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Identification of the Major Cause of Delay in Ethiopian Higher Education Building Project

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Abstract: Construction delays are occurring in every phase of a project and are common problems in the construction industry. Delay in a construction project is defined as the time overrun beyond the agreed completion time specified in a contract for the delivery of a project. Delays can be minimized only when their causes are identified and analyzed. The objective of this study was to investigate the cause of delay in building construction of Ethiopia's higher education. This study was carried out based on a literature review, a questionnaire survey and a case study to collect data on delay. A total of 60 questionnaire surveys were distributed and 51 questionnaires were collected from construction professionals. The 76 delay factors compiled through the literature review and classified into eight groups (owner, contractor, consultant, early planning and design, manpower, materials, equipment and external factors). In addition, the ranking of the 76 factors was carried out to identify the most crucial causes of delay. Data was collected and analyzed using the Importance Index (II) and Statistical Package for Social Science (SPSS), whereby the score with the highest II is one that mostly influences the delay. Furthermore, case studies of 91 completed and ongoing construction projects were investigated. The results revealed the top main significant factors that contributed to causes of delay in building construction project for Ethiopia higher education are Rise in the prices of material, shortage of required materials, poor economic conditions (currency, inflation rate, etc.), delay in material delivering, financial problems (delayed payments financial difficulties and economic problems), difficulties in financing project by contractor, Political instability (Conflict, war and public energy), referral of bid to the lowest price, poor design and delay in the preparation of drawings and Improper project feasibility study. The case study result shows that in

Ethiopia higher education only 3.85% of projects have been finished to the originally targeted completion date and 7.69% projects to the original targeted completion Budget. The remaining 96.15% project delayed up to 500% of its contractual time and 92.31% project delayed up to 189.14% of its contractual Budget. The ongoing project also has delay 25.64% original targeted completion Budget and 66.67% contractual time. This paper finally came up with solutions and recommendations towards reducing the impact of delays on construction projects in Ethiopia to help all contracting parties and the concerned body.

INTRODUCTION

The construction industry is complex because it involves large numbers of parties as owners, contractors, consultants, stakeholders, shareholders and regulators. The construction industry performances are affected by national economies[1] and it has unique characteristics in comparison to other industries. This means that every project is different, a situation which emanates from the project's characteristics. For example, the project type, size, geographic location and personnel involved originating from the other subsystems within the industry and also from those of the super-system. The construction industry in Ethiopia suffers from many problems and complex issues. Ethiopia has been implementing a significant number of programs/projects which include the University Capacity Building Program (UCBP), the housing development program and the road sector programs among others. Higher educational institutions are one factor that can contribute to economic growth and development in the competitiveness of youth in an increasingly global society. It also develops human resources that can adapt and compete in society. The idea of the knowledge society is increasingly becoming widespread in the move towards globalization[2]. There have been many studies conducted over the world on the construction delay. However, there is still a lack of investigation on different delay factor, though delay remains a serious concern in Ethiopia. In the selected universities there are many building construction projects which have problems in delay project delivery. Thus, this paper tries to assess and address the cause of delays in building construction for higher education in Ethiopia.

Objective: The general objective of this study was to identify the major cause of delay in Ethiopian higher education building project. The specific objectives of this study were: to identify the main project delay contributor construction parties in the Ethiopian higher education institution projects, to investigate the severity of project delay in Ethiopian higher education construction projects and to develop a model that expresses the relationship between the dependent variable and independent variable.

Literature review: Koshe and Jha *et al*.[3] investigate the causes of construction delay in Ethiopian construction Industries, they identified 88 key factors causing delay in Ethiopian construction industries and then the most common and critical causes of construction delay were evaluated by using both the data collected in a survey of construction managers, resident engineers, contractors and clients and interviews with senior professionals in the field and conclude that the main critical factors that cause construction delays in Ethiopia are: difficulties in financing project by a contractor, escalation of the materials price, Infective project planning, Scheduling or resource management, delay in progress payments for completed works, lack of skilled professionals in the field of construction management in the organization and Fluctuating labor availability season to season. Also, it shows that in Ethiopia only 8.25% of projects have been finished to the originally targeted completion date. The remaining 91.75% delayed 352% of its contractual time.

Taye[4] identifies the time and cost overruns in construction projects (case study at defense construction enterprise). Questionnaire survey and desk studies were used to collect data on time and cost overruns. Desk studies of 10 completed construction projects were investigated and from the analysis, it was found that 100% of the construction projects suffered by both time and cost overruns. The rate of time overrun ranges from a minimum of 13% to a maximum of 181% of the contract time and cost overrun ranges from a minimum of 1% to a maximum of 47% of the contract amount. A total of 48 questionnaires were distributed and collected from DCE managers, team leaders and experts. The result revealed that the main factors causing time and cost overruns are less emphasis on planning, poor contract management and poor pre-planning process. The top-ranked effects of time and cost overruns identified by this research are the contribution of the construction industry to the growth of the national economy of the country will be less, delayed payments to contractors and inability to deliver value for money.

