors to compete for a project by tendering bids. The award is made based on the bidder with the lowest quoted price [4]. However, the price cannot guarantee the delivery of a project with the expected quality, using the best techniques, or meeting the delivery date. Contractors must have the capability to deal with various bidding situations successfully in today's highly competitive construction market [10].

Contractors' competitiveness, which has the end goal of getting the market share and being productive for the project, delivering the project while sustaining the profitability of the company, is determined by a large number of factors for numerous challenges and problems [18]. These challenges begin with the bidding process. Ofori [18] listed challenges such as the inability to prepare responsive bids, completeness issues, failure to meet the special requirements, lack of the required annual turnover and line of credit, lack of experienced and qualified staff, and inadequate contract administration system. Of course, it may be challenging to address all the challenges and satisfy the factors that contribute to them simultaneously, as management practices often face limited resources, such as money, manpower, time, and management efforts. Therefore, identifying a list of critical success factors is valuable for helping contractors focus more on developing their competitiveness ([7]; [15]; [25]).

Even if some domestic Contractors are registered in the higher classes or grades for road construction, in Ethiopia, most of them are incapable of submitting responsive bids as expected, despite their ability or the efforts of some stakeholders and the government. While in the era of free trade, where not just one of a country's business owners' computers, but also those from all around, the ability to win and sign an International Competitive bid becomes tough for Domestic ones, other than those from within the company. Hence, this competitive and unsustainable construction environment necessitates that Ethiopian construction organisations must be more strategic and proactive to increase their chances of survival in the sector. According to [22], the measure of the competitiveness of a construction organization, is an effective way to understand the concept, promote continuous improvement, and enhance performance.

Therefore, to measure competitiveness and develop strategic bidding-related research, the focus was on modelling bidding behaviour by considering competitive relationships. Competitiveness in bidding can be modelled by analyzing: (1) entire bid distributions; (2) competitiveness within bids; and (3) competitiveness between bids for either a single or a series of construction contracts [5].

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To develop this notion, [6] used regression analysis to model competitiveness between the bids of competing contractors. Using data collected from tender reports, they modelled the competitiveness behaviour of 15 contractors toward five different types of construction work. It was found that the competitiveness of the 15 contractors did not differ significantly between some types. The original five types were, therefore, regrouped into three types based on the competitiveness of the contractors. Two of these comprised mainly minor contracts and larger contracts. Some of the contractors displayed the same behavior as those in the Flanagan and Norman [8] study. In addition, it was found that the most competitive contractors had preferred contract sizes for either smaller or larger contracts and that one contractor was more competitive on smaller contracts. They also found that competitiveness differences were greater for different sizes of construction work than for different types of construction work. In other words, the size of construction work appeared to influence competitiveness more than the type of construction work [15]. On the other hand, deciding whether to bid or not in the competitive construction industry is a crucial issue. Because not all tenders are meant to be bid on. Consideration of the resources the contractor will allocate should be given before deciding to bid. For instance, on this issue, the other three models were introduced and developed by Wanous [24], In order to create the weights of the elements taken into consideration, an artificial neural network (ANN) approach on the bid/no-bid and the neuro-fuzzy "bid / no bid" models was evaluated on actual projects. These two methods rely on input data collected from contractors regarding their evaluation of the variables influencing the decision to bid or not to bid, and link it with the actual output data, which ultimately determines the decision. The (ANN) approach then creates connections between the input and the output using its knowledge base, and the weighted link is utilized to develop a straightforward computer software called Smart Bidder to assist in the bid/no-bid decision-making process. The weights of variables from a questionnaire survey given to Syrian contractors were employed in the third model (a parametric solution model) ([24] cited on [15], [7]). However, this model was complex for users to understand. Similar to Drew, D.S., Skitmore, R. M., and Lo, H. P [5] regression model, in El Sawalhi, N. I., and Shrair, A. N [7] and an unpublished master's dissertation of Nasser, S. A. [15] 125 factors were identified, categorized into nine groups, evaluated, and ranked from the contractor's perspectives. A factor analysis technique was employed to develop a model for measuring and forecasting companies' competitiveness strategies. El Sawalhi, N. I., and Shrair, A. N [7] and Nasser, S. A. [15] multiple regression analysis model includes five clusters with 18 factors.

Hence, as it has been an essential issue for other countries' construction industries for many years, Competitiveness and its strategy should have been something that needed to be addressed long ago in Ethiopia's construction industry. Since the situation is alarming, there is a need to study and understand the challenges facing domestic Contractors, especially when competing for large Road work tenders that attract international bidders. The solutions that will be developed will explicitly benefit the competitive strategies of all local contractors and other stakeholders.

