Association Between Delay, Project Size and Low Bid Percentage

Subhadra Maharjan [1], A. K. Mishra [2] & P. S. Aithal [3]
[1] Engineer, Department of Road, Road Division Pokhara
Email: me.subhadra1@gmail.com
[2] D.Sc. Research Scholar, Srinivas University, India, and Associate Professor, Madan Bhandari Memorial College, Kathmandu, Nepal,
OrcidID: 0000-0003-2803-4918; Email: anjaymishra2000@gmail.com
[3] Professor, Institute of Management & Commerce, Srinivas University, Mangalore, India,
OrcidID: 0000-0002-4691-8736; E-mail: psaithal@gmail.com

Subject Area: Procurement Management.
Type of the Paper: Review Paper.
Type of Review: Peer Reviewed as per |C|O|P|E| guidance.
Indexed In: OpenAIRE.
DOI: https://doi.org/10.5281/zenodo.8142656
Google Scholar Citation: IJAEML

How to Cite this Paper:
Maharjan, S., Mishra, A. K., & Aithal, P. S. (2023). Association between Delay, Project Size and Low Bid Percentage. *International Journal of Applied Engineering and Management Letters (IJAEML)*, *7*(2), 216-231. DOI: https://doi.org/10.5281/zenodo.8142656

International Journal of Applied Engineering and Management Letters (IJAEML)
A Refereed International Journal of Srinivas University, India.

Crossref DOI: https://doi.org/10.47992/IJAEML.2581.7000.0183

Received on: 17/05/2023
Published on: 30/06/2023

Association Between Delay, Project Size and Low Bid Percentage

Subhadra Maharjan [1], A. K. Mishra [2] & P. S. Aithal [3]

[1] Engineer, Department of Road, Road Division Pokhara
Email: me.subhadra1@gmail.com

[2] D.Sc. Research Scholar, Srinivas University, India, and Associate Professor, Madan Bhandari Memorial College, Kathmandu, Nepal,
OrcidID: 0000-0003-2803-4918; Email: anjaymishra2000@gmail.com

[3] Professor, Institute of Management & Commerce, Srinivas University, Mangalore, India,
OrcidID: 0000-0002-4691-8736; E-mail: psaithal@gmail.com

ABSTRACT

Purpose: *The aim of this study was to assess the effects of some prominent factors like low bid amount, contract size and geographical locations of the projects on causing delayed completion in road and bridge projects carried out by the Road Division Offices under the Department of Roads (DoR) of Nepal.*

Design/Methodology/Approach: *Fifteen construction contracts from each of the seven provinces of the country were selected for the study. The projects were completed in three Nepali fiscal years starting from 2074/75 till 2076/77 irrespective of their starting date. The contracts were grouped under various categories like stipulated project duration, percentage of contract amount bid below estimate amount, contract amount and the project locations including the mountains, hills and terai. Projects from mountain districts like Sankhuwasabha and Baitadi; Kathmandu, Kaski and Surkhet in the hills and Siraha and Rupandehi in terai were selected. The research approach included both qualitative and quantitative methods of information collection. Secondary data sources comprised of the DOR office documents including the work completion reports, IPCs, time extension documents, work variation orders and other pertinent records. SPSS software has been used for processing the input data and thus relationships between different variables such as delay, size of contract; percent below estimate amount, initial contract duration, project geographical location etc. have been checked. Correlation and regression analysis have been carried out between delay of contracts (dependent variable), and independent variables like size of contract, percent below estimate amount and geography.*

Findings/Result: *Spearman rank correlation value between delay category and estimate amount category was 0.210 with p value of 0.031 (< 0.05) thus suggesting weak correlation but significant relationship between these two variables. Further, Pearson correlation value between delay and percent below estimate was 0.243 with p value of 0.013 (< 0.05) thus suggesting weak correlation but significant relationship between these two variables too. Binary logistic regression analysis showed Nagelkerke R square value of 0.139 which provides an indication that the amount of variation in the dependent variable (project delay) which is only around 14% of variance was due to the effects of independent variables (size of contract, percentage below estimate amount and geography). This suggests that remaining 86% variance was caused by some other factors which were not considered under the scope of this study. Also, p value of 0.013 which was less than 0.05 suggested there was statistically significant relation between dependent and independent variables.*

Originality/Value: *The paper assesses the effects and association of some prominent factors for timely performance of projects.*

Paper Type: *Review paper*

Keywords: Road and bridge construction contracts, Correlation coefficient, Delay of contracts, Nagelkerke R square.

1. INTRODUCTION :

In developing countries, the budget gap is a big issue [1 & 2] still construction industry found to be allocated the highest budget the value added in construction usually accounts for between three and eight per cent of the GDP although there are considerable variations. Recent statistics show that between 50 and 60 per cent of Gross Fixed Capital Formation (GFCF) or investment goes to the construction sector in most countries whether developed or developing [3]. GFCF is a measure of the additions to the stock of capital in a country, i.e. new investment in fixed assets like buildings, roads, plant and machinery, and includes depreciation, repairs and maintenance expenditures. This shows that construction industry covers a huge part of nation's economy. However, in most cases, it is seen that construction projects have not been completed within estimated schedule ultimately resulting in delay. Delay has uncountable negative impacts on all people involved, directly or indirectly, in construction industry, be it financially or economically or socially. There is also a saying that time is money. Therefore, completion of any construction works within stipulated time is of prime importance.

In Nepal, road is one of the basic infrastructures of development and road construction can be seen all over the country. Major road construction works are carried out in Nepal by Department of Roads (DoR) acting as employer. According to the recent data, 11178.92 km of road network are currently under the supervision and construction of DoR, where 6836.45 km lie under bituminous road, 1116.36 km lie under gravel road and 3226.12 km are earthen roads (DoR, 2021) [4]. These road networks include bridges that lie within the given road network as well. The road and bridges currently being constructed and supervised by DoR lie in all seven provinces (Province 1, Province 2, Bagmati Province, Gandaki Province, Lumbini Province, Karnali Province and Sudurpashchim Province) and covers all three geographical regions of Nepal (Mountain, Hilly and Terai). In Province 1, 1892.86 km road network is currently being constructed and supervised by DoR. Similarly, 914.74 km in Province 2, 1889.68 in Bagmati Province, 1299.97 km in Gandaki province, 2385.10 km in Lumbini Province, 1441.19 km in Karnali Province and 1355.38 km in Sudurpashchim Province are under construction and supervision of DoR. But the major problem faced by beneficiaries in all types of road and bridge network in any province or geographical region is delay in construction and it has become a nation-wide burning issue. This research intended to incorporate few selected factors causing delay of road and bridge construction works under DoR and then checks statistical relationship between them and thus analyze them with a view of finding suitable delay minimizing measures.