Teferra[5] pointed out the causes of delay in project implementation for DBE financed projects to determine the most important according to the key project participants; the bank and its customers. A total of 42 factors that caused delays were identified. These factors were grouped into three groups of causes of delays: clients-related delays, bank-related delays, external-related delays (neither due to the bank nor the clients). The target projects for the study are selected from the three different types of priority area projects namely;

industrial, agriculture and agro-processing projects of the head office. The collected data is analyzed by establishing the relative importance of the various factors identified as responsible for project implementation delay and the degree of agreement between the rankings of any two parties using Spearman's rank correlation coefficient. The result of the analysis showed that a shortage of foreign currency, failure to contribute equity contribution in time and scope change by clients or client-initiated variations were the top three effect, that delays resulting from the client's actions are rated first followed by delays resulting from the bank's actions.

Albatsh[6] assess the causes of a delay construction project in Palestine the research looked at delay causes through making an interview with contracting parties and by distributing a questionnaire to asses important degree of the causes. The data were analyzed to identify problem areas, upon the result concludes that referral of bid to the lowest price, incorrect and inappropriate bid pricing, lack of sufficient cash for the project implementation, contractor failure to regulate the cash flow of the project and irregular cash flow for the project on owner's side are the main cause for the project delay. Also, the researcher developed some of the proposed solutions that helps to minimize the cause of delays such as find a suitable mechanism for the process of evaluating and awarding attender without restoring always to the lowest price, should be available to the contractor sufficient experience in bidding pricing and adequate financial resource.

Odeh and Battaineh *et al*.[7] aim to develop a model to find the expected percentage of time overrun (delay index) in a construction project, in view of that, six major groups causing the time delay in the project were identified from literature survey and opinions from the experts in construction sectors. A questionnaire was designed and the project managers were asked to fill the percentage of delay for each group related issue and the overall delay duration of the construction projects. Likewise, 112 completed project details were collected from various constructors. Then the collected data were analyzed using regression analysis. The results of a model were used to fine-tune the relationship between the percentage of delay and the major group related issues that cause a delay.

Aiyetan *et al*.[8] have made a prediction model to establish the relationship between the critical attributes for assessing the impacts of these factors. Hence, the relationship was formulated between initial estimated and finally achieved construction time using regression analysis.

MATERIALS AND METHODS

The research methodology includes a literature review, a construction industry survey, data collection and analysis. From the literature review, it was found that there are two basic research approaches: quantitative and qualitative. The quantitative approach includes the generation of data in quantitative form using quantitative analysis in a suitable way, whereas the qualitative approach depends on subjective decisions which are based on attitudes, opinions and behavior[9]. Data collection methods employed for this research were Questionnaires, document analysis, interviews and case study. A quantitative data analysis technique of putting the Importance of Index (II) for each cause of delay is used to analyze the data collected from primary and secondary data sources.

The questionnaire was designed in order to evaluate the frequency of occurrence and degree of severity of the identified 76 causes of delay factors. In the process of the questionnaire design, two parameters are selected that used to measure the frequency of occurrence and degree of severity. In the questionnaire design for a frequency of occurrence of adopted CCDF 1-5 LS (1 for Strongly Disagree and 5 for Strongly Disagree) was assigned and for the degree of severity level also 1-5 LS (1 for no effect and 5 for extremely severe). In order to be able to select the appropriate method of analysis, the level of measurement must be understood. For each type of measurement, there is/are an appropriate method/s that can be applied and not others. In this research, ordinal scales were used. The numbers assigned (1-5) do not indicate that the interval between scales are equal, nor do they indicate absolute quantities they are merely numerical labels. The collected data was analyzed by using the severity index, frequency index and an important index. The analysis included the ranking of CCD factors and sources of delay factors.

Frequency index: A formula is used to rank causes of delay based on the frequency of occurrence as identified by the participants:

$$\text{Frequency Index (FI\%)} = \sum_{i=1}^{5}\left(\frac{a_{if} \times n_{if}}{5 \times N}\right) \times 100$$

Severity index: A formula is used to rank causes of delay based on severity as indicated by the participants:

$$\text{Severity Index (SI\%)} = \sum_{i=1}^{5}\left(\frac{a_{is} \times n_{is}}{5 \times N}\right) \times 100$$

Where:

a_{if} and a_{is} = Numbers of respondents who choose a certain frequency and severity degree respectively

n_{if} and n_{is} = Degrees of frequency and severity respectively (1 or 2 or 3 or 4 or 5)

N = The total number of respondents

Importance index: The importance index of each cause is calculated as a function of both frequency and severity indices as follows:

$$\text{Importance Index (IMPI\%)} = \frac{[\text{FI}(\%) \times \text{SI}(\%)]}{100}$$

RESULTS AND DISCUSSION

Using structured questionnaire there are in total of Sixty sets of the survey questionnaire was distributed to the targeted respondent in order to identify the most important factors that cause delays, the common effect of delays and methods of minimizing construction delays. Out of these sixty sets, 10(16.67%) of the questionnaire survey has been distributed to Owners while 25 (41.67%) of the questionnaire survey has been distributed to Consulting staff and 25 (41.67%) to contractors as shown in Fig. 1. The 51 questionnaires were returned (85%) as follows: 7 (11.67%) from owners, 20 (33.33%) from contractors and 24 (40%) from consultants as respondents.