From different previous reviews especially taking [5, 7,15] studies as a significant base for this Ethiopian based research, six major groups were drawn to represent challenging factors, which are the company's /firm's/ characteristics, project/contract/ characteristics, bidding situation, contract documentation and administration, tenderers' internal relationships, and social and economic conditions—using that this study tends to develop a statistical model framework based on critical factors to strengthen Ethiopian Contractors' competitiveness in federal international competitive bidding (ICB) road projects based on essential factors that affect them so that the Ethiopian contractors' and other main stakeholders on road projects aware on enhancing mechanisms for competitiveness.

A. Objective of the study

The study intends to achieve the following objectives:

- To develop a statistical model framework based on critical factors affecting the competitiveness of Ethiopian Contractors in federal international competitive bidding (ICB) road projects.
- To recommend enhancing mechanisms for the competitiveness of Domestic Contractors in the ICB of Ethiopian federal road projects.

II. METHODS

A. Research Area

The study focused on the competitiveness of Ethiopian road contractors. Most of these Contractors are based in the significant business town and capital city of Ethiopia, Addis Ababa. Additionally, since the headquarters of the Ethiopian Road Authority is also located in Addis Ababa, Ethiopia, the study area was chosen to be in this city.

B. Research Population

The target population in this research was:

- Domestic Road Contractors registered in grade one
- Ethiopian Road Authority's (ERA) Engineering Procurement Directorate staff

This group of stakeholders is considered for this research because they have a right-hand relationship with procurement, bid evaluation criteria, and implementation of the ICB tender. The study covered twenty-two domestic road contractors registered in Grade One and thirteen staff members from ERA in the Engineering Procurement Directorate department. Additionally, five higher-ranking officers, including project senior advisors, directorate directors, and leaders of the Engineering Procurement team, were interviewed face-to-face.

C. Population Sampling and Sampling Techniques

This study considered two groups of the population: grade one Road Contractors and ERA's Engineering and Procurement staff, which were addressed through non-probability sampling.

- Grade one Road Contractors: Snowball sampling and Purposive sampling techniques have been used.
- ERA's Engineering and Procurement staff: A Purposive sampling

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technique has been used.

Purposive sampling has been employed with the guidance and assistance of the ERA Engineering and Procurement department, as documented in the organisation's records. The Snowball sampling technique has been used for groups that are difficult to reach. In addition, there are few registered grade-one road contractors in Ethiopia. Hence, the study attempted to include as many participants as possible, based on the recommendations of willing participants.

D. Research Data Required and Instruments

Primary data were obtained from questionnaires via Google Forms and interviews. In addition, to verify the model framework, two case studies were considered. Secondary data have been obtained from various sources, including published books, journals, and research.

E. Research Instrument Quality Test

(1) Validity Test

- Face Validity Test: This involves the expert looking at the items in the instruments and agreeing that the test is a valid measure of the concept that is being measured, just on the face of it. Therefore, advisors and experts, such as contract administration staff and the ERA's engineering procurement directorate staff, evaluated whether each of the measuring items and questions in the instrument matched the domain of the research.
- Content Validity Test: the
- content validity of the instruments was achieved by a rational analysis of the instrument by raters (experts) familiar with the construct of interest; Research Advisors and experts on the research subject; Contractors' Contract administration staff and ERA's engineering procurement directorate experts, and researchers. Raters reviewed the relevance in terms of readability, Clarity, and Comprehensiveness and came to a level of agreement on which items should be included in the final questionnaire and interview. The content validity index, commonly known as I-CVI, has been computed by having experts give a rating of 'relevance' for each question. The scale-level content validity index (S-CVI) measures the overall content validity of the questionnaire and interview items. The result was obtained by dividing each item by the number of experts. Eight experts were used (i.e. N=8) and the total number of questionnaires was thirty-six. According to Lynn [13], for six to eight experts acceptable CVI value is at least 0.83.

I-CVI (agreed item)/ (number of experts) (1)

S-CVI/AVE = (sum of I-CVI scores)/ (number of items) (2)

S-CVI/UA (sum of UA scores)/ (number of items) (3)

Table 1 presents the detailed outcome of the content validity results for the thirty-six questions of both the Google Form survey questionnaire and the interview. The result of I-CVI and S-CVI/UA was 0.96 and 0.83, respectively. Hence, the results showed that the items of the instruments are relevant enough.

