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Effects Of Engineering Service Quality On Completion Time In Road Construction Projects In Ethiopia

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ABSTRACT

Construction delay is worldwide problem and it is not uncommon in Ethiopia. Construction time overrun in road construction projects has become prevalent in Ethiopian. As a result, it is costing implementing agencies and the society at large. Moreover, unsatisfied public needs are compromised. The objective of the study was to measure the effects of engineering service quality and to identify the major factors causing time overrun in road construction projects in Ethiopia. Quantitative research and purposive sampling method was used. Primary data was collected through structured survey questionnaire. 60 companies and 119 professionals took part in this study. Data analysis using statistical tools like reliability test, association between variables and multiple regression analysis has been performed. Identified factors causing delay in road construction projects were categorized under five factors (client, design, contract management, contractor and external). The result of the study showed very strong correlation between customer satisfaction and engineering service quality. Furthermore, the study illustrated factors related to contractor (16.9%), client (7.7%), consultant (6%) and external (6.6%) accounted for the overall 37.2% of the variance on time overrun. On the other hand, the result revealed that contract management factors have little significance on time overrun based on the dataset. The researchers suggested some recommendations including - consultants must invest on people and physical facilities that are crucial for service delivery. Furthermore, the long-term quality objectives of the company should be explicitly communicated with all staff as well as quality control shall become part and parcel of the system.

Keywords: Customer, Customer Satisfaction, Delay Factors, Service Quality, Time Overrun

1. INTRODUCTION

Construction delay is an international concern and worldwide problem. It is caused by several factors. Many projects worldwide encounter difficulties and completion time widely exceeds original envisaged time table and as a consequence projects suffer additional expense (Frimpong *et al*, 2003). Largely, the effect of delay is time and cost overrun, claims, litigations and underutilization of resources (Haseeb *et al*, 2011; Haq *et al*, 2014).

Furthermore, organizations overall performance would be compromised as a result of an expected budget increase.

Project completion within original anticipated time is of overriding importance to clients, contractors, consultants and stakeholders at large provided that the initial estimated time of completion was defined realistically taking the scope of works into account to allow the builder (contractor) engage pragmatically and deliver projects within the planned schedule (El-Razek *et al*., 2008; Shaikh *et al*., 2010).

Infrastructure development projects are key success factors in Ethiopia and are considered as basic indicators for the country development and economic growth (MoFED, 2011; The World Bank, 2010; 2012). According to MoFED (2011), the construction sector accounts for 5.6% of the GDP in 2012/13 at constant prices (i.e., 2003 EFY Base year series).

Construction delays are not uncommon in Ethiopia. Delay in road construction projects in Ethiopia has become a crucial concern for implementing agencies, financing institutions and stakeholders (ERA, 2009, The World Bank, 2010; 2012). Albeit, the majority of the national budget goes to the federal road construction projects, due to common planning and preparation phase mistakes and several other factors, project management has become a challenge. Projects suffer time and cost overrun that often trigger problem on the feasibility of projects from what had been perceived during appraisal stage. As a consequence of construction delays, the country faces difficulty to respond to unsatisfied public needs. Likewise, delay in road construction projects will have effect on national budget and also the problem conveys a negative impression on international contracts in Ethiopia (The World Bank, 2010; 2012).

The aim of this study is to determine the delay factors in road construction projects in Ethiopia in relation with engineering service quality that may have significant effect on projects completion time.

1.1 STATEMENT OF THE PROBLEM

Time overrun is prevalent in road construction projects in Ethiopia (The World Bank, 2012; ERA, 2009). Construction delay is considered worldwide occurrence and one of the key challenge for the construction industry (Sambasivan and Soon, 2007). Customers in Ethiopia (clients, the general public and financing institutions) are not satisfied with the current project delivery because of schedule delay, product quality problems and cost overrun (ERA, 2009; World Bank, 2010; 2012). Customer satisfaction is the key measuring tool for the construction industry. It is measured when the product is tested and validated during implementation stage (Barret, 2000; Maloney, 2002; Kamara and Anumba, 2000). Satisfactory performance is a precondition to establish good working relationships between stakeholders (Soetanto *et al*., 2001). Construction projects are often considered to be successfully executed when the construction is done within anticipated time, budget, quality and when it meets customers (stakeholders) expectations (Challal and Tkiouat, 2012). Delay is costly

for client and construction firms. According to ERA (2009) an average 30% for time overrun from the original anticipated time for federal road construction projects is estimated.

The road engineering service industry is purported to take the major share of the problem (ERA, 2009) and therefore, the present study purpose is to identify the effects of service quality on completion time in conjunction with other delay factors.

1.2 RESEARCH HYPOTHESIS

The following research hypothesis will be tested:

Table 1: Service quality and Customer satisfaction model (SQCSM)

Hypothesis 1:	A consistent engineering service quality offering has significant effect on customer satisfaction.

Table 2: Road construction time overrun model (RCTOM)

Hypothesis 2:	Design and contract management consultant related factors have significant effect on completion time in road construction projects in Ethiopia.
Hypothesis 3:	Client related factors have significant effect on completion time in road construction projects in Ethiopia.
Hypothesis 4:	Contractor related factors have significant effect on completion time in road construction projects in Ethiopia.
Hypothesis 5:	External related factors have significant effect on completion time in road construction projects in Ethiopia.

The service quality and customer satisfaction hypothesis is based on SERVQUAL and SERVPERF models (Parasuraman *et al* 1988; Cronin and Taylor, 1992) respectively. Likewise, the construction time overrun model is based Rehsid *et al* (2013) and Al-Khalil and Al-Ghafly (1999).

2. LITERATURE REVIEW

2.1 SERVICE MARKETING MIX STRATEGIES

The core concept of service is how companies intend to deliver the intended service and ascertain above average earnings through adequate competitive marketing mix strategies while satisfying customer's requirement (Lovelock, 2001). Service offering strategy is a gateway to marketplace for companies and customers tend to buy services that meet their requirements. The product component (service quality), thus, is the core element which buyers have deep attachment and companies to acquire market share and compete with rivals, their service quality must exceed the customer's expectations (Kotler, 2000; Gronroos, 1990; Levitt, 1983).

2.2 SERVICE QUALITY

Service offering firms to establish growth and stay in the business with success for long time, should deliver quality service that should be to the standard and must exceeds customer expectation. The quality of service is a delicate issue that emanates during service offering process and the process may get disrupted by customer participation (Parasuraman *et al*, 1985; LeBlanc and Nguyen, 1988).

Furthermore, service quality has become an important marketing strategy by companies. Scholars underlined the advantages of service quality are many and some of the perceived advantages include satisfied customer, company reputation, attracts new customers and enhances relationship with customer, creates more business opportunity, increase in market share and profit margins (Crosby, 1991; Edvardsson et al, 1991; Adil, 2012)

Parasuraman *et al* (1985) developed a model to explain service quality and identified five gaps in his model "SERVQUAL" service quality model (Figure 1). In the model the lower part of the gaps represents the marketer's gaps while the upper part designated the customer side gap. Gap-1 represents the customer expectation-management perception; gap-2 identifies the gap related with management perception and service quality specifications while gap-3 defines the service quality specifications and service delivery process. On the other hand, gap-4 represents the service quality and external communications and finally gap-5 designate the expected service quality and perceived services (Parasuraman *et al*, 1985).