Figure 2 shows that 1.96% (1) of the respondents have experience1 years or less, 19.61% (10) of the respondents experience is between 2-4 years, 31.37% (16) of respondents have experience from 5-8 years, 29.41% (15) of respondents have experience from 9-12 years and 17.65% (9) are with service year of above 12 years.

Figure 3 shows that 1.96% (1) of the respondent have a diploma, 64.71% (33) of the respondents' qualification is BSc and 33.33% (17) of respondents have the educational background of MSc.

Responsible parties for causes of delay: This part consists of discussion and results of responsible parties for the causes of delay. These factors include Owners, Consultant, Contractors, Materials, External factors, Early planning and design, Equipment and Manpower. From the responsible parties for the causes of delay contractor is the first as shown in Table 1.

The severity of project delay: After calculation the importance index of each cause from the questionnaire responses, the result is as indicated in the table below. Accordingly, Table 2 below indicates the importance index and rank of the top causes of time and cost overruns for combined causes of delay. The combined results show that the delay in construction projects is mostly occurred by Rising in the prices of material, Shortage of required materials, Poor economic conditions (currency, inflation rate, etc.), delay in material delivering, Financial problems (delayed payments financial difficulties and economic problems), difficulties in financing project by contractor, political instability (Conflict, war and public

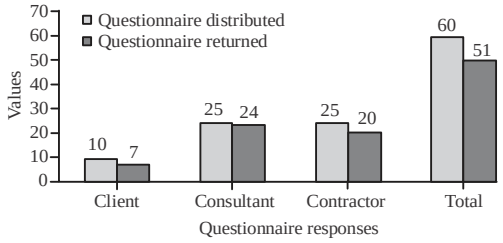

Fig. 1: Questionnaire distributed and questionnaire returned

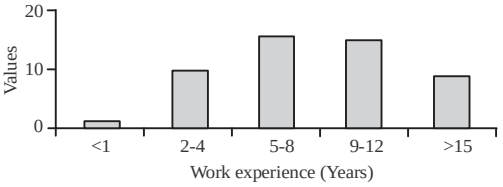

Fig. 2: Respondent's work experience

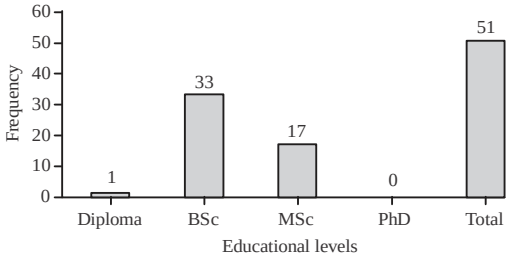

Fig. 3: Respondent's educational qualification

energy), referral of bid to the lowest price, poor design and delay in the preparation of drawings and improper project feasibility study as presented in Table 3.

From the owner's point of view: From the client's point of view uppermost 10-construction delay factors are listed in Table 4. Among the listed top ten delay factors the most frequent and most critical delay factors are the Shortage of required materials and insufficient data collection and survey before design.

From consultants's point of view: From the consultant's/supervisor's point of view, the top 10 construction delay factors are listed in Table 5. Among the listed top ten delay factors the most frequent and most critical delay factors are delay in material delivery and Rise in the prices of material.

From contractors's point of view: From the contractor's point of view, Top-10 construction delay factors are listed in Table 6 among the listed top ten delay factors the most frequent and most critical delay factors are Poor design and delay in the preparation of drawings and Rise in the prices of material.

Table 1: Ranking of sources (Category) of delays

	Frequency of occurrence		Degree of Severity		Importance Index	
Categories	F.I	Rank	S.I	Rank	I.I	Rank
Materials	81.57	1	82.75	1	67.79	1
External factors	75.76	7	77.76	2	59.42	2
Contractors	77.05	3	76.10	4	58.77	3
Consultant	76.32	4	76.62	3	58.59	4
Early planning and design	77.65	2	75.29	5	58.46	5
Equipment	75.95	6	74.84	6	56.87	6
Owners	76.05	5	72.34	8	55.46	7
Manpower	73.89	8	73.89	7	54.82	8