Table I: Content Validity Test Result

Item	expert 1	expert 2	expert 3	expert 4	expert 5	expert 6	expert 7	expert 8	expert in agreement	I-CVI	Universal Agreement
Q1	1	1	1	1	1	1	1	1	8	1	1
Q2	1	1	1	1	1	1	1	1	8	1	1
Q3	1	1	1	1	1	1	1	1	8	1	1
Q4	1	1	1	1	1	1	1	1	8	1	1
Q5	1	1	1	1	1	1	1	1	8	1	1
Q6	1	1	1	1	1	1	1	1	8	1	1
Q7	1	1	1	1	1	1	1	1	8	1	1
Q8	1	1	1	1	1	1	1	1	8	1	1
Q9	1	1	1	1	1	0	0	1	6	0.75	0
Q10	1	1	1	1	1	1	1	1	8	1	1
Q11	1	1	1	1	1	1	1	1	8	1	1
Q12	0	1	1	1	0	1	1	1	7	0.88	0
Q13	1	1	1	1	1	1	1	1	8	1	1
Q14	1	1	1	1	1	1	1	1	8	1	1
Q15	1	1	1	1	1	1	1	1	8	1	1
Q16	1	1	0	1	1	0	1	1	6	0.75	0
Q17	1	1	1	1	1	1	1	1	8	1	1
Q18	1	1	1	1	1	1	1	1	8	1	1
Q19	0	1	1	1	1	1	1	1	7	0.88	0

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Q20	1	0	1	1	1	1	1	1	7	0.88	0
Q21	1	1	1	1	1	1	1	1	8	1	1
Q22	1	1	1	0	1	1	1	0	6	0.75	0
Q23	1	1	1	1	1	1	1	1	8	1	1
Q24	1	1	1	1	1	1	1	1	8	1	1
Q25	1	1	1	1	1	1	1	1	8	1	1
Q26	1	1	1	1	1	1	1	1	8	1	1
Q27	1	1	1	1	1	1	1	1	8	1	1
Q28	1	1	1	1	1	1	1	1	8	1	1
Q29	1	1	1	1	1	1	1	1	8	1	1
Q30	1	1	1	1	1	1	1	1	8	1	1
Q31	1	1	1	1	1	1	1	1	8	1	1
Q32	1	1	1	1	1	1	1	1	8	1	1
Q33	1	1	1	1	1	1	1	1	8	1	1
Q34	1	1	1	1	1	1	1	1	8	1	1
Q35	1	1	1	1	1	1	1	1	8	1	1
Q36	1	1	1	1	1	1	1	1	8	1	1
									S-CVI/Ave	0.96	
proportion relevance	0.94	0.97	0.97	0.97	0.97	0.94	0.97	0.97	S-CVI/UA		0.83

(2) Reliability Test

Cronbach's Alpha: This method was used to measure the reliability of the questionnaire by comparing the mean of each field with the overall mean of the questionnaire. The normal range of Cronbach's coefficient alpha value is between 0.0 and + 1.0, and the higher values reflect a higher degree of internal consistency ([7]; [15]). The closer the Alpha is to 1, the greater the internal consistency of items in the instrument. The formula that determines alpha is fairly simple and makes use of the items (variables), k, in the scale and the average of the inter-item correlation (r).

$$\alpha = kr/1+(k-1)r \quad [9] \qquad (4)$$

Where: $0.9 \leq \alpha \leq 1.0$ Excellent ; $0.8 \leq \alpha < 0.9$ Good; $0.7 \leq \alpha < 0.8$ Acceptable; $0.5 \leq \alpha < 0.6$ Poor; $0.0 \leq \alpha < 0.5$ Unacceptable [9,15] .

However, for this study, the Cronbach's alpha for reliability was calculated using SPSS (Statistical Package for the Social Sciences) to enhance efficiency and accuracy.

The results are presented in Table 2. Therefore, a Cronbach's Alpha value of greater than 0.6 indicates that this study instrument is reliable.

Table II: Reliability Coefficient Alpha, Cronbach Technique

	Reliability Statistics	
Factor Domains	**Cronbach's Alpha**	**Number of Items/factors**
Company's /Firm's/ characteristics	0.809	24
Project/contract characteristics factors	0.789	10
Bidding situation	0.888	13
Contract documentation and administration factors	0.684	4
Tenderers' internal relationships	0.731	4
The social and economic conditions	0.679	7
ERA's Major Factors cause	0.749	7

III. RESULTS AND DISCUSSION

The objectives of this study have been addressed through a selected factor that identifies challenges to competitiveness, using a structured questionnaire with a Likert scale, among Ethiopian Road Contractors. Frequency distribution, correlation analysis, factor analysis, and multiple regression were used to analyse and organize data, to give meaning to the response rates, address the research objectives, and facilitate

Insight. Table III illustrates the response rate of the respondents. Twenty-seven questionnaires, each with a list of subsections for domestic contractors, and sixteen questionnaires for Ethiopian road authority and procurement staff, were distributed and administered using Google Forms to elicit responses. Additionally, five interviews were held with higher management officers from ERA to strengthen the study and explore different prospects.