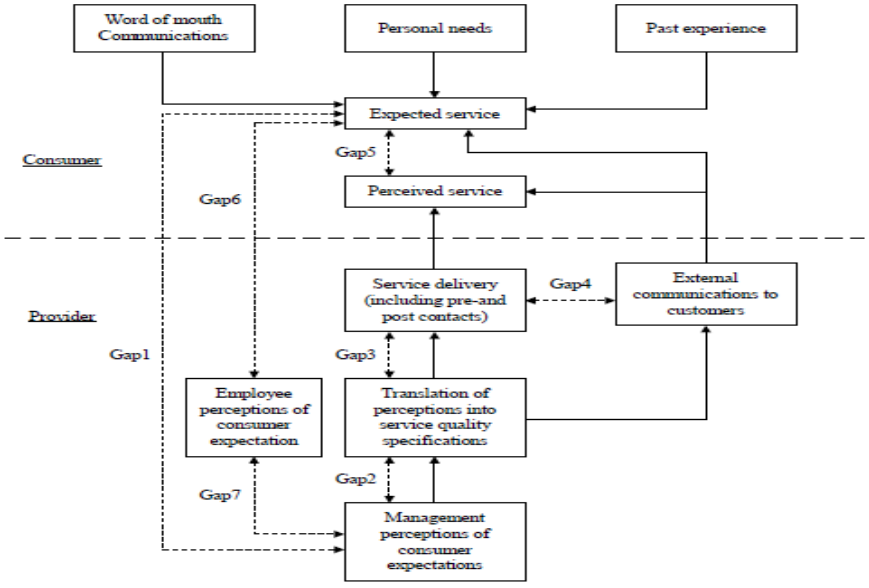


Figure 1: SERVQUAL gap model

Source: Parasuraman et al (1985)

In the same line, another scholars Cronin and Taylor (1992) challenged the Parasuraman *et al* (1985; 1988) the conceptualization and measurements of service quality model. Cronin and Taylor (1992) proposed a performance-based approach to measure service quality. This performance-based approach is named 'SERVPERF' perceptions alone. The argument was customer approach should be the basis for service quality and there is no empirical evidence to support importance of the quality gap (expectations and perceptions). Likewise, Brady et al. (2002) conducted replication and extension of Cronin and Taylor (1992) study and declared that SERVPERF was better model when compared with other service quality models. The dimensions of SERVQUAL and SERVPERF models based on the three elements of 7Ps marketing mixes were considered

to develop the service quality measurement scale in such a way that both expectations and perceptions are considered.

Consequently, the service quality that is being offered by road engineering consulting companies in Ethiopia has many gaps and as a result during implementation of road construction projects the effect has become evident as time overrun, cost overrun and disputes between parties (ERA, 2009; World Bank, 2010; World Bank, 2012).

2.3 TIME OVERRUN

Kaming *et al*. (1997) defined time overrun as "extension of time beyond planned completion dates usually traceable to contractors" Similarly, Elinwa and Joshua (2001) defined delay as: "the lapse between the agreed estimation or completion date and the actual date of completion".

Construction delay is worldwide problem. Several delay factors were quantified by researchers over the years. Frimpong *et al*. (2003) quantified in his study in Ghana 70% out of 47 projects were not completed within the original agreed time. Similarly, the study by Ogunlana *et al* (1996) in Thailand also revealed the extent of delay in construction projects and identified the major factors that attributed to time overrun. In the same line, Al-Momani (2000) studied construction projects performance in Jordan and the study depicted that 82% out of 130 public projects were delayed.

Rehsid *et al*. (2013) studied construction project delays in Punjab-Pakistain and employed an empirical method to determine the relationship among delay causing variables. Rehsid categorized the causes of delay onto seven causes as related to contractors, client, consultant, material, equipment, labour and general environmental factors.

Nevertheless, three of these causes like material, equipment and labour related factors could have been grouped under contractor related factors since these items are generally in control of the construction company. On the other hand, materials related issues which may fall in the category of unforeseen physical situations could have been seen under the general environmental factors. In contrast, Ahmed, *et al* (2003) used two general categories to classify causes of delay. These are internal and external. He then grouped client, consultant and contractor related factors under internal category while for causes of delay that are not under the control of parties were considered under external factors.

This classification and categorization of delay causing factors generally responds to the actions of the organizations involved in construction and due regard was given to unforeseen factors that are beyond the control of any of the parties or stakeholders in construction. Thus, similar categorization with few changes is adopted for this study. Consequently, the causes of delay in road construction projects in Ethiopia are classified into four categories for this study. These are:

- Client related factors;

- Consultant related factors (design related and contract management related);
- Contractor related factors; and
- External related factors

2.4 RELATIONSHIP BETWEEN SERVICE QUALITY, CUSTOMER SATISFACTION AND TIME OVERRUN

Customer satisfaction is a multi-dimensional concept like service quality and it arises at different levels in an organization operations. Moreover, it should be assessed using similar factors that are applied for service quality functionality (Lee *et al.*, 2000). On the other hand, Parasuraman *et al*., (1985) highlighted customer satisfaction and service quality are directly correlated. When the perceived service quality is high, the customer satisfaction increases in the same way. Likewise, Saravana & Rao, (2007) and Lee *et al.*, (2000) supported that service offering companies may establish customer satisfaction with delivery of high service quality. According to Fen & Meillian (2005) there exists quite positive strong relationship between service quality and customer satisfaction.

Service quality and customer satisfaction play a key role in establishing success for consulting firms in road sector in Ethiopia. Consulting firms will benefit of high customer satisfaction since it is the only option to remain the client (customer) prospective partner for the future. Service quality not only upset the relationship between parties, it will put burden on the client because projects will not be completed as per envisioned schedule and unsatisfied public need in terms of infrastructure will be dragged due to time and cost overrun.

2.5 CONCEPTUAL FRAMEWORK

The functional and technical aspects of service quality and its effect on completion time as a result of client, consultant, contractor and external related factors are studied. The conceptual framework for the study is as shown on Figure 2.

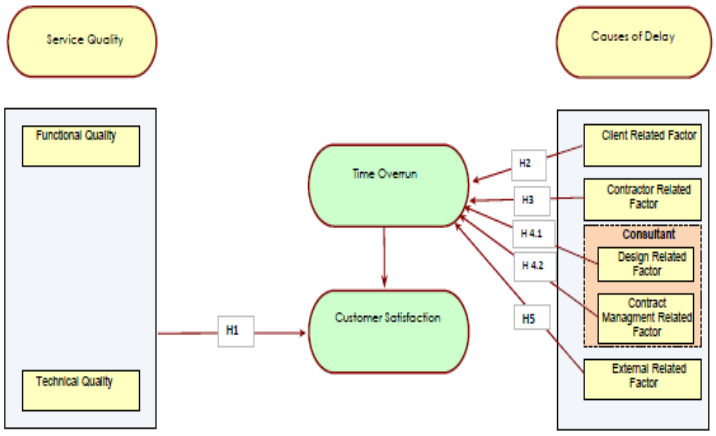


Figure 2: Conceptual framework (research model)

Source: Authors' conceptualization

3. METHODOLOGY

3.1 RESEARCH APPROACHES

This study is dominantly based on quantitative (positivist) method that allows this research use cross-sectional study and generalize from a sample of population. All professional engineers working in road construction sector in Ethiopia are included for the study. The population for this study are road construction professionals who are working on federal road construction projects with the Ethiopian Roads Authority (ERA). Therefore, the list of consultants and contractors who are currently engaged with ERA was obtained from the regional directorates. Consequently, it has become overt that 35 consulting firms and 15 contractors are working in the 5 client's regional directorate's offices. Out of these, 35 consultants, 15 contractors and all the 5 client's regional directorate's offices were selected and the size of sample included in the study "research population' was 150 professional engineers. These professionals were approached to take part in the survey.