Table 2: Combined Ranking of causes of delay

Delay factors	Categories	F.I	Rank	S.I	Rank	I.I	Rank
Lack of experience of owner in construction	Owners	70.20	68	60.39	76	42.39	74
Referral of bid to the lowest price	Owners	86.27	4	81.96	9	70.71	8
Improper project feasibility study	Owners	83.92	7	80.39	10	67.47	10
The technical requirement of the bid (Due to unrealistic requirement most of the projects overloaded on few Constructers)	Owners	76.08	39	72.94	55	55.49	51
Financial problems (delayed payments financial difficulties and economic problems)	Owners	88.24	1	83.14	8	73.36	5
Delay in furnishing and delivering the site to the contractor by the owner	Owners	75.69	43	69.02	69	52.24	63
Unrealistic contract duration	Owners	79.61	15	77.25	27	61.50	20
Delay in the settlement of contractor claims by the owner	Owners	70.98	64	65.49	73	46.49	71
Interference by the owner in the construction operations	Owners	64.71	75	62.75	75	40.60	75
Conflict among partner	Owners	67.45	73	65.10	74	43.91	73
Design change by owner during construction	Owners	76.47	34	76.08	38	58.18	38
Bureaucracy (excessively complicated administration procedure)	Owners	77.25	28	71.76	61	55.44	52
Suspension work by owner	Owners	71.76	62	74.12	48	53.19	58
Lack of motivation among contractor’s members	Contractors	69.41	71	68.24	70	47.36	69
Shortage of contractor’s administrative personnel	Contractors	74.12	54	70.59	63	52.32	61
Delays in mobilization	Contractors	71.76	63	69.41	68	49.81	65
Improper technical studies by the contractor during the bidding stage	Contractors	77.65	23	76.08	39	59.07	31
Ineffective planning and scheduling of the project by the contractor	Contractors	78.82	21	77.65	24	61.20	22
Ineffective control of project progress by the contractor	Contractors	77.65	24	75.29	42	58.46	36
Improper construction methods implemented by the contractor	Contractors	78.82	22	78.43	20	61.82	16
Difficulties in financing project by contractor	Contractors	83.92	8	85.49	5	71.74	6
Poor communication and coordination by the contractor with other parties	Contractors	75.69	44	77.25	28	58.47	35
Poor qualification of the contractor's technical staff	Contractors	72.94	59	77.25	29	56.35	49
Poor site management and supervision by contractor	Contractors	76.47	35	78.04	23	59.68	27
Rework due to errors activities during construction	Contractors	76.47	36	78.43	21	59.98	26
Ineffective resource coordination	Contractors	77.25	29	76.86	32	59.38	29
Stop work without valid reason	Contractors	74.12	55	74.51	46	55.22	53
Not verify the validity of the design before starting work	Contractors	81.57	12	75.29	43	61.42	21
Lack of timely decision	Contractors	83.14	10	77.25	30	64.23	13
Incompetent sub-contractors	Contractors	74.90	49	76.08	40	56.98	43
Delay in material delivering	Contractors	85.49	31	86.27	3	73.76	4
Inadequate construction experience	Contractors	75.69	45	75.29	44	56.99	42
Irregular payment for sub-contractors	Contractors	76.86	31	73.33	52	56.37	48
Frequent change of subcontracts	Contractors	75.29	47	70.98	62	53.44	57
Poor qualification of a consultant engineer’s staff assigned to the project	Consultant	73.73	57	76.47	33	56.38	49
Poor design and delay in the preparation of drawings	Consultant	82.35	11	85.10	6	70.08	9
Delay in the approval of contractors submissions by the consultant	Consultant	80.78	13	80.39	11	64.94	11
Slow response and poor inspection	Consultant	76.86	32	76.47	34	58.78	33
Absence of consultant’s site staff	Consultant	70.59	65	74.12	49	52.32	62
Incomplete documents	Consultant	75.29	48	78.82	16	59.35	30
Poor communication between the consultant engineer and other parties	Consultant	74.51	52	73.33	53	54.64	54
Changes in design and specification	Consultant	80.39	14	80.39	12	64.63	12
Mistake and discrepancies in design and contract documents	Consultant	75.69	46	76.08	41	57.58	40
Quality assurance/control	Consultant	70.59	66	65.88	72	46.51	70
Poor site management and supervisor	Consultant	76.08	40	73.33	54	55.79	50

Table 2: Continue

Delay factors	Categories	F.I	Rank	S.I	Rank	I.I	Rank
Corruption	Consultant	76.08	41	78.43	22	59.67	28
Lack of experience of staff in management and technical	Consultant	73.33	58	72.94	56	53.49	56
Insufficient data collection and survey before design	Consultant	76.47	37	78.82	17	60.28	25
Prepare incomplete and undetailed BOQ	Consultant	79.22	17	77.65		61.51	17
Delay time for approval of drawings and test samples of materials	Consultant	79.22	18	77.65	26	61.51	18
Original contract duration is too short	Consultant	77.65	25	75.29	45	58.46	37
Shortage of manpower (skilled, semi-skilled, unskilled labor)	Early planning and design	77.25	30	78.82	18	60.90	24
Low productivity level of labor	Manpower	79.22	19	80.00	13	63.37	14
Personal conflict among labor	Manpower	66.67	74	66.67	71	44.44	72
Nonattendance/ absentee	Manpower	68.24	72	69.80	66	47.63	68
Labor strikes	Manpower	70.20	69	70.59	64	49.55	66
Low motivation of labor	Manpower	76.47	38	74.12	50	56.68	45
Fluctuating labors availability season to season	Manpower	79.22	20	77.25	31	61.20	23
Shortage of required materials	Manpower	86.27	5	89.02	1	76.80	2
Location of materials from site	Materials	76.86	33	76.47	35	58.78	34
Shortage of required equipment	Materials	79.61	16	78.82	19	62.75	15
Failure of equipment	Equipment	77.65	26	74.51	47	57.85	39
Inadequate equipment used for the works	Equipment	74.90	50	72.55	57	54.34	55
Equipment allocation problems	Equipment	76.08	42	74.12	51	56.39	46
Low level of operator's skill	Equipment	72.55	60	72.55	58	52.63	59
Low productivity and efficiency of equipment	Equipment	74.90	51	76.47	36	57.28	41
Rise in the prices of material	Equipment	88.24	2	87.06	2	76.82	1
Poor economic conditions(currency, inflation rate, etc)	External factors	87.84	3	85.88	4	75.44	3
Changes in governmental regulation low and tax	External factors	72.55	61	72.16	60	52.35	60
Political instability (Conflict, war and public energy)	External factors	83.92	9	84.71	7	71.09	7
Major disputes and negotiations	External factors	74.51	53	76.47	37	56.98	44
Natural disasters(flood, hurricane, earth quake)	External factors	58.04	76	69.80	67	40.51	76
Delay in proving services from utilities (such as water and electricity)	External factors	77.65	27	79.22	15	61.51	19
Adverse weather condition	External factors	74.12	56	79.61	14	59.00	32
Accident during construction	External factors	70.59	67	70.20	65	49.55	67
Unexpected surface and sub surface condition	External factors	70.20	70	72.55	59	50.93	64