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Table III: Distribution and Collection of Data

Targeted Group	Addressed	Responded
Grade 1 General or Road Contractors	27	22
Ethiopian road authority procurement staff	16	13
Higher officers from the Ethiopian Road Authority	5	5
Response rate	Those who did not respond – 16.67%	Those who returned – 83.33%

A. Questionnaires Data Result and Discussion

(1) Critical sub-factor selection

The reviewed literature mainly takes [5], [7] and [15] as bench mark and the study of current ways of the International Competitive Bid Road Construction sector in Ethiopia given way to categorize factors affecting Local Contractors' Competitiveness into Six Major Groups. 24 Company (Firm's Characteristics) factors, 10 Contract (Project) characteristics factors, 13 bidding situation factors, 4 Contract documentation/administration factors, 7 Social and economic condition factors, and four tenderers' internal relationships were identified. A total of 62 factors were ranked by the 22 contractors and their representatives per group. To determine the relative ranking of the factors, the scores were transformed into importance indices using the following formula.

$$\text{Relative Importance Index} = \frac{\sum w}{AN} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N} \quad (5)$$

Table IV displays the critical sub-factors selected based on RII ranked in each of the six major groups.

Table IV: Critical Sub-Factors Affecting Contractor's Competitiveness in ICB Road Projects

Critical Sub-Factors (CSFs)	Mean	Std. Deviation	(Importance Index) II	Rank
Financial resources and financial stability for the bid (CSF 1)	4.864	0.351	97.27%	1
Experience in Certain kinds of bidding (CSF 2)	4.818	0.395	96.36%	2
Failure to meet the Turnover requirement of the ICB Tender (CSF 3)	4.682	0.477	93.64%	3
Experience in similar ICB Road projects /company strength in the industry (CSF 4)	4.636	0.658	92.73%	4
Availability of qualified and Experienced Staff (CSF 5)	4.591	0.590	91.82%	5
Social, Economic, and Political conditions of the country (CSF 6)	4.591	0.666	91.82%	6
Completeness of Bid document (CSF 7)	4.500	0.598	90.00%	7
Bid Contract Conditions /special requirements/ (CSF 8)	4.500	0.673	90.00%	8
Managerial ability (CSF 9)	4.500	0.678	90.00%	9
Project cash flow (CSF 10)	4.455	0.596	89.09%	10
Project size (CSF 11)	4.409	0.666	88.18%	11
Contract Coordination difficulties (CSF 12)	4.364	0.658	87.27%	12
Pre-qualification requirement (CSF13)	4.364	0.727	87.27%	13
Expected number of competitors (degree of competition) (CSF 14)	4.364	0.734	87.27%	14
Site Conditions (CSF 15)	4.364	0.747	87.27%	15
The Contract Administration System (CSF 16)	4.273	0.827	85.45%	16
The commitment of the Firm to ongoing projects (CSF 17)	4.273	0.883	85.45%	17
Contractors' Relationship with stakeholders (CSF 18)	4.227	0.528	84.55%	18
Government Procurement regulations (CSF 19)	4.227	0.869	84.55%	19

(2) Factor analysis and Extraction

Principal component analysis and basis vectors are used to select the basis of the factors. Which component causes variations to occur most frequently? The process of producing linear combinations of variables using factor analysis to explain as much variance in the obtained data as feasible is known as principal components analysis ([7];[15]). The critical-sub factor components are arranged in order of how much they contribute to the variation. It has identified 19 Linear components within the data are shown in Table IV above. In factor analysis and extraction with the assistance of SPSS, The Eigenvalues associated with each factor represent the variance explained by that particular linear component. It also displays the Eigenvalue in terms of the percentage of variance explained (e.g., factor 1 explains 25.402% of the total variance, as shown in Table V below).

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Table V: Eigen-Value for the Nineteen Critical Sub-Factors

	Initial Eigenvalues		
Critical Sub-Factors (CSFs)	**Total**	**% of Variance**	**Cumulative %**
Financial resources and financial stability for the bid (CSF 1)	4.826	25.402	25.402
Experience in Certain kinds of bidding (CSF 2)	3.699	19.470	44.872
Failure to meet the Turnover requirement of the ICB Tender (CSF 3)	1.986	10.451	55.322
Experience in similar ICB Road projects /company strength in the industry (CSF 4)	1.710	8.999	64.321
Availability of qualified and Experienced Staff (CSF 5)	1.557	8.194	72.515
Social, Economic, and Political conditions of the country (CSF 6)	1.162	6.114	78.630
Completeness of Bid document (CSF 7)	0.962	5.066	83.695
Bid Contract Conditions /special requirements/ (CSF 8)	0.720	3.788	87.483
Managerial ability (CSF 9)	0.649	3.417	90.900
Project cash flow (CSF 10)	0.483	2.544	93.444
Project size (CSF 11)	0.368	1.935	95.378
Contract Coordination difficulties (CSF 12)	0.271	1.427	96.806
Pre-qualification requirement (CSF13)	0.247	1.302	98.108
Expected number of competitors (degree of competition) (CSF 14)	0.177	0.934	99.042
Site Conditions (CSF 15)	0.087	0.457	99.499
The Contract Administration System (CSF 16)	0.045	0.235	99.734
The commitment of the Firm to ongoing projects (CSF 17)	0.033	0.173	99.908
Contractors' Relationship with stakeholders (CSF 18)	0.013	0.068	99.976
Government Procurement regulations (CSF 19)	0.005	0.024	100.000

This factor's Eigenvalue is once again shown, along with the column labelled "% of the variance," which indicates how much of the variation is explained by these factors.