The respondents for this study are managers, senior road professionals, resident engineers, team leaders and contract engineers who are engaged in federal road construction project in Ethiopia. These professionals were selected because they possess the necessary experience to furnish answers for the research questions and are well versed to reasonably relate the topic area with the research problem. Consequently, multiple respondents from client, consultants and contractors were considered. Therefore, on the onset of this study decision was made to distribute the questionnaire to multiple respondents of the three primary stakeholders in construction.

Purposive sampling technique is employed. This sampling technique is suitable because it allows selecting respondents who could best fit for the study and conversant to answer the research questions. Moreover, the technique is valid and highly employed for small size of population (Saunders *et al*., 2009; Fisher, 2007). A total of 150 questionnaires were distributed in person directly to the respondents and few questionnaires were sent through email. 119 were returned and all returned questionnaire were usable with response rate 79%. 55 companies were selected to take part in the study and in total and 40 participated making 73% participation ratio.

Secondary data for this study (final contract completion reports) for selected road construction projects that were constructed between 2008 and 2014 were collected from ERA regional directorates. Ten projects were selected and pertinent contract details like contractual matters and related extension of time claims issues were reviewed and evaluated from the contract completion reports to determine factual information on time overrun. A spread sheet model was prepared to summarize the data for further analysis. Descriptive and inferential statistics are used to analyse the data. Primary data was collected through extensive structured survey questionnaire from knowledgeable senior professionals operating in road construction sector. The primary data collection in quantitative (positivist) research paradigm with self-administered questionnaire was employed.

The key sources for constructing the measuring instrument were in-depth literature review and secondary data evaluation. The conceptual framework for the study and similar empirical studies in the topic area (service quality, customer satisfaction, time overrun) were extensively researched. Accordingly, 22-item scale for service quality measurement were based on SERVQUAL and SERVPERF models (Parasuraman *et al* 1988; Cronin and Taylor, 1992) while for customer satisfaction 22-item scale were based on Kärnä et al (2004). Likewise, 56-item scale was used for construction time overrun based on Rehsid *et al* (2013) and Al-Khalil and Al-Ghafly (1999). Respondents were requested to select measurement responses on five point Likert Scales.

3.2 RELIABILITY AND VALIDITY TEST

Validity assessment was carried out. In the first instance, the questionnaire was pre-tested and the feedback from knowledgeable professionals has been used to improve the final construct. Furthermore, as far as feasible, the instruments were selected from various previous similar studies and conceptual framework constructed for the study. Consequently, the content validity was verified in conjunction with the pre-test survey.

Table Error! No text of specified style in document.: Reliability coefficients

Variable name	Description	Number of Items	Reliability Coefficient
Service Quality	Tangibles	4	0.868
	Reliability	5	0.890
	Responsiveness	4	0.835
	Assurance	4	0.925
	Empathy	4	0.889
	Service quality	21	0.932
Customer Satisfaction	Quality Assurance	6	0.878
	Environment and safety	4	0.927
	Personnel	3	0.886
	Co-operation	5	0.868
	Site Supervision	3	0.954
	Customer Satisfaction	21	0.955
Time overrun	Client related factors	14	0.796
	Design related factors	5	0.885
	Contract management related factors	14	0.921
	Contractor related factors	20	0.927
	External related factors	7	0.778

Source: Authors' own data analysis

According to Pallant (2005) for reliability the alpha coefficient should be more than 0.8. As Table 3 depicts, the analysis revealed that ranged from 0.778 to 0.955 meeting the requirements for sound and reliable measuring instrument.

3.3 PROCEDURE FOR TESTING HYPOTHESIS

The association (correlation) between the research variables is tested using Pearson's r correlation and Spearman's rho for significance level of the correlation among the variables at p=0.05 (95% confidence) is considered to test the research hypothesis significance level.

Table 4: Customer satisfaction and time overrun hypotheses

Model	Dependent variable	Independent variables
Hypothesis 1: Service quality and customer satisfaction model	Customer satisfaction	Service quality (*tangibles, reliability, responsiveness, assurance, empathy*)
Customer Satisfaction = $\beta_0 + \beta_1$(service quality)+ε_1		
Hypothesis 2, 3, 4 and 5: Road construction time overrun model	Time overrun	client related factors; Consultant related factors; contractor related factors; external related factors
Time overrun = $\beta_0 + \beta_1$(client related factors) + β_2(consultant related factors)+ β_3 (contractor related factors)+ β_4(external related factors)+ ε_2		

4. RESULTS AND DISCUSSION

4.1 REGRESSION ANALYSIS

Regression analysis was performed to recognize the factors that have influence on customer satisfaction and time overrun in road construction projects in Ethiopia. Ordinal Logistic Regression (OLR) was done for customer satisfaction (DV1: dependent variable) and service quality (IV1: independent variable). On the other hand, for time overrun and engineering service quality simple linear regression model is conducted where time overrun (DV2) was dependent variable and the independent variable (IV2) was engineering service quality. Furthermore, another multiple regression analysis was carried out for time overrun (DV3: dependent variable) and all factors causing time overrun independent variables (IV3: client, IV4: design, IV5: supervision or contract management, IV6: contractor and IV7: external related factors).

4.2 HYPOTHESIS TESTING

In section 1, the research hypothesises were stated to measure the effects of service quality on customer satisfaction and completion time of road construction projects in Ethiopia. Furthermore, it was intended to measure the effects of identified factors causing time overrun categorized into five factor structures. Hypothesis test results are presented herein.

4.2.1 CUSTOMER SATISFACTION AND ENGINEERING SERVICE QUALITY MODEL

Ordinal Logistic Regression (OLR)

Correlation and Ordinal Logistic Regression (OLR) analysis was performed to determine the relationship between customer satisfaction and engineering service quality. Table 6 presents the case processing summary in which the level of customer satisfaction was manifested among the respondents representing the client.

Table 5: Case processing summary

Variable	Level of satisfaction	N	Marginal Percentage
Customer Satisfaction	Mostly Dissatisfied	3	13.0%
	Somewhat Satisfied	18	78.3%
	Mostly Satisfied	2	8.7%
Total		23	

13% of the respondents expressed their general dissatisfaction while the majority (78.3%) tempted to generalize the level of service quality in between and seems they could not be able to endorse it to the next satisfaction level. These groups are generally undecided to classify the service quality either to dissatisfied or satisfied category. Only 8.7% purported to witness that they are satisfied with the services quality of consultants in the road sector.

Table 6: Correlations

	Variable		Tangibles	Reliability	Responsiveness	Assurance	Empathy	Service Quality (Overall)
Spearman's rho	Customer Satisfaction	Correlation Coefficient	.593**	.433*	.241	.431*	.319	.694***
		Sig. (2-tailed)	.003	.039	.269	.040	.137	.000
		N	23	23	23	23	23	23

***. Correlation is significant at the 0.001 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

Likewise, the correlation between the dependent variable (customer satisfaction) and independent variable service quality is shown in Table 6. The result illustrates that customer satisfaction and service quality have a positive and strong correlation indicating that out of the five dimensions tangibles ($r=.593$, $p<0.01$), reliability ($r=.433$, $p<0.05$) and assurance ($r=.431$, $p<0.05$) of service offering measurements tend to have strong correlation in which provision of error free design, performing designs right the first time, calibre of the consultants technical staff and their competence are key to gain customer satisfaction. Parasuraman *et al* (1988) in the SEVEQUAL model illustrated this fact as gap-3 and define the service quality specifications and service delivery processes are of vital importance to win customer satisfaction. The overall service quality is positive and strongly correlated with customer satisfaction ($r=.694$, $p<.001$).

OLR results are presented in Table 7, 8 and 9. Two models are shown, the dependent variable for each is customer satisfaction with two thresholds (Mostly Dissatisfied =2 and somewhat satisfied =3) and the independent variable for each model was engineering service quality.