The intended factors are effect of low bid, contract size, and geography. Correlation and regression analysis of these factors with delay are carried out in road and bridge construction contracts in order to figure out the actual scenario. Likewise, correlation between time overrun and cost overrun is also established to see if time - overrun results in cost variations or not in the projects selected for the study. For the study, seven road division offices were selected through convenient sampling. One road division office was selected from each province ensuring that projects from all the seven provinces were represented equally. Moreover, road division offices were selected in such a way that all the three geographical regions were included in the study. Inclusion of all seven provinces and three geographical regions in the study would help to find out the actual scenario of road and bridge construction projects in whole Nepal.

2. STATEMENT OF PROBLEMS :

Nepalese Construction Industry uses major part of its budget to road and bridge construction and delay in road and bridge construction means underutilization of available budget, resulting in delay of access to infrastructure facilities. This has been a serious issue that ultimately leads to huge economic loss along with inaccessibility to transportation facilities to the beneficiaries. Delays are costly and often result in disputes and claims, impair the feasibility for project owners, and retard the development pace of the construction industry [5, 6, & 7].

Anderson and Tucker (1994) [8] and (Love, et al., 2015) [9] have both revealed that approximately a third of architectural and engineering projects miss cost and schedule targets. Often reported are the public dissatisfaction and resentment due to the difficulties resulting from delay of road and bridge construction works [10 &11]. Delay has compelled people to live inside the cloud of dust during the dry season and navigate through muddy and slippery road during monsoon, exposing tens of thousands of people to severe health risk and loss of millions of rupees by affecting their respective business.

This proves that delay in construction works not only affect the particular construction project but also the economic and social activities of the concerned region as a whole. One study shows that road or transport infrastructure is the major indicator of economic growth and several important indicators of economy like trade, electricity, communication, health are positively correlated with the road infrastructure [12]. Delay in construction of these infrastructures affect other construction activities of the whole connected region as well.

Extensive delays in the planned schedule, cost overruns and failure to meet desired level of quality are major problems faced by most construction projects in Nepal resulting in a failure to achieve desired objectives. Many researches [13 &14] show that awarding the lowest bid is one of the major causes of delay and major impacts of delay are cost overrun and a host of related factors. In Nepalese construction industry too, trend of low bidding can be highly experienced as Nepal adopts the criteria of awarding bid to substantially responsive lowest bidder.

Similarly, other researches (Al-Hazim & Abusalem, 2015; Senouci, et al., 2016; Shrestha, et al., 2013) [15, 16 &17] have shown that geography, terrain conditions, contract size and duration also affect the timely completion of contracts. In Nepal, the geography and terrain conditions vary greatly within a short distance throughout the country. Likewise, huge numbers of road and bridge projects are being constructed all over the country with varying budgets and contract durations. So, contractors with varied experience and capacity bid the contracts as per size of contract, which might affect timely completion of contract.

This study intended to analyze the common causes of delay in selected road and bridge construction contracts in Nepal under the domain of DoR and thus explore suitable solutions where the findings are expected to provide invaluable insights for the future use by DoR and other organizations intending to undertake road and bridge construction works. The findings can be equally valuable to the planners and other stakeholders including the local people too. The study has reviewed wide range of Articles [19, 20, 21, 22. 23. 24 & 25].

It is often found that delays in road and bridge construction projects lead to cost overrun, disputes and litigations [6, 7, 10, 27, 28, &29]. Thus, the findings can validated to provide significant insights to the construction industry in case of Nepal, which can be used by policy makers to make strategic planning and policies in order to avoid delays and their consequences. Also, it would help in minimizing the risks related to contract disputes.

Thus, this research aimed to check statistical relationships between few pertinent factors like low bid percentage, contract size and duration and geographical location on delay of road and bridge construction projects under Nepal's DoR.

3. OBJECTIVES :

The general objective was to find out statistical relationships between construction delay, project size and low bid percentage of selected road and bridge projects in various geographical regions of Nepal.

4. METHODOLOGY :

4.1 Research design and approach:

The continues research on the issue in Nepal illustrates the importance of Research [30, 31, 32, 33, 34, 35&36], Quantitative approach was used to calculate the statistical relationships between delay, low bid, contract size and geography and also for cost and time overruns.

4.2 Study area:

The research study consisted of selected road and bridge projects constructed and supervised by divisional offices under Department of Roads (DoR) in Nepal that have been completed in three fiscal years between 2017/18 to 2019/20. The following road division offices were selected for the study whose province wise location and geographical region are mentioned in the table 1. Road division offices have been selected in such a way that road and bridge construction in all provinces and geographical regions are covered as Area Sampling Technique.

Table 1: Road division offices with their respective provinces and geographical regions

S. N.	Road Division Office	Province	Geographical region
1	Tumlingtar	Province 1	Mountain
2	Lahan	Province 2	Terai
3	Kathmandu	Bagmati Province	Hilly
4	Pokhara	Gandaki Province	Hilly
5	Butwal	Lumbini Province	Terai
6	Surkhet	Karnali Province	Hilly
7	Baitadi	SudurPaschim Province	Mountain

In table 1, it can be seen that one road division office has been selected from each province where two lie under mountain region, two lie under terai region and three lie under hilly region. Road Division Tumlingtar and Road Division Baitadi construct and supervise major of the road and bridge construction works in mountain region while Road Division Lahan and Road Division Butwal construct and supervise major of the road and bridge construction works in terai region whereas Road Division Kathmandu, Road Division Pokhara and Road Division Surkhet construct and supervise major of the road and bridge construction works in hilly region.