The recovered clusters in Table V, which show the results of the principal component analysis, account for 78.63% of the variance. This means that only six factors among the nineteen stood out. On the contrary, with [7, 15] study, which selected eight factors by the Eigenvalue result, accounting for 71.38%.

The value for the elements that were disregarded was ignored, as shown in Fig. 1 for the plot of total variance, since the Eigenvalue of those factors is less than 1.

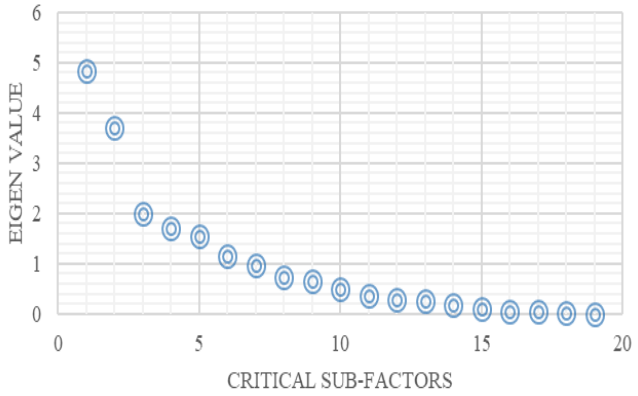

Fig. 1. Total Variance Plot

(3) Factor Rotation

Since factor rotation maximizes the variance of factors across the variables, which produces a more straightforward solution [15]. Even though this is the default setting in most statistical programs.

In a more detailed explanation, 19 identified CSFs were subjected to factor analysis using principal components analysis and Varimax rotation, which has already been done with Principal components. Varimax rotation is used for this level of factor analysis to clarify the relationships among the factors. Hence, it involves adjusting the coordinates of data that result from the principal components analysis.

The rotated factor matrix in factor analysis, which is a matrix of the factor loadings for each variable onto each factor, is illustrated in Table VI. This matrix contains the same information as the component matrix, which is calculated after rotation. A few things that needed to be considered about this matrix were as follows.

- Factor loading is suppressed by 0.4.
- The Factor loading output is to be sorted by size.

To get a more straightforward solution, the above considerations have been done for the matrix of El Sawalhi, N. I., and Shrair, A. N [7] and unpublished master's dissertation of Nasser, S. A. [15].

Table VI presents the factor rotation between new clusters and all Critical sub-factors that affect the competitiveness of ICB Road projects. For presentation and factor analysis purposes, only those with the above-selected criteria are presented in the table. The results also showed the strength of the correlation between the extracted factors and their corresponding variables (CSFs).

Table VI: Extracted Group Matrix After Varimax Rotation

Critical Sub-factors	Critical Factors					
	CF.1	CF.2	CF.3	CF.4	CF.5	CF.6
Completeness of document (CSF 7)	0.841					
Managerial ability (CSF 9)	0.839					
Pre-qualification requirement (CSF 13)	0.810					
Government procurement regulations (CSF 19)	0.751					
Project size (CFS 11)	-0.663					
The contract administration system (CFS 16)		0.909				
Availability of qualified and Experienced Staff (CFS 5)		0.858				
Contract Coordination difficulties (CFS 12)		0.728				
Experience in similar projects /company strength in the industry (CFS 4)	-0.495	0.605		0.448		
Failure to meet the Turnover requirement (CFS 3)			0.800			
Financial resources and financial stability for the bid (CSF 1)	-0.501		0.646			
Project cash flow (CFS 10)				0.869		
Expected number of competitors (degree of competition) (CFS 14)		0.504		0.607		
Bid Contract Conditions/special requirements/ (CFS 8)			0.499	0.582		
Experience in Certain kinds of bidding (CFS 2)					0.844	
The commitment of the Firm to ongoing projects (CFS 17)					0.647	
Contractors' relationship with stakeholders (CFS 18)			0.433		0.477	
Social, Economic, and Political Conditions of the country (CFS 6)						0.863
Site Conditions (CSF 15)						0.738

(4) Extracted Critical Factors Interpretation

The six retrieved clusters have been renamed as follows.

Cluster 1: Contract and Project Administration Conditions

This cluster includes the Completeness of the document, Managerial ability, Pre-qualification requirements, Government procurement regulations, and Project size.

Cluster 2: Experience Influence

This cluster includes the Contract administration system, the Availability of qualified and Experienced Staff, Coordination difficulties, and experience in similar projects or company strength in the industry.

Cluster 3: Financial Influence

This cluster includes Failure to meet the Turnover requirement and Financial resources.