Table 3: Top ten delay factors

		Frequency of occurrence		Degree of severity		Importance index	
Delay factors	Categories	F.I	Rank	S.I	Rank	I.I	Rank
Rise in the prices of material	External factors	88.24	2	87.06	2	76.82	1
Shortage of required materials	Materials	86.27	4	89.02	1	76.80	2
Poor economic conditions(currency, inflation rate, etc)	External factors	87.84	3	85.88	4	75.44	3
Delay in material delivering	Contractors	85.49	6	86.27	3	73.76	4
Financial problems (delayed payments financial difficulties ,and economic problems)	Owners	88.24	1	83.14	8	73.36	5
Difficulties in financing project by contractor	Contractors	83.92	8	85.49	5	71.74	6
Political instability (Conflict, war and public energy)	External factors	83.92	9	84.71	7	71.09	7
Referral of bid to the lowest price	Owners	86.27	4	81.96	9	70.71	8
Poor design and delay in the preparation of drawings	Consultant	82.35	11	85.10	6	70.08	9
Improper project feasibility study	Owners	83.92	7	80.39	10	67.47	10

Table 4: Ranking of causes of delay by client-side

	Frequency of occurrence		Degree of severity		Importance index	
Delay factors	F.I	Rank	S.I	Rank	I.I	Rank
Shortage of required materials	94.29	1	91.43	1	86.20	1
Insufficient data collection & survey before design	88.57	2	85.71	2	75.92	2
Delay in material delivering	85.71	6	85.71	3	73.47	3
Prepare incomplete and undetailed BOQ	85.71	7	85.71	4	73.47	4
Incompetent sub-contractors	88.57	3	82.86	6	73.39	5
Poor site management and supervisor	88.57	4	82.86	7	73.39	6
Poor qualification of a consultant engineer's staff assigned to the project	85.71	8	82.86	8	71.02	7
Poor design and delay in the preparation of drawings	85.71	9	82.86	9	71.02	8
Delay in the approval of contractors submissions by the consultant	85.71	10	82.86	10	71.02	9
Changes in design and specification	82.86	20	85.71	5	71.02	10

Table 5: Ranking of causes of delay by consultant side

	Frequency of occurrence		Degree of severity		Importance index	
Delay factors	F.I	Rank	S.I	Rank	I.I	Rank
Delay in material delivering	87.50	4	89.17	1	78.02	1
Rise in the prices of material	88.33	2	87.50	2	77.29	2
Referral of bid to the lowest price	90.00	1	85.83	4	77.25	3
Poor economic conditions (currency, inflation rate, etc.)	88.33	3	86.67	3	76.56	4
Shortage of required materials	85.00	7	85.00	6	72.25	5
Improper project feasibility study	87.50	5	81.67	10	71.46	6
Difficulties in financing project by contractor	82.50	11	85.83	5	70.81	7
Financial problems (delayed payments financial difficulties and economic problems)	86.67	6	80.00	14	69.33	8
Improper construction methods implemented by the contractor	81.67	13	81.67	11	66.69	9
Poor site management and supervision by contractor	79.17	17	83.33	7	65.97	10

Table 6: Ranking of causes of delay by contractor side

	Frequency of occurrence		Degree of severity		Importance index	
Delay factors	F.I	Rank	S.I	Rank	I.I	Rank
Poor design and delay in the preparation of drawings	90.00	3	91.00	2	81.90	1
Rise in the prices of material	91.00	1	90.00	3	81.90	2
Financial problems (delayed payments financial difficulties and economic problems)	91.00	2	88.00	6	80.08	3
Political instability (Conflict, war and public energy)	89.00	5	89.00	4	79.21	4
Shortage of required materials	85.00	8	93.00	1	79.05	5
Unrealistic contract duration	90.00	4	86.00	10	77.40	6
Delay in the approval of contractors submissions by the consultant	88.00	6	87.00	8	76.56	7
Poor economic conditions (currency, inflation rate, etc)	88.00	7	87.00	9	76.56	8
Changes in design and specification	84.00	11	88.00	7	73.92	9
Difficulties in financing project by a contractor	85.00	9	86.00	11	73.10	10

Table 7: Spearman's rank correlation coefficient between parties

Spearman's rho	Contractor	Consultant	Client
Contractor			
Correlation Coefficient	1	0.334**	0.456**
Sig. (2-tailed)	-	0.003	0.000
N	76	76	76
Consultant			
Correlation Coefficient	0.334**	1	0.292*
Sig. (2-tailed)	0.003	-	0.010
N	76	76	76
Client			
Correlation Coefficient	0.456**	0.292*	1
Sig. (2-tailed)	0.000	0.01	-
N	76	76	76

Coefficient significant level 0.95; **Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed)

Correlation: The Spearman's rank correlation coefficient is applied to measure the degree of agreement or disagreement associated with the importance ranking of each two stakeholders for a single factor of delay while ignoring the ranking of the third party. The results present that the highest degree of agreement is between clients and consultants. The lowest degree of agreement is between client and contractor and contractors and consultants. The relative agreement using SPSS software version 20 between every two parties is shown in Table 7.