Table 7: Model fitting information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	26.421			
Final	10.036	16.384	1	.000

Link function: Logit.

Table 8: Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval		Odds ratio		
							Lower Bound	Upper Bound	Exp_B	Lower_95_CI	Upper_95_CI
Threshold	[Customer Satisfaction = 2.00]	17.958	8.061	4.963	1	.026	2.160	33.756	62959405	8.667	4.57361E+14
	[Customer Satisfaction = 3.00]	28.930	12.038	5.775	1	.016	5.335	52.525	3.67E+12	207.483	6.47479E+22
Location	Service Quality (Overall)	.375	.160	5.472	1	.019	.061	.690	1.46	1.06	1.99

Link function: Logit.

Table 9: Test of parallel lines

Test of Parallel Lines[a]

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	10.036			
General	.883[b]	9.153[c]	1	.002

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

a. Link function: Logit.

b. The log-likelihood value cannot be further increased after maximum number of step-halving.

c. The Chi-Square statistic is computed based on the log-likelihood value of the last iteration of the general model. Validity of the test is uncertain.

A test of technical theory

The result of the model revealed that customer satisfaction declines as the unit of integrated service offering decreases. The coefficient on service quality variable illustrates a unit decrease in service quality was associated with a decrease in the odds of considering customer satisfaction, as Table 5-9 depicts, with an odds ratio of 1.46 (95% CI, 1.06 to 1.99), a statistically significant effect, Wald $\chi^2(1) = 5.47$, $p < .05$. According to the model chi-square statistic, the model fitting information illustrated statistical significant at $p < .001$. On the basis of this dataset the 'odds ratio'1.46 (95% CI, 1.06 to 1.99) explains that a unit increase in service quality would improve customer satisfaction level by 1.46 times. This is explained by forecasting, planning and decision-making theories in connection with the reasons why customers are dissatisfied. Quality problems related to errors or omission, lack of competence, estimation and forecasting would result dissatisfaction (Armstrong, 2001).

Therefore, based on the significant level the OLR model is as follow to establish the minimum level of satisfaction:

$$\ln\left(\frac{\text{prob(event)}}{(1-\text{prob(event)})}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k$$

Source: Snedker et al (2002)

Ln(Sustmer Satisfaction**) = 28.930 + 0.375 (**Service Qulaity**)** …… Equation 1: Customer satisfaction model

Source: Authors computation based on survey data

Discussion (Customer satisfaction model)

The model predicator (service quality) and the corresponding hypothesis are explained as follows.

Research Hypothesis: H1: A consistent engineering service quality offering has significant effect on customer satisfaction.

The statistical analysis based on OLR revealed that a consistent engineering service quality offering has significant effect on customer satisfaction and H1 is accepted ($\rho<.001$).

According to Barret (2000) quality in construction is seen as an overall satisfaction by stakeholder and hence, it is prudent to see service quality from customer orientation and satisfaction perspective. Further to the OLR model, the level of customer satisfaction was evaluated by computing the relative satisfaction index for the 22-item customer satisfaction scales in tandem with the above model. The ranking for the items are listed in Table 11. The technical dimension (what) of service quality is governed by the terms of reference and project specification and it usually comes to an end when service is delivered and completed. On the other hand, the functional aspect of service quality how the customer received the service, considered the product and the consumption process is crucial in construction projects. Nevertheless, it would not be easy to access functional objectives like the technical dimension. The unforeseen situation is that perceived quality is highly linked with functionality of the service quality.

Table 10: Quality of Overall Service x Quality of Design and Supervision services Cross tabulation

			Quality of Design and Supervision Services			
			Mostly Dissatisfied	Somewhat Satisfied	Mostly Satisfied	Total
Quality of Overall Service Level	Mostly Dissatisfied	Count	5	2	0	7
		% within quality of overall service level	71.4%	28.6%	0.0%	100.0%
	Somewhat Satisfied	Count	1	10	0	11
		% within quality of overall service level	9.1%	90.9%	0.0%	100.0%
	Mostly Satisfied	Count	0	3	2	5
		% within quality of overall service level	0.0%	60.0%	40.0%	100.0%
		% of Total	0.0%	13.0%	8.7%	21.7%
Total		Count	6	15	2	23
		% within quality of overall service level	26.1%	65.2%	8.7%	100.0%

As it can be seen in Table 10, Cross tabulation for overall service quality and design & supervision service revealed that 26.1% of the respondents representing the client are mostly dissatisfied, the majority 65.2% are somewhat satisfied (in between or undecided) and only 8.7% of the client professional engineers believed with the current service quality and considered the service as mostly satisfied. If deficiencies in service quality were identified during the process and if it is fixed with proper corrective measures to the satisfaction of the customer, then the result of deficiency handing mechanism would have sound technical quality. On the other hand, if the deficiency handling mechanism had been mishandled and took time, the functional quality for customer

satisfaction fails to meet customer expectation in road construction projects, therefore technical and functional service quality are seen how well engineering firms fulfill the customer expectations (Barrett, 2000).

In Table 11, the 22-items measuring scale were weighted and ranked to measure customer satisfaction with regard to the engineering service quality. Relative satisfaction index (RSI) weighting for each case was computed using Equation 1 and items were ranked based on their RSI.

$$RSI = \frac{\sum Wi}{AN}$$

Where W_i = weighting given to each item by the respondents, A=the highest weight and N=the total number of respondents.

Equation 2: Relative satisfaction index

Source: Sambasivan and Soon (2007)

The results of the relative satisfaction index are shown in Table 11. As it can be seen, the weighting varies from 0.427 to 0.645.

Table 11: Relative satisfaction index ranking

Cases	Weight	Rank	SD.
Quality and availability of proposed road construction materials	0.645	1	0.813
Skill of design professionals and site supervisors	0.645	2	0.869
Understanding to site supervision duties	0.645	3	1.020
Workability or constructability of the design	0.636	4	0.853
Capacity of site supervisors / personnel for co-operation	0.636	5	0.795
Skill of head office support team	0.627	6	0.774
Management and implementation of agreed quality assurance procedures	0.609	7	0.785
Allow your team have access to information and site details	0.609	8	0.653
Conformity of site supervisors to the contract	0.591	9	0.899
Quality of overall service level	0.582	10	0.750
Contracted work quality (design and supervision)	0.564	11	0.588
Adequate information flow on site	0.564	12	0.795
Proactive site design modification for identified deficiencies during implementation	0.555	13	0.528
Management of order on site and tidy / cleanliness	0.555	14	0.752
Prompt agreement or decision about changes	0.545	15	0.631
Commitment of management to set goals	0.536	16	0.839
Degree of in-depth participation during design development	0.518	17	0.666
Tendency to inform defects or deficiencies timely	0.509	18	0.858
Adherence to schedule in accordance with Works Contract	0.500	19	1.102
Management of environmental issues and related know-how during design	0.491	20	1.011
Management of work safety on site	0.464	21	0.839
Tendency to adequately engage and monitor safety and environmental obligations	0.427	22	1.125

From table 11, it has become evident that quality and availability of construction materials, qualification of design professionals, experience of supervision professionals, and lack of understanding of site supervision duties, constructability of design, cooperation and team work are the top five key items that trigger customer dissatisfaction. Services offered by Consultants in these areas were found deficient from the perceived standards.

The lower customer satisfaction is the result of lack of standard procedures and quality assurance mechanism on the part of the consultant. Likewise, client doesn't provide clear requirements and does not have validation instruments that would have been the basis to take over completed services. The result is not unexpected having

seen the current problems like time and cost overrun in the road sector. The challenge on the part of the client is validation of design before tendering which makes the whole burden to stay with Consultants until the client builds its capacity to partly validate designs on ground and carry out in-depth review before moving to the next phase of the project cycle. Needles to mention that firm's business model should fit into this situation where long term quality and higher customer satisfaction should be their prime target but it is admitted that no one is selfless. Under the current circumstance, client must be able to develop its own strong quality control system to minimize problems during later stage (construction phase).