Cluster 4: Bid Requirement. This cluster includes Project cash flow, the expected number of competitors (degree of competition), and Bid Contract Conditions/special requirements.

Cluster 5: Internal situation

This cluster encompasses experience in certain types of bidding, the Firm's Commitment to projects, and Contractor relationships with stakeholders.

Cluster 6: Security Conditions

This cluster encompasses the Social, economic, and Political conditions of the country, as well as site conditions.

The cluster of El Sawalhi, N. I., and Shrair, A. N [7] and unpublished master's dissertation of Nasser, S. A. [15] were eight based on their factor extraction.

(5) Statistical Model Development based on Multiple Regression Analysis

Multiple regressions are a statistical technique that allows us to predict someone's score on one variable based on their scores on several other variables. Regression analysis includes techniques for modelling and analyzing several variables when the focus is on the relationship between a dependent variable and one or more independent variables, as shown in equation 5 [7,15].

$$Y = b1Fi + b2\,Fii + b3\,Fiii \ldots\ldots\ldots + bn\,Fn + c \quad (6)$$

where:

b1, b2, b3 …bn are intercepts (coefficients)

c is the constant coefficient

Fi Fii + Fiii …Fn are critical factors (Independent Variables)

Y is the dependent variable (Competitiveness)

By creating a model to forecast the percentage of competitiveness in the ICB Road projects, this study employed a technique to identify the most significant element impacting the Contractor's competitiveness.

To assess their utility for forecasting changes in the dependent variable, competitiveness, the selected 19 essential success elements that influence competitiveness were used as independent variables.

Table VII presents six structures that incorporate various factors. The criteria variable's observed value and anticipated value are correlated, and this is indicated by the letter R. R Square (R2) is the square of this correlation measure and represents the percentage of the criterion variable's variation that is accounted for in the model framework. It serves as a gauge of how well we can predict the criterion variable using the predictor factors (i.e. independent variables) [7,15].

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Table VII: R Measures for Predictor Variable

Model	R		R Square	Adjusted R Square	Std. An error in the Estimate
1	.844[a]		0.713	0.598	0.223
2	.879[a]		0.772	0.681	0.223
3	.882[a]		0.778	0.689	0.266
4	.923[a]		0.852	0.792	0.300
5	.896[a]		0.803	0.724	0.310
6	.888[a]		0.788	0.703	0.363

As in this model, the adjusted R-squared was 0.792. This meant that the independent variables explained almost 80% of the variance in the dependent variable. Based on the selected Model, only three variables were significant out of the six independent variables, as shown in Table VIII below.

The p-value of the statistic should be less than 0.05(level of Significance) for a model to be selected. This means that, at least, one of the predictor variables is significantly related to the outcome variable.

Table VIII: Predictor/Coefficient/ of the Selected Model.

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	4.636	0.064		72.528	0.000
REGR factor score 1 for analysis 1	-0.326	0.065	-0.495	-4.975	0.000
REGR factor score 2 for analysis 1	0.398	0.065	0.605	6.080	0.000
REGR factor score 3 for analysis 1	-0.084	0.065	-0.128	-1.291	0.216
REGR factor score 4 for analysis 1	0.295	0.065	0.448	4.507	0.000
REGR factor score 5 for analysis 1	-0.099	0.065	-0.150	-1.511	0.152
REGR factor score 6 for analysis 1	-0.024	0.065	-0.037	-0.370	0.716

Hence, the model equation can be written as:

Competitiveness = (4.636 – 0.326*C1 + 0.398*C2 + 0.295*C4) *(100/6.471) (7)

Where: Following are explanations of the ranking scores of the components that made up the average weighted scores of C1, C2, and C4.

C1: Factors included in Cluster 1, which are CSF 7, CSF 19, CSF 9, CSF 13, CSF 11

C2: Factors included in Cluster 2, which are CSF 16, CSF 5, CSF 12, CSF 4

C4: Factors included in Cluster 4, which are CSF 10, CSF 14, CSF 8

The value 6.471 is the result of summing the equation's terms if all Critical success factors have a maximum score of 5. Also, 100 was the maximum expected competitiveness result from an Ethiopian road contractor.

When it comes to the result of El Sawalhi, N. I., and Shrair, A. N [7] and unpublished master's dissertation of Nasser, S. A. [15], the competitiveness model had equation of Competitiveness model = (-12.704 +12.351 C4+5.221C1+2.654C2+ 8.331C6 +5.824C3) *(100/159.201).

(6) Model Application and Verification for Validation

Model verification and validation (V&V) are essential parts of the model development process if models are to be accepted and used to support decision-making ([14] cited on [7,15]). El Sawalhi, N. I., and Shrair, A. N [7] and unpublished master's dissertation of Nasser, S. A. [15] has done the verification of the mathematical model they created with 18 critical factors under five clusters, also with a bidder who stood from one to three i.e. six bidders for a total of two cases.