4.3 Study population and sample selection:

The study was conducted on selected road and bridge contracts that have been completed in fiscal year 2074/75 (2017/18), 2075/76 (2018/19) and 2076/77 (2019/20) under DoR. There are hundreds of contracts that have been completed within these fiscal years and incorporating all of them in the study would not be possible due to time and budget constraint. Therefore, only few projects have been selected. It was ensured that projects from all the seven provinces representing all the three geographical regions are included for the study. Fifteen contracts from each selected road division offices were considered during data collection and processing. Therefore, a total of 105 contracts were selected for sampling, 15 contracts from each 7 road division offices. Purposive sampling was adopted while collecting data from different road division offices and projects due to budget and time constraints. In this way, it was a multistage sampling consisting area sampling and purposive.

While analysing the statistical relationship, the contracts were categorized as follows on basis of purpose:

In terms of initial contract duration:

- Less than or equal to 6 months
- 6 months to 1 year
- 1 year to 2 years
- More than 2 years

In terms of size of contract (NRs.):

- Less than or equal to 60 lakh
- 60 lakh to 2 crore
- More than 2 crore

In terms of percentage of low bidding:

- Less than or equal to 0%
- 0 to 10%
- 10 to 20%
- 20 to 30%
- 30 to 40%
- More than 40%

In terms of geography:

- Mountain region
- Hilly region

- Terai region

4.4 Data collection method:

Secondary data: Secondary data were collected from official documents of the divisional offices under DoR. The relevant documents were like work completion reports, IPCs, VOs, time extension documents or any other related documents.

4.5 Data analysis:

The data collected were processed, mainly using two software, which were Excel and SPSS software. The data collected from secondary sources were summarized, classified and tabulated. All data collected were compiled together and interpreted outcomes were presented in figures and tables. SPSS software was used for interpreting and presenting secondary data as the correlation between different variables like delay (dependent variable), and independent variables like contract size, percentage of low bidding and geographical regions.

For both correlation analysis and regression analysis, confidence level of 95% was set.

In this study, decision rule applied for assessing if the correlation and regression test is significant or not [for α (level of significance) = 0.05)] are as follows:

If $p \leq .05$, the test is significant (there is significant relationship between dependent and independent variable).

(A p-value under 0.05 is genuinely huge. It shows solid proof against the invalid speculation, as there is under a 5% likelihood the invalid speculation is right (and the outcomes are irregular). Consequently, we reject the invalid speculation, and acknowledge the elective speculation.)

If $p > .05$, the test is not significant (there is no significant relationship between dependent and independent variable)

In this study, it has been supposed that null hypothesis assumed correlation to be zero and alternative hypothesis assumed correlation not equal to zero in case of correlation analysis. But for relapse examination, invalid theory accepted that there was no connection among reliant and free factors while elective speculation expected that there was connection among reliant and autonomous factors.

4.6 Research matrix:

The summary of research methodology is presented in Table 2.

Table 2: Summary of Methodology

Objectives	Data required	Data collection/ analysis tools	Outcomes
To find correlation and regression between different variables like low bid, contract size, geography and delay in road and bridge construction projects in Nepal	Agreement date, initial completion date, actual completion date, estimate and contract agreement amount, geographical region	Secondary data as collected from all related offices of DoR/ SPSS software	Statistical relationship between different variables like low bid, contract size, geography and delay

5. RESULTS AND ANALYSIS :

Statistical relationship between different variables like percentage of low bid, size of contract amount, geography and delay in road and bridge construction contracts in Nepal.

5.1 Analysis of Contracts Categorized on basis of Size of Contract:

The contracts have been categorized on various bases and interpreted accordingly. Each category has been linked with timely completion of contracts and then analysed how each category has impact on timely completion of contracts. They are as follows:

Table 3: Contracts categorized on basis of size of contract (estimate amount)

Estimate amount (including VAT & PS) (in 000)		Frequency	Percent	Cumulative Percent
Valid	<= 6000.00	37	35.2	35.2

	6000.01 - 20000.00	39	37.1	72.4
	20000.01+	29	27.6	100.0
	Total	105	100.0	

Table 3 shows the number of contracts and their percentage based on size of contract, i.e. according to estimate amount category. The contracts were categorized into 3 groups according to estimate amount. Out of 105 contracts, 37 fall under Rs. 60 lakh category whereas 39 were in between 60 lakh to 2 crore category and remaining 29 were above 2 crore category. Therefore, all groups have more or less significant number of contracts.

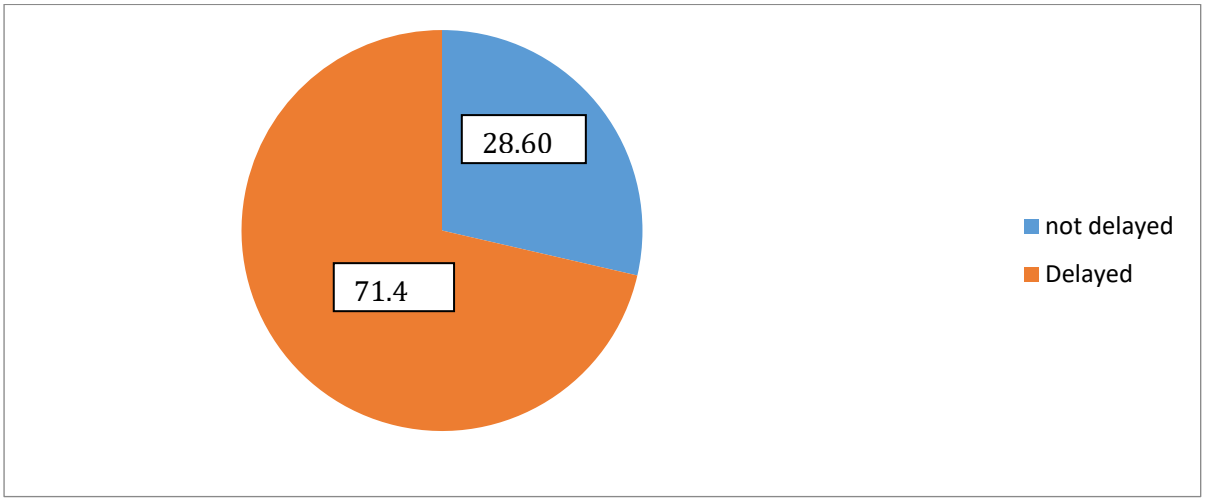

Fig. 1: Contracts categorized on the basis of timely completion

Figure 1 shows that among the selected 105 contracts, 71.4% got delayed whereas only 28.60% were completed in time. This suggests that more than two third of the contracts got delayed whereas only around one third of the total contracts got completed in time. It might be because of joint effect of different factors like low bid, political instability, allocation of insufficient contract duration, poor management skills of contractors etc.