4.2.2 TIME OVERRUN AND ENGINEERING SERVICE QUALITY MODEL

Linear Regression Analysis

Simple linear regression analysis was conducted to measure the effect of service quality on completion time while excluding all other factors. The dependent and independent variants descriptive statistics are shown in Table 12.

Table 12: Variant descriptive statistics

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Dependent (Time Overrun)	119	1.00	5.00	3.21	.940
Independent (Service Quality Factors)	119	2.00	5.00	3.25	.679

Correlation and regression analysis is carried out for predicting time overrun (DV2: dependent variable) from independent variable (IV2: engineering service quality) taken as major factor instigating time overrun in road construction projects in Ethiopia and excluding all other factors related to client, contractor and external factors. Table 13 demonstrates the correlation and the regression weighting for time overrun and engineering service quality model.

Table 13: Correlation

		Engineering Service Quality
Time Overrun	Pearson Correlation	.222*
	Sig. (2-tailed)	.015
	N	119

*. Correlation is significant at the 0.05 level (2-tailed).

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.238[a]	.057	.049	.08478	.057	7.015	1	117	.009

a. Predictors: (Constant), Design Factors

b. Dependent Variable: Time Overrun

As it can be seen, the result reveals moderate positive correlation between time overrun and engineering service quality ($r = .222$, $\rho < .05$). Based on the regression model summary (see Table 18) the predictor (service quality)

is significant (ρ=.009). The model predictor discovered R^2= 0.057, F (1,117) = 7.015, ρ<.01 that illustrates meaningful relationship between engineering service quality and time overrun. Furthermore, the model predicator service quality is observed to account for only 6% of the variance on time overrun in road construction projects based on the dataset and it is explained by the model predictor (service quality) excluding all the other factors.

On the basis of the dataset, the beta (standardized regression coefficient) for service quality, 0.238 explains a change of one standard deviation in engineering service quality in road construction projects would result in a change of 23.8% standard deviation in time overrun in Ethiopian context. The test on the hypothesis (see Table 14 to 18) is an evidence to conclude for the existence of relationship between time overrun and engineering service quality. Furthermore, it has become evident from the statistical output that engineering service quality have significant effect on completion time in road construction projects in Ethiopia (H2 is supported) at ρ<.01.

Table 14: Analysis of variance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.050	1	.050	7.015	.009[b]
	Residual	.841	117	.007		
	Total	.891	118			

a. Dependent Variable: Time Overrun

b. Predictors: (Constant), Design Factors

Table 15: Model coefficients

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.160	.034		34.392	.000		
	Design Factors	.027	.010	.238	2.649	.009	1.000	1.000

a. Dependent Variable: Time Overrun

Time Overrun = 1.16 + 0.027 (Design Factors) ……..… Equation 3: Time overrun and service quality model

Discussion (Time overrun and engineering service quality model)

Each group of factors causing time overrun were analysed using relative frequency index (RFI) and ranked by their RFI weight (see Equation 3).

Research Hypothesis: H2: Engineering service quality has significant effect on completion time in road construction projects in Ethiopia.

H2 is accepted (ρ<.01). Table 16 displays the engineering service quality (design and contract management) in combination for factors related to consultants causing time overrun and ranking based on all respondents' response towards these factors. The relative frequency index was computed using Equation 4.

$RFI = \sum a\,(\frac{n}{N})$ Where a = constant expressing weighting given by each respondents, n=the frequency of the responses and N=the total number of respondents.

Equation 4: Relative frequency index

Source: Assaf and Hejji (2006)

It can be seen from the analysis that incorrect estimation of quantities and design errors are on the top of consultant's factors causing time overrun. This illustrates that the service quality in terms of reliability dimension is very low and far-off from the envisioned standards. Relative frequency weighting from all responds representing the three categories (client, consultant and contractor) also supported the deficiencies of the engineering service quality (see table 16).

Table 16: Overall consultant's factor relative frequency index

Factors	RFI	Rank
Incorrect estimation of quantities and work volume	0.746	1
Mistakes and Errors in design	0.688	2
Lack of implementing early warning approach to reduce problems	0.684	3
Lack of consultant experience in construction projects	0.661	4
Over inspection (obsession with quality)	0.652	5
Incomplete design at the time of tender	0.63	6
Poor communication and coordination of staff members/ client/ contractor	0.627	7
Poorly drafted contract documents	0.623	8
Delay in inspection, testing and approval of materials and completed works	0.62	9
Lack of impartial decisions	0.605	10
Poorly defined project requirements	0.602	11
Inadequate project management assistance	0.589	12
Lack of concern, team spirit, incentive towards progress	0.586	13
Delay in approval of working drawings	0.575	14
Lack of multi-disciplinary team involvement	0.57	15
Incompetent /inexperienced technical staff	0.568	16
Lack of senior management support and commitment	0.538	17
Frequent and late design changes	0.509	18
Delay in supply of setting out data and design information	0.491	19

On the other hand, independent assessment of the factors (see Table 17) revealed that the client and consultant respondents agreed that incorrect estimation of quantities and work volume are the supreme significant factors causing time overrun while Contractor professionals considered design error should assume the most significant position and incorrect estimation should follow.

Table 17: Consultant's relative frequency index based on category

Description of factor	Client		Contractor		Consultant	
	RFI	Rank	RFI	Rank	RFI	Rank
Incorrect estimation of quantities and work volume	0.764	1	0.714	2	0.751	1
Mistakes and Errors in design	0.727	2	0.714	1	0.667	3
Lack of implementing early warning approach to reduce problems	0.682	3	0.676	6	0.649	4
Lack of concern, team spirit, incentive towards progress	0.673	4	0.667	9	0.641	5
Poorly drafted contract documents	0.655	5	0.590	16	0.623	7
Frequent and late design changes	0.655	6	0.714	3	0.684	2
Inadequate project management assistance	0.655	7	0.657	10	0.609	10
Poorly defined project requirements	0.618	8	0.600	13	0.597	12
Lack of impartial decisions	0.618	9	0.695	4	0.597	13
Lack of multi-disciplinary team involvement	0.573	10	0.552	19	0.606	11
Lack of senior management support and commitment	0.573	11	0.610	12	0.614	9
Incompetent /inexperienced technical staff	0.564	12	0.667	7	0.542	16
Delay in supply of setting out data and design information	0.564	13	0.638	11	0.548	15
Incomplete design at the time of tender	0.555	14	0.686	5	0.638	6
Delay in inspection, testing and approval of materials and completed works	0.536	15	0.600	14	0.472	19
Lack of consultant experience in construction projects	0.536	16	0.600	15	0.519	17
Delay in approval of working drawings	0.536	17	0.667	8	0.559	14
Poor communication and coordination of staff members/ client/ contractor	0.527	18	0.552	18	0.614	8
Over inspection (obsession with quality)	0.436	19	0.581	17	0.481	18

This illustrates the sources of incorrect estimation is rooted within the quality of the design and hence contractors argument could be correct and seen as compatible. If errors or omissions are apparent in the design, it is overt that quantities will be under or over estimated. In contrary, consultant argues that frequent and late design changes should be given more weight in causing time overrun. Time overrun model

Multiple Regression Analysis

Multiple regression analysis was applied to identify factors that have significant effect on time overrun. The model for predicting time overrun (DV3: dependent variable) from independent variables (IV3: client, IV4: design, IV5: contract management, IV6: contractor and IV7: external related factors) is carried out.