Model to reduce delays: Regression analyses were conducted to determine by how much percent the independent variable and dependent variable establish relation as indicated in Table 8. Tables were employed to present the data and Statistical Package for Social Science (SPSS) Version 20 were used to support the analysis.

Base on the conceptual model of the study expressed, mathematically the relationship between delay factors and project delay is expressed in the regression equation as follow:

$$\text{Overall project delay} = X0 + X1\,(OW) + X2\,(CN) + X3\,(CS) + X4\,(EP) + X5\,(MP) + X6\,(MT) + X7\,(EQ) + X8\,(EF)$$

The regression equation can be explained as follows: Constants of 0.160 can be defined as Owner (X1), Contractor (X2), Consultant (X3), Early planning (X4), Manpower (X5), Material (X6), Equipment (X7), External Factors (X8) and dependent variable is project delays in work of Ethiopian higher education (Y) value is 0.160.

Similarly, for other the regression coefficient of the model (X1 up to X8), any change of model variable is one unit, it will result in the change of project delay on work of Ethiopian higher education for the model coefficient of the unit.

Case study: This study investigates 91 projects taken as a case study. Among that Arbaminch University assembly

Table 8: Determinants of project delay

	Unstandardized coefficients		Standardized coefficients		
Coefficients/Model	B	SE	Beta	t-values	Sig.
1. (Constant)	0.160	0.064		2.506	0.016
Owners	0.114	0.024	0.142	4.735	0.000
Contractors	0.127	0.024	0.147	5.183	0.000
Consultant	0.102	0.019	0.133	5.342	0.000
Early planning design	0.128	0.009	0.279	13.663	0.000
Manpower	0.117	0.021	0.161	5.671	0.000
Materials	0.109	0.017	0.150	6.311	0.000
Equipment	0.099	0.022	0.125	4.532	0.000
External factors	0.164	0.021	0.205	7.636	0.000

a. Dependent variable: Delay

Table 9: Case study of cost overrun for the completed project

Cost overrun range (%)	Frequency of project
0-10	4
11-20	7
21-30	4
31-40	2
41-50	5
51-60	2
61-70	1
71-80	3
81-90	2
91-100	7
101-110	15
111-120	16
121-130	10
131-140	7
141-150	1
151-160	1
161-170	1
171-180	1
181-190	2

Table 10: Case study of Time overrun for the completed project

Time overrun range (%)	Frequency of project
0-50	3
51-100	12
101-150	20
151-200	20
201-250	15
251-300	12
301-350	7
351-400	1
401-450	0
451-500	1

project is one of the largest projects constructed. The project cost is 160,814,769.65. The time for completion is 540 days. This project has been a cost overrun about 189.14% of the actual period; also UCBP undertaken by MH consultant has been time overrun 500.00% as clearly presented in Table 9 and 10. The data was collected via reviewing project documents. The rate of time overrun ranges from a minimum of 26.78% to a maximum of 500% of the contract time and cost overrun ranges from a minimum of 7.64% to a maximum of 189.14% of the contract amount.

The case study result shows that in Ethiopia higher education only 3.85% of projects have been finished to the originally targeted completion date and 7.69% projects

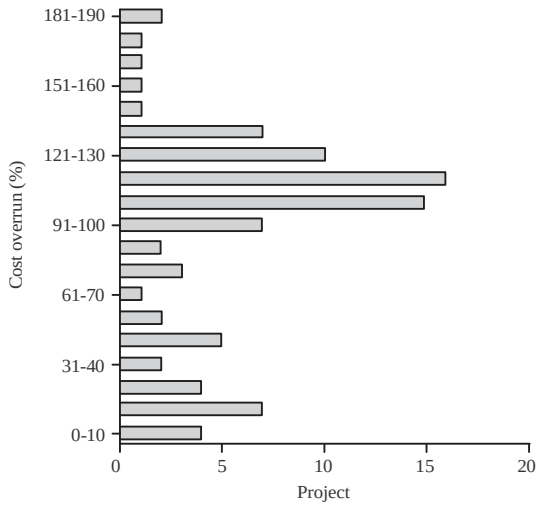

Fig. 4: Cost overrun vs. total project

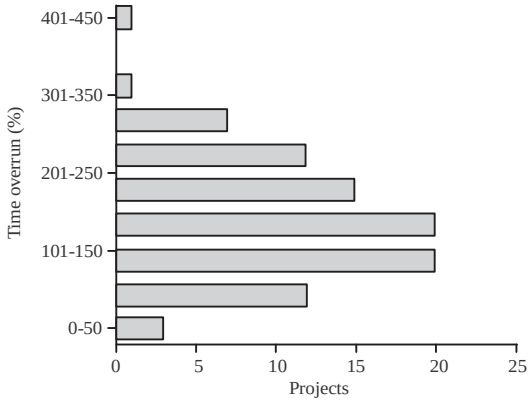

Fig. 5: Time overrun vs total project

to the original targeted completion Budget as shown in Fig. 4 and 5. The remaining 96.15% project delayed up 500% of its contractual time and 92.31% project delayed up 189.14% of its contractual Budget. The ongoing project also has delay 25.64% original targeted completion date and 66.67% contractual time as indicated in Fig. 6.