Hence, for this research model equation to be applied and tested for validity, a new form was developed based on three clusters and the 12 critical factors. The form was distributed for two road projects of Construction Managers and Resident Engineers.

- *Verification cases*

Two cases were analysed to evaluate the model verifications and measure its accuracy and strength in forecasting and assessing the competitiveness of local contractors participating in this research survey, representing Domestic Contractors of Road Construction who participate in international competitiveness bidding. The first two contractors who participated in two projects have been studied.

Case 1. Construction Works of Design and Build Road Project

Project description

A 57 km road project, awarded through an international competitive bid, has been implemented for 956,000,000 ETB. The contract period was 36 months. The Ethiopian government has financed it.

According to Equation 6, the results presented in Table IX indicate that the two companies bidding for this project were rated on a Likert scale of 1 to 5 for the critical factors grouped into three clusters.

The results show that the 1st place bidder has higher competitiveness than the 2nd, with 97% and 95%, respectively. The first bidder secured a better position in the actual bid competition, and according to the developed mathematical model, it also has a more effective competitive strategy. Additionally, the company emphasises its internal characteristics.

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Table IX: Result of the First Case Project Competitiveness Model Test

Cluster	Critical Sub-Factors (CSF)	1st bidder	Average of the 1st bidder	2nd bidder	The average of the 2nd bidder
Cluster 1	Completeness of the document	5	4.4	5	4.2
	Managerial ability	4		5	
	Pre-qualification requirement	5		5	
	Government procurement regulations	3		2	
	Project size	5		4	
Cluster 2	The contract administration system	5	4.5	4	4.25
	Availability of qualified and Experienced Staff	4		4	
	Contract Coordination Difficulties	4		4	
	Experience in similar projects /company strength in the industry	5		5	
Cluster 4	Project cash flow	4	4.333333333	5	4
	Expected number of competitors (degree of competition)	4		3	
	Bid Contract Conditions/special requirements/	5		4	
	Competitiveness		96.91%		94.86%

Case 2: Construction Works of Road Upgrade

Project Description

A road project of upgrading a kilometre of 13.6 and a Contract Amount of 736,910,325 ETB, built in the past seven years with International Competitive Bidding. Which was planned to take 30 months. The Ethiopian government funded it. For case two, the first two bidders have also been requested to fill out the form to test the statistical model. Table X summarized it. The results show that the 1st place bidder has higher competitiveness than the 2nd, with 93% and 88%, respectively. The first bidder secured a better position in the actual bid competition, as it also possesses a more effective competitive strategy and core competence, according to the developed mathematical model.

Table-X: Result of the Second Project Competitiveness Model Test

Cluster	Critical Sub-Factors (CSF)	1st bidder	Average of the 1st bidder	2nd bidder	The average of the 2nd bidder
Cluster 1	Completeness of the document	5	4	5	3.8
	Managerial ability	5		3	
	Pre-qualification requirement	3		3	
	Government procurement regulations	3		3	
	Project size	4		5	
Cluster 2	The contract administration system	3	4	3	3.5
	Availability of qualified and Experienced Staff	5		5	
	Contract Coordination Difficulties	3		2	
	Experience in similar projects /company strength in the industry	5		4	
Cluster 3	Project cash flow	4	3.666666667	3	3
	Expected number of competitors (degree of competition)	3		3	
	Bid Contract Conditions/special requirements/	4		3	
	Competitiveness		92.80%		87.70%

B. Interviewed data results and discussion

This study aims to raise awareness among internal and external stakeholders of the need to improve the competitiveness of Contractors in Ethiopia. In addition to the results of questionnaires and the creation of a mathematical competitiveness measurement mechanism based on the above analysis, one-on-one interviews were conducted with five higher-level personnel and management personnel at the Ethiopian Road Authority, specifically to strengthen the second objective of the study. Hence, different competitiveness enhancement mechanisms have been suggested for Ethiopian domestic road Contractors in ICB road projects.

1) Domestic Contractors' Role and Responsibility

- Contractors need to hire experienced contract administrators, work on professionalism, and handle work with an equipped staff.
- Train technical staff according to ICB, filling process, new technologies to increase efficiency and effectiveness,
- Increasing commitment to ongoing projects,
- Being legitimate and lawful,
- Acquaintance with ERA's procurement and evaluation system,
- Building good relationships and reputations with the stakeholders, and solving disputes and litigation processes promptly,
- Working on the value of money on the tender to enhance competitive strategies,

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- Working in close collaboration with PPA, CRB, and any Governmental entity that relates to construction projects, specifically ICB road projects, to influence policies and regulations so that they become conducive enough.