Multivariate correlation analysis was performed to identify the level of association among the variables. The predicators were the five identified factors (independent variables: client, design, supervision (contract management), contractor and external related actors) whereas the dependent variable was time overrun. Table

18 reveals the correlation coefficients to indicate the relative association of the individual predictors. It can be seen that all the bivariate correlations between the five factors and time overrun were positively correlated as anticipated. Four of the five predictors were statistically significant. Contractor related factors (r=.418, p<0.001) and external factors (r=.315, p<0.001). Similarly, design factors (r=.244, p<0.01) and supervision (r=.209, p<0.05). The client related factors are weakly correlated as per this dataset (r=.125).

Table 18: Correlations

		Factors				
		Client	Design	Supervision	Contractor	External
Time Overrun	Pearson Correlation	.125	.244**	.209*	.418***	.315***
	Sig. (2-tailed)	.174	.007	.022	.000	.000
	N	119	119	119	119	119

***. Correlation is significant at the 0.001 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

Table 19, the model summary revelled the result for R^2 = .268, F (5,112) =8.213, ρ<.001. The standardized regression coefficient (beta) for contractor related factors was 0.411, representing 16.9% of the variance of time overrun for the sample while client and external related factors account for 14.3% in combination. The surprising result is the consultant factors categorized as design and supervision were not statistically significant when evaluated with other factors. This is unexpected. The reason could be the inter correlation between the factors with client and contractor factors and as a result the contribution of the two factors has become very low at 95% confidence interval. This suggests further investigation despite the design factors were significant when examined as exclusive predicators for time overrun in the earlier model.

Table 19: Model Summary

Model Summary[b]

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.518[a]	.268	.236	.07462	.268	8.213	5	112	.000

a. Predictors: (Constant), EXTERNAL FACTOR, CONTRACTOT FACTORS, Supervision Factors, Design Factors, Client Factors

b. Dependent Variable: Time Overrun

The model depicted client, consultant, contractor and external related factors have significant effect on completion time in road construction projects in Ethiopia. H3 is accepted at ρ<.001.

Based on the beta, standardized regression coefficient (table 21), it is appealing to conclude that the key meaningful predictors are client, contractor and external related factors. Contractor related factors accounted for 16.9% (r=.411, coefficient of determination r^2=.169) of the variance of time overrun, whereas the other

factors in combination contributed 14.3% (31.2%-16.9% =14.3%). Notwithstanding, the association of all predicators with time overrun, it has become evident that contractor related factors do have strong prediction power. The client related factors causes 7.7% the variance of time overrun and stands as the second important predictor. External factors explain 6.6% the variance of time overrun.

Table 20: Analysis of variance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.229	5	.046	8.213	.000[b]
	Residual	.624	112	.006		
	Total	.852	117			

a. Dependent Variable: Time Overrun

b. Predictors: (Constant), EXTERNAL FACTOR, CONTRACTOT FACTORS, Supervision Factors, Design Factors, Client Factors

On the basis of the dataset, design and supervision factors are statistically insignificant when assessed with all factors causing time overrun. The result illustrates that a unit change in the factors causing delay related to client, contractor and external interacting together have a tendency to bring significant amount of time overrun in road construction projects in Ethiopia. The result submits that projects with right of way problem, financial difficulties, lack of resource and planning in tandem with inadequate management and unforeseen site situation are more likely to delay the anticipated completion time of road projects to a higher extent.

Table 21: Multiple regression coefficients for time overrun and all factors model

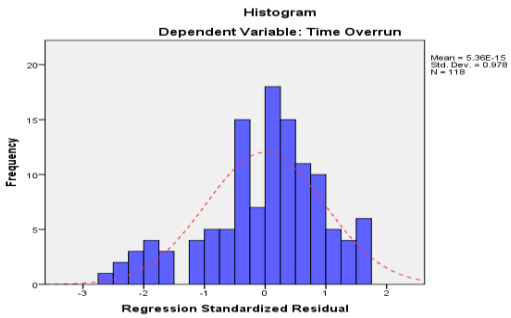
Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.774	.097		7.979	.000		
	Client Factors	.105	.039	.277	2.655	.009**	.602	1.661
	Design Factors	.014	.011	.129	1.248	.214	.613	1.631
	Supervision Factors	.004	.012	.031	.308	.759	.665	1.504
	CONTRACTOT FACTORS	.047	.011	.411	4.388	.000***	.747	1.339
	EXTERNAL FACTOR	.036	.012	.257	2.945	.004**	.855	1.169

a. Dependent Variable: Time Overrun

***. Correlation is significant at the 0.001 level; **. Correlation is significant at the 0.01 level; *. Correlation is significant at the 0.05 level

Time Overrun = 0.774 + 0.105 (Client Factors) + 0.014 (Design Factors) + 0.004(Supervision Factors) + 0.047 (Contractor Factors) + 0.036(External Factors) …….. Equation 5: Time overrun and all factors model



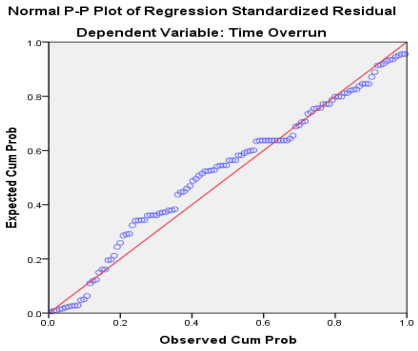


Chart 1: *Histogram (Dependent variable, time overrun)* ***Chart 2****: Normal P-P plot of regression standardized residual*

Chart 1 shows the approximate normal distribution of the dependent variable histogram while Chart 2 depicts normal P-P plot of regression standardized residuals. Nevertheless, few outliers were observed and no adjustment is done as the outliers account not more than 5% and supposing not to affect the results, the data has been used as it is without labelling (Hoaglin et al., 1986).

Discussion (Time overrun model, all factors)

Client related factors causing time overrun

Research Hypothesis: H3: Client related factors have significant effect on completion time in road construction projects in Ethiopia.

H3 is accepted at ρ<.01.For client related factors the overall respondents relative frequency index (weighting) is ranked as displayed in Table 22. It has become apparent from the ranking that delays in removing obstruction (right of way) is agreed by all respondents that it is the most significant factor causing time overrun followed by time allowed to undertake design preparation and delay in decision making.

Table 22: Overall client's factor relative frequency index

Factors	RFI	Rank
Delays in removing obstruction / ROW	0.821	1
Inadequate time and resources allocation for design preparation	0.739	2
Delays in decisions making	0.659	3
Unrealistic contract duration and requirements	0.645	4
Inadequate stakeholders engagement during design	0.639	5
Inadequate experience of staff	0.618	6
Delay in progress payment by owner	0.607	7
Change in the scope of the project	0.605	8
Lack of culture or leadership in using contractual instruments	0.588	9
Poor selection of contracting strategy	0.557	10
Stringent tendering & selection of contractor requirements	0.548	11
Owner interference	0.504	12
Stop work orders because of undue influence by third parties	0.473	13
Suspension / termination	0.414	14

The assessment of the weighting form each group's perspective for client related factors is shown in Table 23. As displayed in Table 23 all (client, contractor and consultant) professionals agreed that delay in removal of obstruction and inadequate time and resources are the most significant factors causing time overrun and ranked first and second respectively. Nevertheless, contractor's and consultant's professional averred that delays in decision making is causing time overrun and should be placed as the third most significant factor while the client staff contended that change in scope of work is more significant than delay in decision making in their perspective.