Table 4: Contracts categorized on basis of estimate amount (size of contract) and timely completion

		Estimate amount (including VAT & PS) (in 000)					
		<= 6000.00		**6000.01 - 20000.00**		**20000.01+**	
		No.	**in %**	**No.**	**in %**	**No.**	**in %**
delay category	not delayed	16	43.2%	8	20.5%	6	20.7%
	Delayed	21	56.8%	31	79.5%	23	79.3%
	Total	37	100.0%	39	100.0%	29	100.0%

Table 4 shows that around 57% contracts below 60 lakhs got delayed whereas around 79% contracts between 60 lakhs and 2 crore got delayed along with around 79% contracts above 2 crore getting delayed. This suggests that contracts below 60 lakh have lower ratio of being delayed comparatively whereas contracts ranging between 60 lakh to 2 crore and above 2 crore have higher ratio of failing to complete in time. It might be because of allocation of similar contract duration, regardless of size of contract and also because of poor management skills of contractors to handle large contracts.

5.2 Analysis of Contracts Categorized on basis of Percentage of Low Bidding and Timeliness:

Table 5: Categorized on basis of percentage of low bidding and timely completion

		Percent below estimate amount											
		<= .00		.01 - 10.00		10.01 - 20.00		20.01 - 30.00		30.01 - 40.00		40.01+	
		No.	In %	No.	In %	No.	In %	No.	In %	No.	In %	No.	In %
delay category	not delayed	1	100.0%	2	66.7%	6	40.0%	4	28.6%	12	28.6%	5	16.7 %
	Delayed	0	0.0%	1	33.3%	9	60.0%	10	71.4%	30	71.4%	25	83.3 %
	Total	1	100.0%	3	100.0 %	15	100.0 %	14	100.0%	42	100.0 %	30	100.0 %

Table 5 clearly shows that with increase in percentage of lower bidding amount in comparison to estimate amount, more is ratio of delay of contracts, meaning that higher the percentage of low bidding more is the percentage of delayed projects. For contracts with contract amount (0.01 - 10%) below estimate amount, around 33% got delayed whereas, for (10-20%), it increased to 60% and for (20-40%), it was about 71% and above 40%, it rose to around 83%. It might be because bidders awarded with lower bid amount have the tendency of delaying the construction works due to less gain in profit or sometimes falling into financial losses.

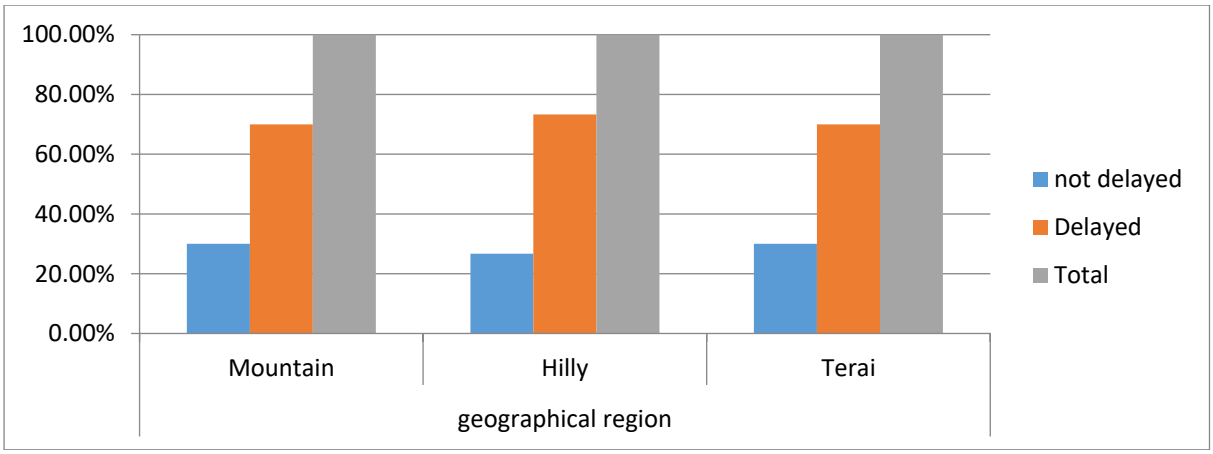

Fig.2: Contracts categorized on basis of geographical region and timely completion

Figure 2 shows that in mountain and terai regions, percentage of delayed contracts are around 70% while in hilly region, it is around 73%. This shows that delay ratio is somewhat similar in all geographical regions, irrespective of difficulty in terrain and climatic conditions that vary in each geographical region.

The above graph therefore, shows that the ratio of delay of contracts in all three geographical regions (mountains, hills and terai) is more or less similar which suggests that geography does not show positive or negative impact in timely completion of contracts.

5.3 Analysis of Categorized on basis of Size and Initial Duration of Contract:

Table 6: categorized on basis of size of contract and initial contract duration

		initial contract duration category (days)									
		<= 180 (less than 6 months)		181 – 365 (6 months to 1 year)		366 – 730 (1 year to 2 year)		731+ (more than 2 years)		Total	
		No	In %	No.	In %	No.	In %	No.	In %	No.	In %
Estimate amount	<= 6000.00	35	53.0 %	2	8.3 %	0	0.0%	0	0.0 %	37	35.2 %
	6000.01 - 20000.00	26	39.4 %	12	50.0 %	0	0.0%	1	20.0 %	39	37.1 %

	20000.01+	5	7.6%	10	41.7 %	10	100.0 %	4	80.0 %	29	27.6 %

This table 6 shows that out of 105 contracts, 66 contracts had been allocated initial contract duration of less than 6 months regardless of size of contract. Out of these 66 contracts, 53% are below 60 lakhs, around 39% are in between 60 lakhs to 2 crore and around 8% are above 2 crore. Similarly, for contract duration of (6 months to 1 year), 50% of the contracts are in between 60 lakhs to 2 crore and around 42% are above 2 crore. This points out the debatable issue whether initial contract duration allocated are justifiable or not and whether similar range of contract duration allocated for vast range of contract size result in difficulty of timely completion of contracts or not, although allocating contract duration depends on various factors. DoR has adopted certain criteria in determining contract duration according to nature of work, size of contract, difficulty due to terrain type etc but it is used mainly for large multiyear contracts only. It might be because of difficulty to follow the above rule for small contracts, yearly contracts and for maintenance works due to budget allocation criteria.