Therefore, it shows the local contractors themselves know that strategies of competitiveness consider adequate market share, productive manner, and profitability, as mentioned with building core competence [11] and having a competitive and comparative advantage ([21]; [1]) are crucial. On the other hand, [23] offered a competitive strategy of a lower bidding price than other competitors to increase the chance of winning the contract. However, contrary to this, the findings of this research, based on the interviews, suggest that a low bid strategy may pose a risk to profitability and market value. Alexanderson and Hultén [3] also Ngai and Wat [16] agreed with that in their study.

2) Ethiopian Road Authority (ERA) Responsibility

ERA, as a client representative for road projects, a major organisation that leads high-class procurement systems, and a Government entity, plays a significant role in enhancing the competitiveness of domestic contractors.

- ERA should provide regular training to contractors on bidding & bid submission strategies,
- To provide regulation for the provision of slots where local Contractors can be specially considered,
- ERA needs to work on capacity-building programs intensively,
- To formulate a suitable procurement management strategy with clear objectives, monitoring systems, and evaluation mechanisms,
- To bring down the turnover figure for domestic Contractors,
- Equipping its (ERA's) staff, especially those related to procurement and contracts,
- Create a system that increases the participation of subcontractors on ICB projects so that they can enhance their experience and capacity.
- To be more serious and direct on the local contractors' performance and supervision, not compromising quality and performance, so that the whole process and system get refined.
- Regular assessment of the Contractors' technical team and assistance,
- To cooperate with the Contractor's association to train Contractors in the international bidding system,
- Revise the minimum Bid requirement to be fulfilled by the domestic Contractors set for the ICB projects,
- ERA should advise other government entities who are directly or indirectly involved in the procurement system to launch the system to build the capacity of Local Contractors in a short and long-term strategy to improve their competitiveness,
- Working on Transparency and formal ways of communication,
- Avoid Corruption practices; encourage a fair and transparent procurement system,
- Encouraging domestic Contractors to undertake sub-contract works from foreign contractors to enhance the experience,
- Proper monitoring and evaluation system,
- Facilitate loans in the form of finance or capital goods for domestic Contractors,
- To create a stable system and enforce the requirement that JV should do all mega projects between local and foreign firms.

Therefore, integration is another key factor, as Aidah Nassazi [2] too mentioned in Uganda's business, it is a necessity to improve competitiveness internally and increase trust externally so that the company continues to gain the trust of the project owner to continue getting sustainable construction project work. The finding also relates highly to the improvement mechanism of Nurisra [17] and Kumaraswamy [12] maintaining a good relationship with the government, owner, and consultant, considering joint ventures, has a significant impact on an improving mechanism.

3) Public procurement and property administration Agency and other Government entities (CRB, Financial Institutions: Financers, Construction Council, etc.)

- To support efforts by Contractors aimed at improving their capacity to compete effectively, such as the formation of Joint Ventures or joining forces in tendering, processing, and execution of contracts,
- Procurement agency policies and regulations should be revised, and laws that hinder the progress of Domestic Contractors should be amended.
- Creating a means of providing security and guarantees for domestic Contractors,
- Improve the Preferential availability of foreign currency to a local bidder,
- Manage material price escalations,
- Keeping the peace and security of the site areas and the Country,
- Integrate work from all Government entities and create a system conducive enough to elevate domestic Contractors' competitiveness,
- Arrange loans in cash or the form of a Construction plant,
- Jointly work with ERA to build the capacity of Local Contractors and improve the parameters of the licensing system.
- The procurement policy should be reviewed as per the project's uniqueness,
- Foreign financiers' Requirements and policies should be conducive to local contractors,
- Simplify the loan processes,
- The government should review its policy in the field to give preferential treatment to domestic contractors, e.g. Importing materials, equipment, and plant processes.
- Create a rooted regulation that would force foreign contractors to hire or subcontract with domestic contractors for the bids they win.

IV. CONCLUSIONS

This study has attempted to assess the competitiveness of domestic contractors while exploring the challenges they face in procuring Ethiopian federal ICB road projects, focusing on the period from 2015/16 to 2020 E.C. The study revealed that local contractors face many challenges, as identified in the study.

Some of the challenges were severe enough to prevent local road Works bidders from attempting to bid for ICB projects. A statistical model framework attempted to reveal areas such as bid document completeness, internal matters of the bidder, financial considerations, and the nature of the project, which were crucial areas for enhancing the competitiveness of domestic Contractors. This will enable local contractors to be competent in ICB road construction projects.

Due to the large number of Ethiopian road contractors with higher grades, which allows them to practice ICB Works, the analysis, specifically the regression model, is affected by this. Therefore, it is better to undertake a study on related topics, but with areas that have a larger sample size. Additionally, since the construction industry is dynamic and interrelated, other parameters and factors affecting contractors that were not considered in this study are suggested for inclusion in further research.

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Authors Contributions	Hanna Moges Dereje was the principal researcher, responsible for reviewing papers and data collection, as well as analysing the study. Wubishet Jekale Mengesha was the principal advisor and mentor to the study's success, also providing additional data.

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