Linear regression: The regression analysis was used to develop cost and Time overrun prediction models for each project type. The analyzed sample included 52 completed projects with contract prices ranging from 1,843,000 million to 594,593,037.8 million.

The scatter plot Fig. 7 indicates a good fit, the correlation coefficient r = 0.9727 suggests a strong linear relationship between the contract and actual amount. This can be explained by the fact that the higher contract prices are the higher are the risks associated with the project due to its increased size and/or complexity and r^2 = 0.9461 indicates that the predictive ability of the equation found is high.

A relationship in the form of Y = 1.31x -8E+06 was obtained where, Y is actual amount and X is contract duration.

A linear regression test was conducted also to determine the relationship between the contract and the Actual times of contracts. The analyzed sample included 52 completed projects with contract duration ranging from 90-720 days.

Based upon the correlation coefficient r = 0.7938, the relationship between contract and actual duration can be deemed to be strong and statistically significant because the p<0.05 as shown in Fig. 8. The predictive ability r^2 = 0.63009 is high. Therefore, the equation Y = 1.453x +197.22 can be used to predict the Actual duration of projects where, Y is actual completion duration and X is contract project duration (Fig. 9).

It can be seen from the above linear regression analysis that using the current trend its allocated contract duration is too short to accomplish the project specified

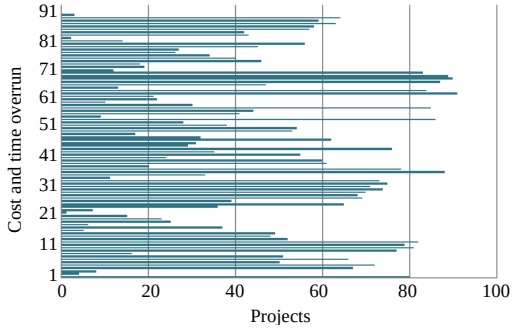

Fig. 6: Cost overrun and Time overrun vs total project

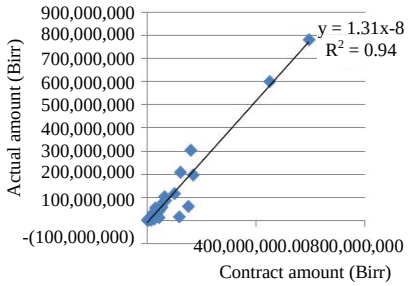

Fig. 7: Scatter plot for contract and actual duration; Case study for cost overrun

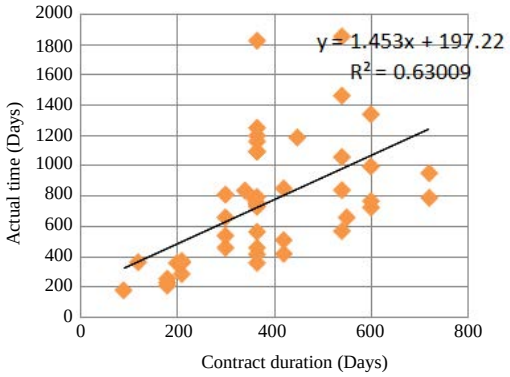

Fig. 8: Scatter plot for contract and actual amount; Case study for time overrun

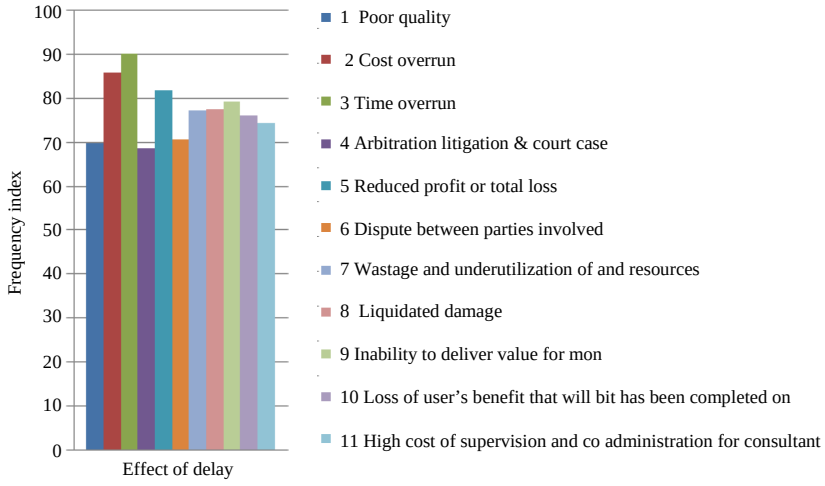

Fig. 9: Effects of the delays on the project

time. The contract amount is not properly prepared as observed in the case study. The actual project amount much greater than from the contract amount has cause critical cost and time overrun. So, Based on the above result both for cost and time overrun using the developed equation it can be predicted for ongoing project (in our case) and another similar project.