5.4 Analysis of Categorized on basis of Initial Duration of Contract, Size and Timeliness:

Table 7: Categorized on basis of initial duration, size and timely completion of contract

			Estimate amount							
			<= 6000.00		6000.01 - 20000.00		20000.01+		Total	
			No.	In %	No	In %	No	In %	No.	In %
initial contract duration (days)	<= 180	not delayed	14	40.0 %	2	7.7%	0	0.0%	16	24.2%
		Delayed	21	60.0 %	24	92.3%	5	100.0 %	50	75.8%
	181 – 365	not delayed	2	100.0 %	6	50.0%	3	30.0 %	11	45.8%
		Delayed	0	0.0%	6	50.0%	7	70.0 %	13	54.2%
	366 – 730	not delayed	0	0.0%	0	0.0%	0	0.0%	0	0.0%
		Delayed	0	0.0%	0	0.0%	10	100.0 %	10	100.0%
	731+	not delayed	0	0.0%	0	0.0%	3	75.0 %	3	60.0%
		Delayed	0	0.0%	1	100.0%	1	25.0 %	2	40.0%

For initial contract duration of less than or equal to 6 months:

40% of contracts under estimate amount 60 lakhs were delayed whereas 92.3% of contracts with estimate amount between 60 lakh and 2 crore were delayed. Moreover, 100% of contracts above 2 crore were delayed. This shows that contract duration should be increased with proportion to estimate amount as delay ratio increased directly with increase to estimate amount for similar initial contract duration.

Similarly, for initial contract duration of more than 6 months to less than or equal to 1 year:

0% of contracts under estimate amount 60 lakh were delayed whereas 50% of contracts with estimate amount between 60 lakh and 2 crore were delayed. Moreover, 70% of contracts above 2 crore were delayed. This shows that increase in contract duration from (less than or equal to 6 months) to (6 months to 1 year) decreased delay percentage from 60% to 0% in less than 60 lakhs amount estimate category. Similarly, delay percentage decreased from 92% to 50% for (60 lakhs to 2 crore) estimate amount category and for estimate category above 2 crore, delay percentage decreased from 100% to 70%. This clearly indicates that increase in contract duration for the similar range of size of contracts showed lesser percentage of delay. This suggests that contract duration should be allocated carefully

considering size of contract in order to minimize delay. Haphazardly allocated contract duration results in delay and other complications.

For initial contract duration of more than 1 year:

Contracts with contract duration between (1 year to 2 year) showed 0 % delay for both less than 60 lakhs estimate amount category and (60 lakhs to 2 crore) amount estimate category. Contracts above 2 crore with contract duration of (1 - 2 years) showed 100% delay whereas for contracts with more than 2 years which were above 2 crore showed 25% delay. This result also suggests that increase in contract duration decreases delay percentage of contracts.

Contracts above 2 crore showed some deviations in proportion to initial contract duration and timely completion which might be because of very large range of contract size (i. e., for example 3 crore and 30 crore contracts both lie in same group).

Moreover, Shrestha et al. (2013) found that significance test (ANOVA) conducted on plan overwhelms for projects with development length of short of what one working year and ventures with more than one working year, showed that the *P* worth of under 0.001 separately, which were under 0.05. In this manner, the invalid speculation could be dismissed, affirming the distinction in example implies presuming that the timetable overwhelms of activities with development term of short of what one year were lower than those for projects with development length of over one year. Likewise, Senouci et al., (2016) tracked down that ANOVA examination of deferrals for the five undertaking span classes (length not exactly or equivalent 1 year; term somewhere in the range of 1 and 2 years; length somewhere in the range of 2 and 3 years; length somewhere in the range of 3 and 4 years; span more noteworthy than 4 years) brought about P worth of 0.004 which shows that postponements for the five venture classifications were genuinely critical at an importance level of 0.05, indicating increase in delay with increase in contract duration. However, the results from table 7 show that schedule overruns decrease with increase in contract duration. The results contradict with each other which might be because of haphazard allocation of contract duration in Nepal.

5.5 Correlation between Delay with Estimate Amount and Percent below Estimate Amount:

Correlation between different dependent and independent variables have been calculated using Pearson Correlation Coefficient and Spearman rank correlation coefficient at 95% confidence interval using SPSS software. Here the dependent variable is delay category and independent variables are estimate amount category and percent below estimate amount category. Spearman rank correlation coefficient is found out between delay category and estimate amount category whereas Pearson correlation coefficient is found out between delay category and percent below estimate amount category. Different methods have been adopted for calculating correlation coefficients because the type of variables are different and best suitable method have been adopted as per the nature of the variables to be correlated. The resultant correlation coefficients are as follows.

Table 8: Correlation between Delay with Estimate Amount and Percent below Estimate Amount

		Delay Category
Estimate amount category	Spearman's Correlation (rho)	.210*
	Sig. (2-tailed)	.031
	N	105
Percent below estimate	Pearson Correlation	.243*
	Sig. (2-tailed)	.013
	N	105
*. Correlation is significant at the 0.05 level (2-tailed).		

This table shows correlation between different variables.