Table 23: Client factors relative frequency index based on category

	Client		Contractor		Consultant	
	RFI	Rank	RFI	Rank	RFI	Rank
Delays in removing obstruction / ROW	0.809	1	0.876	1	0.809	1
Inadequate time and resources allocation for design preparation	0.773	2	0.714	2	0.736	2
Change in the scope of the project	0.645	3	0.533	10	0.614	7
Unrealistic contract duration and requirements	0.645	4	0.610	7	0.655	5
Delay in progress payment by owner	0.582	5	0.638	5	0.606	8
Delays in decisions making	0.582	6	0.667	3	0.681	3
Inadequate experience of staff	0.582	7	0.590	8	0.638	6
Stringent tendering & selection of contractor requirements	0.573	8	0.571	9	0.533	12
Inadequate stakeholders engagement during design	0.564	9	0.667	4	0.655	4
Poor selection of contracting strategy	0.527	10	0.505	11	0.583	10
Lack of culture or leadership in using contractual instruments	0.518	11	0.610	6	0.603	9
Owner interference	0.500	12	0.381	14	0.542	11
Stop work orders because of undue influence by third parties	0.500	13	0.486	12	0.461	13
Suspension / termination	0.391	14	0.410	13	0.423	14

Contractor related factors causing time overrun

Research Hypothesis: H4: Contractor related factors have significant effect on completion time in road construction projects in Ethiopia.

H4 is accepted at $\rho<.001$. Respondent's weighted average response towards Contractor's related factors are assessed. The overall weighting evaluation revealed that cash flow and financial difficulties are the most significant factors attributed to Contractor related factors. Inadequate planning, delays in material delivery, planning errors and inadequate equipment are among the top five factors causing time overrun. This supports and concedes with the findings from contract completion reports (ERA, 2009; World Bank, 2010).

In the same line, the understating among the three categories is further examined to verify how they agree on each item. Table 24 reveals there is disagreement between client and the other groups (contractors and consultants). Client considered problems related to planning outweigh the cash flow and financial challenges contractors are facing in contrary consultants and contractors contended that cash flow and financial difficulties is the major factor deterring progress. Furthermore, the suspiring observation is Contractor's respondents

admitted that construction planning errors and equipment failure must assume the second most significant position.

Table 24: Overall contractor's factor relative frequency index

Factors	RFI	Rank
Cash flow and financial difficulties faced by contractors	0.823	1
Inadequate planning and scheduling	0.782	2
Delays in material delivery & procurement	0.761	3
Construction planning errors & equipment failure	0.743	4
Insufficient Numbers of equipment	0.741	5
Shortage of Technical, managerial and supervisory personnel	0.738	6
Delays in site mobilization	0.732	7
Poor site management and supervision	0.723	8
Extension of time oriented attitude	0.679	9
Labour productivity	0.661	10
Poor qualification of the contractor and technical staff	0.659	11
Incompetent subcontractors / absence of specialized subcontractors	0.657	12
Under bidding	0.654	13
Focus on petty issues	0.638	14
Lack of experience	0.629	15
Insufficient motivation to employee	0.611	16
Delay in preparation of working drawings	0.58	17
Mistakes during construction	0.564	18
Supply of Poor quality material	0.557	19
Shortage of site workers	0.534	20

External related factors causing time overrun

Research Hypothesis H5: External related factors have significant effect on completion time in road construction projects in Ethiopia.

H5 is accepted at $\rho<.01$. Under external factors causing time overrun seven factors were identified. The overall respondent's assessment (Table 25) discovered that lack of coordination between relevant third parties is the most significant factor followed by inadequate finance, weather and unforeseen ground condition.

Table 25: Overall external's factor relative frequency index

Factors	RFI	Rank
Lack of coordination between relevant third parties (water, telephone, power, irrigation, etc.)	0.746	1
Inadequate finance or budget	0.636	2
Unexpected weather conditions	0.602	3
Unforeseen ground condition	0.571	4
Interference / disruption by third parties	0.552	5
Theft (fuel, oil and other materials)	0.521	6
Change in Laws and Regulatory Framework	0.452	7

Table 26 shows respondents' weighted average response in each category related to external factors causing time overrun. Client, contractor and consultant professionals have agreed that lack of coordination third parties is the most significant factor causing time overrun. Nevertheless, as to the second major factor, client engineers considered unexpected weather is the second significant factor, on the other hand Contractor and Consultant professional engineer argued that inadequate finance or budget for project has become a bottle neck and causing time overrun and they further claim that unexpected weather condition could not outweighs the financial burden. This illustrate lack of financing institutions to support the construction sector have put burden on Contractors to rely on their ability to raise cash through progress payments. For the other four external factors the three groups exclusively agreed and ranked the factors likewise.

Table 26: External factors relative frequency index by category

	Client		Contractor		Consultant	
	RFI	Rank	RFI	Rank	RFI	Rank
Lack of coordination between relevant third parties (water, telephone, power, irrigation, etc.)	0.745	1	0.676	1	0.768	1
Unexpected weather conditions	0.709	2	0.571	3	0.577	3
Inadequate finance or budget	0.645	3	0.61	2	0.641	2
Unforeseen ground condition	0.636	4	0.552	4	0.557	4
Interference / disruption by third parties	0.591	5	0.505	6	0.554	5
Theft (fuel, oil and other materials)	0.464	6	0.533	5	0.536	6
Change in Laws and Regulatory Framework	0.455	7	0.429	7	0.458	7

4.3 TIME OVERRUN MODEL VALIDATION

Statistical analysis was conducted to validate time overrun model developed based on the dataset. Secondary data acquired from Ethiopian Roads Authority was used for validation. Ten international road construction contracts were selected for model validation. In selecting projects, it was believed that extension of time granted for international contracts provides the required information for the present model validation.

Table 27: Provides the descriptive statistics for the selected projects

	N	Minimum	Maximum	Mean	Std. Deviation
Project Length[km]	10	57.11	174.82	90.21	35.659
Original Duration[days]	10	910.00	1277.00	1034.00	121.670
Actual Duration[days]	10	1095.00	2139.00	1577.10	353.583
Extension of Time[days]	10	0.00	735.00	322.30	272.850
Percentage of Delay[%]	**10**	**0.00**	**86.21**	**40.34**	**30.249**
Owner Causes	10	0.00	381.00	113.20	116.070
Consultant Causes	10	0.00	584.00	160.60	215.787
Contractor Causes	10	0.00	826.00	197.80	288.315
External Related Causes	10	0.00	431.00	85.20	133.565

From the ten selected international contracts eight were delayed and only two were completed within anticipated contract period. The overall average percentage of delay was 40% and the uppermost percentage of delay was 86%. Actual duration is calculated taking the difference between actual date of completion of works and commencement date of the project. The factual data was extracted from contract completion report and the amount of extension of time granted was also obtained from the contract completion reports. Contractor related culpable delays were then computed by deducting the original completion period and extension of time granted to the contractor from the actual completion time of the project.

Consequently, model was developed based on the secondary data and the magnitude of factors influencing completion time were investigated. The model is significant ($p<0.05$) and the coefficient of determination, $R^2=0.854$. The validation model explained 40% of the variance of time overrun is as a result of contractor, client, consultant and external related factors. The finding was 15% contractors, 10% client, 15% consultants (design) and 4% external. On the other hand, the dataset explained that 37.2% of the variance for time overrun was attributed to contractors, client, consultant (design) and external factors. The dataset revealed the percentages as 16.9% contractors, 7.7% client, 6% consultants (design) and 6.6% external factors. Generally, it is appealing to conclude that there exists an agreement between the models for the factors causing time overrun with the exception of consultant factors that showed lower result based on the dataset model. The explanation for the variance could be the sample size considered for validation was very small. To investigate the model further based on the secondary data, it is suggested to gather all contract completion reports and carry out exclusive assessment and develop model in this regard to substantiate the findings of this study.