Effects of the delays on the project: The result relieves that among the stipulated effect of delay time overrun is the main as noticed in Fig. 9. Time is the most precious resource, it is important to improve the estimated duration of the activity, according to actual skill levels, unexpected events and the efficiency of working time. The owner has to wait for the provisions of the project longer than the necessary; also the contractor pays for the extra charge for the completion of the project due to time overrun. It is necessary to identify problems in the early stages of construction.

CONCLUSION

From the case study and questionnaires carried out and the analysis of the results, the following conclusions are drawn.

The case study result shows that in Ethiopia higher education the Projects have suffered from time and cost overruns in their execution and completion. For these construction projects, the actual time overruns range from 26.78-500% of the contract completion time and the cost overrun ranges from 7.64-189.14% of the contract completion cost. In addition to that only 3.85% of projects have been finished to the originally targeted completion date and 7.69% projects to the original targeted completion Budget. The remaining 96.15% project delayed up 500% of its contractual time and 92.31% project delayed up 189.14% of its contractual Budget. The ongoing project also has delay 25.64% original targeted completion date and 66.67% contractual time.

The first major question of the statement problem was to identify the causes of delay in higher education building construction projects of Ethiopia. After analysis, Rise in the prices of material (II: 76.82), Shortage of required materials (II: 76.80) and Poor economic conditions (currency, inflation rate, etc.) (II: 75.44) has been ranked in the first, second and third position as the causes of delay.

Importance index analysis and result indicated that Poor design and delay in the preparation of drawings (II: 81.90), the Rise in the prices of material (II: 81.90) and Financial problems (delayed payments financial difficulties and economic problems) (II: 80.08) has been ranked in the first, second and third position as contractors responsibility and in the same manner delay in material delivering (II: 78.02), rise in the prices of material (II: 77.29) and referral of bid to the lowest price (II: 77.25) are consultants' responsibility. Similarly, shortage of required materials (II: 86.20), insufficient data collection and survey before design (II: 75.92) and delay in material delivery (II: 73.47) are client's responsibility.

The data were analyzed using regression analysis. From the results, the delay index model was formulated. The model has a strength of about 98.77% in relation to the percentage of delay and the independent variable.The major groups such as materials were having the highest contribution in the construction delay, so these percentages should be taken into consideration during the planning and scheduling process to minimize the construction delay.

A linear regression analysis model was developed for a case study to establish the relationships between project contract amount and actual amount, to develop prediction models for estimating cost and time overruns for building projects. Cost and time overruns for building projects increased with contract amounts. The current trend for allocating contract duration is too short as well as the contract amount is not enough to accomplish the project with the specified time.

RECOMMENDATIONS

As per this study, the following points are recommended to all parties in order to control, minimize and avoid time and cost overruns in construction projects.

For owners: Releasing payments to the contractor on prescribed time based on the contract agreement. Because it impedes the contractor's cash flow.

- Delegation in decision making should be narrowed down to a single person
- Award of the contract should be done keeping in view the expertise of bidders in the respective field. This will ensure the award of a contract to the best company and chances of project completion within the estimated budget and time will be increased
- Employ experienced and competent professional consultant/supervisor who is capable to carry out his duties and responsibilities related to the work with good payment
- Variation or change orders should be kept to a minimum during construction to avoid delays. If a variation order is issued then it should be approved on time
- Check for resources and capabilities of the lowest bidding contractors before awarding the contract
- The design drawings should be integrated and there mustbe a party for checking the harmonization of various available drawings before the construction phase

For contractors:

- The contractor should manage financial resources and plan cash flow by utilizing progress payments
- Planning and scheduling are one of the most important components of the project from initiation till completion and it should be continuously monitored and updated
- Manpower, equipment and machinery should be allocated based on the criticality of activities in order to ensure the smooth running of the project
- The contractors should employ the right professional for the right position related to work
- Compute with reasonable prices not to win and collect advance payment
- The appropriate construction method and increase productivity
- Periodic maintenance of plants and equipment
- Arrange some incentives and give training, to motivate labors and increase productivity
- Develop on-time order habits and stockpiling of regular materials

For consultants:

- Drawings and design documents should be issued and approved timely
- Drawings and design documents should be free from mistakes and discrepancies
- Sufficient data collection and survey and detail site investigation and design should be done before tender to avoid future variations
- Prepare always clear and adequate detail drawing and BOQ (Bill of quantity) without any mistakes and discrepancies
- During the cost estimation process, the estimator should have to consider appropriate risk factors and escalation factors
- Because during the construction period the cost of construction materials, tools, labors, equipment, etc. may vary from time to time
- Fixing a reasonable time and schedule for the project. Define the scope of work as precisely as possible to avoid change order
- Give orientation to the clients, what impacts are encountered on the construction of the project. For example, immediate approval of payments, variations, additional works and price escalation are improving project success
- Approve the requested payments, additional works, variation orders, etc. on time, as per the rule and regulation of contract, to the successful completion of the construction of the proposed projects on time
- Facilitating the laboratory testing of construction materials and products is crucial to avoid construction project delays and reworks

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