Spearman rank correlation method was used for calculating correlation coefficient between delay category and estimate amount category as both of them are categorical variables with estimate amount category being ordinal variable. For ordinal variables, Spearman rank correlation method is more accurate than Pearson correlation method. Thus, Spearman rank correlation method is used here. Since p value is 0.031 (which is less than 0.05) in case of delay category and estimate amount category, there is significant relationship between these two variables. Spearman rank correlation value of 0.210 suggests that there is weak but positive monotonous relation between delay category and estimate amount category. This suggests that as estimate category changes from “below 60 lakh” to “60 lakh-

2 crore" and to "above 2 crore", ratio of numbers of contracts getting delayed increases. This means as contract size increases, delay of contracts also increases.
Shrestha et al. (2013)[17] found that significance test (ANOVA) conducted on construction schedule overruns for different sizes of projects showed P value of less than 0.001, which was less than 0.05. Therefore, the null hypothesis was rejected, confirming the difference in the sample means showing construction schedule overrun of projects costing less than US $1 million was statistically lower than that of projects costing greater than US $1million, thereby indicating schedule overruns of larger projects were statistically higher than those for smaller projects. And the result from above analysis 7 too showed similar results indicating increase in time overrun as size of contract increases.
Pearson correlation [37] method was used for calculating correlation coefficient between delay category and percent below estimate category as one of the variable is dichotomous variable and other one is interval variable. In this case, Pearson correlation method is more suitable for finding the correlation between the variables. Thus, Pearson correlation method is used here. Since p value is 0.013 (which is less than 0.05) in case of delay category and percent below estimate, there is significant relationship between these two variables. Pearson correlation value of 0.243 is positive which suggests that as discounted percentage increases from "less than 0%" to "0-10" to "10-20" to "20-30" to "30-40" to "more than 40", ratio of numbers of contracts getting delayed increases. It might be because bidders awarded with lower bid amount have the tendency of delaying the construction works due to less gain in profit or sometimes falling into financial losses.

5.6 Testing significance between delay category and geography:

Since geography is nominal variable, correlation cannot be found out between geography and delay category. However, chi – square test can be done to check the significance of the relationship between these two variables.

Table 9 Chi - Square tests between delay category and geography

	Value	Df	Asymp. Sig. (2 - sided)
Pearson Chi – Square	.140[a]	2	.932
Likelihood Ratio	.141	2	.932
Linear - by - Linear Association	.000	1	1.000
N of Valid Cases	105		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.57.			

Chi - Square test was done to check the significance of the relationship between two categorical variables which are delay category and geography where geography is nominal variable. For nominal variable, chi - square test is the best test for determining the statistical significance of the relationship between dependent and independent variables. Thus, chi - square test was used here. Since p value from chi- square test was 0.932 (which is more than 0.05) in case of delay category and geography, there is no statistically significant relationship between these two variables.
Al-Hazim and Abusalem (2015) found out that most road construction projects in Jordan are characterized by delay where the critical factors are: Terrain conditions, weather conditions etc. with the delay time ranging from 125% to 455% with an average of 226% showing terrain conditions affecting timely completion of contract. Thus, this result contradicted with result in table 9 as there was no statistically significant relationship between delay and geography; indicating geography had no effect in timely completion of contracts. It might be because some other factors like insufficient contract duration, political instability etc. (from different researchers like Bhandari and Mishra (2018); Giree (2015); Mahamid et al. (2011)) are dominant in all three geographical regions equally which nullify the effect of geography.

5.7 Regression Analysis Results:

Regression analysis was carried out among different variables where dependent variable was delay category and independent variables were estimate amount category, percentage below estimate amount and geography. Since dependent variable was categorical variable (dichotomous variable), binary logistic regression analysis was performed as it would best fit the model rather than linear regression. The confidence interval was taken as 95% for the analysis. The results are given in following tables:

Table 10: Omnibus tests of model coefficients

		Chi - square	Df	Sig.
Step 1	Step	10.708	3	.013
	Block	10.708	3	.013
	Model	10.708	3	.013

Table 10 shows the test results for the statistical significance of the whole model, where chi – square value was found to be 10.708 with p- value of 0.013 (which is less than 0.05), thus implying that there is statistically significant relationship between dependent and independent variables.

Table 11: Model summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	114.929[a]	.097	.139
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.			

Table 11 gives the value of R square. In linear regression analysis, coefficient of determination (R square) shows the variance in dependent variables due to independent variables. Similarly, Cox & Snell R Square and Nagelkerke R Square give the value of R square in binary logistic regression analysis. Here, in this model, Cox & Snell R Square value is 0.097 whereas Nagelkerke R Square value is 0.139. Nagelkerke R Square value ranges from 0 to 1 but Cox & Snell R Square value does not reach upper bound value of 1. Thus, Nagelkerke R Square value is more accurate and is used in this study to explain the given model. Since Nagelkerke R Square value is 0.139, it implies that around 14% variance in dependent variable (delay category) is explained by given predictor or independent variables (estimate amount category, percentage below estimate amount and geography). That means 86 % variance in dependent variable was caused by some other factors which were not considered under the scope of this study. This R square value is comparatively low in comparison to finding of Kaleem et al., (2014) whose R square value from linear regression analysis was 0.56 where dependent variable was time overrun and independent variables were project size and geographical location.

Table 12: Variables in the equation of regression analysis

	B	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**	**95% C.I. for EXP(B)**	
							Lower	**Upper**
Percent below estimate	.044	.019	5.613	1	.018	1.045	1.008	1.084
Estimate category	.673	.297	5.137	1	.023	1.960	1.095	3.509
Geography	-.151	.298	.258	1	.612	.859	.479	1.542
Constant	-1.460	.972	2.256	1	.133	.232		
a. Variable(s) entered on step 1: percent below estimate, estimate category, geography.								

Table 12 shows regression coefficients between dependent and independent variables along with checking statistical significance between each dependent and independent variables separately. For delay category and percentage below estimate amount, p – value is 0.018 (which is less than 0.05), thus there is statistically significant relationship between these two variables. Similarly, for delay category and estimate amount category (size of contract), p – value is 0.023 (which is less than 0.05), thus there is statistically significant relationship between these two variables too. However, for delay category and geography, p– value is 0.612 (which is more than 0.05), thus there is no statistically significant relationship between these two variables.