Table 28: Validation Model Summary

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.924[a]	.854	.737	15.52268	.854	7.294	4	5	.026

a. Predictors: (Constant), External Related Causes, Contractor Causes, Consultant Causes, Owner Causes

b. Dependent Variable: Percentage of Delay

5. CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

The study examined the relationship between engineering service quality and customer satisfaction. Furthermore, factors causing time overrun in road construction projects were analyzed. Accordingly, the first part, the study revealed positive and strong correlation between customer satisfaction and service quality ($r=.694$, $p<0.001$).

Model was developed based on Ordinal Logistic Regression analysis. The model explained the effects of engineering service quality on customer satisfaction. The model was statistically significant ($p<0.05$). The developed model may be used to estimate the level of satisfaction on the basis of a unit increase or decrease in offering an integrated service. It is useful for consultants to understand the dynamics of service quality dimension and they must update themselves depending on situations to increase client's confidence. The developed customer satisfaction model further identified the items that triggered dissatisfaction and that require attention from consulting firms.

The study investigated the problem statement using statistical methods. The magnitude of service quality that would ascertain customer satisfaction was explored. A unit increase in service quality would improve customer satisfaction level by 1.46 times.

Consequently, consulting firms must recognize the service quality conditions which require situation analysis (internal and external) with regard to meeting customers' expectations. This requires sound marketing plan that shall be constructed recognizing where firms are standing at present and where they want to go.

On the other hand, consulting firms must make customer familiar with the service level they intend to offer taking into account the tools they are using while developing designs and the minimum fee (reasonable price) they require associated with delivering good quality service in a manner that meets customer expectation. Moreover, consulting firms must determine ways to improve the service quality with proper pricing strategy in tandem with the other service marketing mixes in particular **people, process and physical asses** that would allow them gain the customers satisfaction based upon the perceived service level.

The second part of the study was to measure the effects of service quality on completion time in road construction projects. On the basis of the dataset, the study showed that the effect of engineering service quality on completion time was estimated at 6% and weak correlation. This requires further investigation because a contrary result was observed while validating the model through contract completion reports of selected completed road projects.

The third objective of the study was to identify and measure all factors causing time overrun grouped into five factor structure for road construction project in Ethiopia. The study confirmed that client, contractor and external related factors are significant causes for time overrun in Ethiopian context based on the study dataset.

Identification and ranking of factors causing time overrun and their relative weight has been computed. The weights of the top ten identified factors with their corresponding ranks and category for the factors are shown in Table 30. Therefore, it has become evident that out of the top ten factors, six are from contractors' category, two from client, one from consultant and one from external related factors. Consequently, cash flow and financial challenges faced by contractors, right of way problem, inadequate planning by contractors, delay in

materials delivery, incorrect estimation of quantity and work volume by consultants constitute the top five factors causing time overrun in road construction projects in Ethiopia.

Table 30: Overall factors relative frequency index

Factors	RFI	Rank	Category
CRF12:Cash flow and financial difficulties faced by contractors	0.823	1	Contractor
ORF04: Delays in removing obstruction / ROW	0.821	2	Owner
CRF01: Inadequate planning and scheduling	0.782	3	Contractor
CRF08:Delays in material delivery & procurement	0.761	4	Contractor
DRF04: Incorrect estimation of quantities and work volume	0.746	5	Consultant
EXRF06: Lack of coordination between relevant third parties (water, telephone, power, irrigation, etc.)	0.746	5	External
CRF04:Construction planning errors & equipment failure	0.743	7	Contractor
CRF14: Insufficient Numbers of equipment	0.741	8	Contractor
ORF08: Inadequate time and resources allocation for design preparation	0.739	9	Owner
CRF05: Shortage of Technical, managerial and supervisory personnel	0.738	10	Contractor

5.2 RECOMMENDATION

The study explained the effects of engineering service quality on completion time. It further revealed the factors that cause time overrun and the relative frequency weighting for identified factors has been measured. Hence, to improve service quality and adequately intervene on the factors causing time overrun, the following recommendations are made.

5.2.1 SERVICE QUALITY

Consulting firms operating in the road sector must make a paradigm shift and commit to quality. If understanding of service quality dimensions are well addressed, then customers would not be dissatisfied and the service would become recognized at all levels. To avert quality problems, consulting firms must work around the three key service marketing mix elements (people, process, and physical asset). Therefore, to improve service quality, consultants should do the following:

- ***Assurance:*** Consultant's commitment towards quality must originate from the top management. Once the company considers service quality is not negotiable, then all technical and support staff involved in the process will adhere to the quality goal. The long-term quality objectives of the company should be explicitly communicated with all staff.
- ***Process:*** Consultant's top management once commits to offer an integrated quality service, the overall process and procedures to deliver quality service should be stated. Quality control shall become part and parcel of the system. The process should include flow charts, check lists, calculation procedures, documentation, investigation methods, and calibration of measuring instruments, internal review and approval protocols. Furthermore, non-conforming processes and procedures must be communicated and proper internal measures shall be taken.

- ***Invest on people and physical asset:*** Consultants must invest on people and physical facilities that are crucial for service delivery. Training is a tool that shall be used to improve service quality and amend problems. Furthermore, use of up-to-date measuring instruments must be considered. It is also prudent to let the technical and support team see the implication of their actions in a bigger perspective, the effect it may bring on the company overall performance and accountability of individual experts in addition to general ethical consideration.
- ***Quality manual:*** Quality manual can be used as a tool to address service quality problems. The use of such manual will allow enhancing quality and defines job description and responsibility of staff. To improve overall service execution Management must make available adequate and proper resources to continuously implement quality strategy.
- ***Instill good attitude:*** Changing the prevailing approach may not be easy. The cardinal point is bringing sense of ownership and common purpose within the company. Gradually shun resistance and seamless attitude should prevail. Consultants should work in the area of doing service right the first time, feel proud and realize the minimum customer expectations.

5.2.2 FACTORS CAUSING TIME OVERRUN

To make the necessary interventions and avert factors causing time overrun, the following recommendations are made:

- ***Client:*** Client is recommended to improve is decision making capacity in such a way to instill confidence on parties to the contract. Furthermore, the right of way clearing procedures and handling mechanisms should be evaluated as it has become evident as major problem from all respondents. The time allotted for design development must take into account project complexity, location and level of details expected. In addition, to avoid scope changes during implementation phase, meaningful stakeholder's engagement and consultation during design development should be carried out. Progress payments shall be made timely. Addressing these basic items on the part of the client will reduce time overrun effect.
- ***Contractor:*** Contractors are recommended to invest on people, enhance their planning and procurement capability on the outset of project execution. To facilitate cash flow and financial difficulties, through their association must approach financing institutions to allow them have access to finance. Contractors are also advised to allocate adequate number of equipment and improve their maintenance capability and show their commitment towards bringing projects to an end with the original anticipated time. Indeed considering no other major disruption is encountered.
- ***Consultant:*** Consulting firms are recommended to give due attention to the scope of works in the terms of reference and offer reasonable fee that would allow them produce design that exceeds the minimum standards. Furthermore, quality control and assurance shall be established to adequately and correctly quantify the workload for projects. Design errors will upset the original intention of contracts and hence

investigation and testing should be done genuinely. Top management shall be committed to ascertain quality as it is not negotiable and companies' reputation is dependent on the quality of the design. In addition, during contract management, qualified personnel shall be assigned. The contract requirements shall be communicated with all site personnel and staff shall be accountable for their action and inaction. Management must carry out technical audits to make sure that services are offered as promised.

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