In the above table, exp (B) is known as odds ratio. It gives the association between exposure and outcome. The odds ratio represents the odds that an outcome will occur given a particular exposure, in comparison to the outcome occurring in absence of that exposure. Odds ratio of 1 implies that there is no effect of predictor variable on target variable. Odds ratio of greater than 1 represents that there is positive relation between predictor and target variables and less than 1 represents that there is negative relation between predictor and target variable. In above table, odds ratio of 1.960 implies that as estimate category changes from “below 60 lakhs” to “60 lakhs to 2 crore” and “above 2 crore”, the odds of contracts falling into delay category increases by 1.96 times. Similarly, percentage below

estimate shows exp (B) value of 1.045 which is greater than 1, thus indicating odds of falling into target group (delay category) increases with increase in predictor value (percentage below estimate). Likewise, geography has exp (B) value of 0.859 (which is less than 1), thus indicating odds of falling into target group (delay category) decreases with change in predictor value (geography) from "mountain" to "hilly" to "terai". However, p – value of 0.612 (which is greater than 0.05) indicates that the relation between delay category and geography is not statistically significant. Therefore, geography is not particularly useful variable in predicting delay. Contrary to this finding, Kaleem et al., (2014) found that marginal increase in project duration with unit increase in project cost seemed to be linear, and got high if the projects were placed in geographical locations as proposed in the study. Moreover, B value gives the value of regression coefficient. Exponential of this B value gives odds ratio (exp B). Positive B value indicates that with increase in predictor value, there is also increase in likelihood of falling into target group. Negative B value indicates that with increase in predictor value, there is decrease in likelihood of falling into target group. In the above table, B value of 0.044 represents that with 1 unit increase in percentage below estimate amount, the log odds of falling into target group, i.e., falling into delay category increases by 0.044 units and it is similar for other predictor variables too.

6. CONCLUSIONS AND SUGGESTION :

Correlation between cost variation and time overrun was also examined in this study which showed p value of 0.195 (which is greater than 0.05), thus implying that there was no significant relationship between cost variation and time overrun. It can be attributed to the reason that whether a contract is completed in stipulated time or is delayed, final contract amount remains more or less same unless scope of works is changed. Also, many contracts may not have price escalation clause, and even those which have price escalation clause may come with a condition of freezing the escalation coefficients as on the date signed upon as initial contract completion date. So, even if time is extended, price escalation does not go up beyond certain limit and final contract amount doesn't increase unless there is change in scope of work.

Among the viable measures for controlling the project delays include – punish those contractors who delay the project works intentionally, set the project duration based on the location difficulties and size of the project, discourage the tendency of low bidding by awarding contracts to the middle order bidders, improve bid capacity evaluation criteria, solve land accusation issue prior to the contract award, split a large contract into number of smaller packages, prepare cost estimates in such a way that there is less chances of changing the scope of project works, improve technical qualification criteria in selection of contractors and arrange regular meetings or organize seminars for the representatives of the stakeholders.

The effective ways to avoid low bidding were found to be creating awareness among contractors about negative effects of low bidding followed by awarding bid to the one closest to some average, not the highest, not the lowest and charging high performance guarantees to the ones bidding below certain limit.

7. ACKNOWLEDGEMENT :

The author is thankful to all the professionals who took part in the discussions. The Author thanks to Saanvi Lavanya (Betkumar) for being with us during the discussions.

REFERENCES :

[1] Mishra, Anjay Kumar, & Aithal, P. S., (2021). Foreign Aid Movements in Nepal. *International Journal of Management, Te chnology, and Social Sciences (IJMTS), 6*(1), 142-161. DOI: https://doi.org/10.5281/zenodo.4677825.

[2] Mishra Anjay Kumar, & Aithal P. S., (2021). Foreign Aid Contribution for the Development of Nepal. *International Journal of Management, Technology, and Social Sciences (IJMTS), 6*(1), 162-169. DOI: https://doi.org/10.5281/zenodo.4708643.

[3] Mishra A. K. (2020). Project management: theory and practice from different countries. Project management: theory and practice from different countries. Tamilnadu: DK International Research Foundation. 2020. http://doi.org/10.5281/zenodo.4817542.

[4] DoR, (2021). Statistics of National Highway (SNH) 2020/21. https://nepalindata.com/resource/STATISTICS-OF-NATIONAL-HIGHWAY--2020-21/

[5] Sauden, A., Mishra, A. K., & Aithal, P. S., (2022). Assessing the Seeds of Disputes in Projects. *International Journal of Case Studies in Business, IT, and Education (IJCSBE), 6*(2), 538-552. DOI: https://doi.org/10.5281/zenodo.7348289.

[6] Mishra, A. K. (2018). Dispute Resolution Practice of Project Management in Nepal. *J Adv Res BusiLaw Tech Mgmt, 1*(4): 1-11. https://doi.org/10.5281/zenodo.7288359.

[7] Mishra, A. K., Mandal, L., & Pant, R. R. (2018). Causes of dispute in international competitive bidding road contracts funded by Asian Development Bank in Nepal. *J. Adv. Res. Busi. Law Technol. Manage, 1*(3), 5-16. DOI: https://doi.org/10.5281/zenodo.7288516.

[8] Anderson, S. D., & Tucker, R. L., (1994). Improving project management design. *ASCE Journal of Management in Engineering, 10*(1), 35–44.

[9] Love, P.E.D., Smith, J., Simpson, I., Regan, M. and Olatunji, O., (2015). Understanding the landscape of overruns in transport infrastructure projects. *Environment and Planning B: Planning and Design, 42*(3), 490–509. Google Scholar↗

[10] Mishra, A. K., Sudarsan, J. S., and Nithiyanantham, S. (2021). Assessment of Time–Cost Model of Public Health Buildings in Nepal. *Asian Journal of Civil Engineering, 22*(1), 13–22. https://doi.org/10.1007/s42107-020-00294-4

[11] Mishra, A. K., and Singh, N. K. (2018). A Review on Time and Cost Issues of Infrastructure Projects. *Journal of Advanced Research Construction and Urban Architecture, 3*(1-2), 32–46. DOI: https://doi.org/10.5281/zenodo.7066243.

[12] Kaliba, C., Muya, M. and Mumba, K., (2009). Cost escalation and schedule delays in road construction projects in Zambia. *International Journal of Project Management, 27*(5), 522–531. DOI: http://dx.doi.org/10.1016/j.ijproman.2008.07.003.

[13] Mahamid, I., (2013). Effects of project's physical characteristics on cost deviation in road construction. *Journal of King Saud University - Engineering Sciences, 25*(1), 81–88. DOI: http://dx.doi.org/10.1016/j.jksues.2012.04.001.

[14] Santoso, D. S. and Soeng, S., (2016). Analyzing Delays of Road Construction Projects in Cambodia : Causes and Effects. pp.1–11. DOI: https://doi.org/10.1061/(ASCE)ME.1943-5479.0000467.

[15] Al-Hazim, N. and Abusalem, Z. (2015). Delay and cost overrun in road construction projects in Jordan. *International Journal of Engineering & Technology, 4*(2), p.288. https://doi.org/10.1016/j.proeng.2017.03.105

[16] Senouci, A., Ismail, A. and Eldin, N. (2016). Time Delay and Cost Overrun in Qatari Public Construction Projects. *Procedia Engineering, 164*(6), 368–375. DOI: http://dx.doi.org/10.1016/j.proeng.2016.11.632.

[17] Shrestha, P. P., Burns, L. A. and Shields, D. R., (2013). Magnitude of Construction Cost and Schedule Overruns in Public Work Projects. *Journal of Construction Engineering, 2013*(2), 01–9. DOI: https://doi.org/10.1155/2013/935978

[18] Aibinu, A. A. and Jagboro, G. O. (2002). The effects of construction delays on project delivery in Nigerian construction industry. 20(1), 593–599. DOI: https://doi.org/10.1016/S0263-7863(02)00028-5

[19] Assaf, S. A. and Al-Hejji, S. (2006). Causes of delay in large construction projects. *International Journal of Project Management, 24*(4), 349–357. https://doi.org/10.1016/j.ijproman.2005.11.010

[20] Ayman, H., (2000). Construction delay: a quantitative analysis. *International Journal of Project Management, 18*(1), 51–59. DOI: http://www.sciencedirect.com/science/article/B6V9V-40Y4JMT-7/1/76499cc2c8a18bfa35b740d31975214d>.

[21] Aziz, R. F. and Abdel-hakam, A. A., (2016). Exploring delay causes of road construction projects in Egypt. *Alexandria Engineering Journal, 55*(2), 1515-1539. DOI: http://dx.doi.org/10.1016/j.aej.2016.03.006.

[22] Bergman, M. A. and Lundberg, S. (2013). Tender evaluation and supplier selection methods in public procurement. *Journal of Purchasing and Supply Management, 19*(2), 73-83. https://doi.org/10.1016/j.pursup.2013.02.003

[23] Herbsman, Z. and Ellis, R., (1992). Multiparameter Bidding System—Innovation in Contract Administration, ASCE. 118(1), 142–150. DOI: http://worldcat.org/oclc/8675438

[24] Kaleem, S., Irfan, M. and Gabriel, H.F. (2014). Estimation of highway project duration at the planning stage and analysis of risk factors leading to time overrun. In: T and DI Congress 2014: Planes, Trains, and Automobiles - Proceedings of the 2nd Transportation and Development Institute Congress. DOI: https://doi.org/10.1061/9780784413586.05

[25] Kikwasi, G. (2017). Causes and Effects of Delays and Disruptions in Construction Projects in Tanzania. *Australasian Journal of Construction Economics and Building - Conference Series, 1*(2), 52-59. DOI: https://doi.org/10.5130/ajceb-cs.v1i2.3166.

[26] Nepal, M. P., Park, M. and Son, B. (2006). Effects of Schedule Pressure on Construction Performance. *Journal of Construction Engineering and Management, 132*(2), 182–188. https://doi.org/10.1061/(ASCE)0733-9364(2006)132:2(182)

[27] Odeck, J. (2004). Cost overruns in road construction - what are their sizes and determinants? *Transport Policy, 11*(1), 43–53. DOI: https://doi.org/10.1016/S0967-070X(03)00017-9

[28] Odeh, A.M. and Battaineh, H.T., 2001. Causes of construction delay: Traditional contracts. *International Journal of Project Management, 20*(1), 67–73. DOI: https://iranarze.ir/wp-content/uploads/2017/08/7621-English-IranArze.pdf

[29] Sweis, G., Sweis, R., Abu Hammad, A. and Shboul, A., (2008). Delays in construction projects: The case of Jordan. *International Journal of Project Management, 26*(6), 665–674. https://doi.org/10.1016/j.ijproman.2007.09.009

[30] Mishra, A. K., & Aithal, P. S., (2023). Evaluating the Impact of Disputes on Time and Costof Projects. *International Journal of Applied Engineering and Management Letters (IJAEML), 7*(1), 15-27. DOI: https://doi.org/10.5281/zenodo.7545084.

[31] Mishra, A. K. (2022). Effect and Remedies of Bidding Trend in Road and Bridge Projects. *International Journal of Darshan Institute on Engineering Research and Emerging Technologies, 11*(1), 01–07. DOI: https://doi.org/10.32692/IJDI-ERET/11.1.2022.2201.

[32] Mishra, A. K., Megh Bahadur K. C. & Aithal, P. S. (2020). Association of Number of Biddersand Minimum Bid Ratio (AEr) with Effect of E-bidding of Different Project. *International Journal of Management, Technology, and Social Sciences (IJMTS), 5*(2), 201-215. DOI: http://doi.org/10.5281/zenodo.4111956.

[33] Bahadur, K. C. M., & Mishra, A. K. (2019). Bidding Trends of Contracts based on Types and Sizes of Projects under Road Divisions Butwal and Shivapur. *J Adv Res Const Urban Arch, 4*(3&4), 7-16. DOI: https://doi.org/10.24321/2456.9925.201905.

[34] Nepal, M. P., Park, M. and Son, B. (2006). Effects of Schedule Pressure on Construction Performance. *Journal of Construction Engineering and Management, 132*(2), 182–188. Google Scholar↗

[35] FCAN, Federation of Contractor's Associations of Nepal (FCAN). [Online] Available at : http://nepalconstructions.com/challenges-and-prospects-of-nepalese-construction-industry/

[36] Hong, H. and Shum, M. (2002). Increasing Competition and the Winner's Curse: Evidence from Procurement. *Review of Economic Studies, 69*(4), 871-898. DOI: https://www.jstor.org/stable/1556725

[37] Aaron O'Neill, Mar 31, (2021). https://www.statista.com/statistics/425750/nepal-gdp-distribution-across-economic-sectors/

******