

# Analysis of Cost and Time Performance in Construction Projects: A case study of Town Development Program III Projects

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## Abstract

The timely completion of the project seems to be exceptional in TDP III projects under the Town Development Fund (TDF). This study analyzes the irregularity in the construction timing of various projects for positive monitoring process in the upcoming new projects under the fund of TDF. A set of performance factors believed to have an impact on the project was generated. Case studies of ten selected projects were done with a total of 74 questionnaires distributed to four survey groups of project participants namely; clients, consultants, contractors, and funders. The survey is mostly concentrated on identifying and order-wise ranking the main performance factors causing an impact on the project performance and suggesting measures. The results of the case study of the projects showed that cost variation ranged up to 25% above the contract cost and time extension up to 317% beyond the scheduled time in the projects under study. It was further found that lack of materials in markets, suspension of work by contractor, delay in decision making in case of variation, client's untimely decision making, and unreliable design are the five major factors having an impact on performance. The data from the questionnaire was statistically analyzed using ranks from RII. The five main factors having an impact on project performance in TDP III projects were the suspension of work by the contractor, unusually low bid, contractor's financial difficulties, Covid-19, and no land acquisition/site verification by the client. One-way ANOVA test determined that client and contractor-based factors had the most impact. The summary of the case study and questionnaire also depicted that the client and contractor-based factors have high impact on performance factors. The mitigation measures as suggested by the interviewee include: encourage effective planning and scheduling by the contractor, quick decision-making by the client, discourage low bid and verify contractor capacity, discourage study/ planning of the project prior to land verification, ease litigation process of the funder loan process, follow the schedule as per the contract documents, and encourage consultant to be dedicated towards output of design.

## Keywords

KfW (Kreditanstalt für Wiederaufbau), TDF (Town Development Fund), TDP III, Cost Performance, Time Performance

## 1. Introduction

The German Development Bank (KfW) has been implementing the Town Development Program (TDP) since 1995 with the objective of establishing the TDF as a financial intermediary body to mobilize long-term loans for urban infrastructure development and to provide municipal infrastructure and technical assistance in the concept of debt financing.

With the motto "Prosperous Nepal, Happy Nepalese", Nepal is growing with both short and long-term development strategies and sustainable urban development. The TDF plays an important role in building the capacity of the local level (municipalities) by building urban infrastructure through the mobilization of various financial alternative sources through loan investment methods. TDF is associated with the Government of Nepal and various international organizations such as the World Bank, GTZ, KfW, ADB, EU, and UNCDF to provide financial and technical assistance and fund mobilization for developing, expanding, and enhancing the capacity of social or economic infrastructure. It has been providing continuous support for 32 years. From its inception to FY 2019/20, the fund has provided more than Nepalese Rupees (NR) 2 billion as a grant and more than 9 billion as a loan to more than 83 municipalities and 94 small towns [1].

In 1995, the KfW provided approximately Euro 4.5 million under TDP, Phase I, which helped to develop social and revenue-generating urban infrastructure in the total number of 32 municipalities. With the successful implementation of Phase I of the TDP, TDF continued to receive funding from KfW, resulting in Phase II of the TDP in 2000 and Phase III of the TDP in 2010. Significant contribution has been made in the development of urban infrastructures including Bus Park, commercial buildings, amusement parks, vegetable markets, municipal buildings, roads, etc. The fund has been continuing the urban development program for the additional infrastructure development of the municipalities by re-mobilizing the revolving fund for the infrastructure development of the municipalities. The TDP III program ended in July 2021 [2].

## 2. Literature Review

There is a strong indication in the literature that there are numerous factors that are encountered in project implementation in the construction industry. The accomplishment of a project is based on cost and time performance[3]. However, several studies have tried to identify the major factors contributing to the delay of projects with respect to cost and time.

One of the main goals and principles of any public or private department involved in the implementation of the project is to improve project performance by minimizing costs, completing the project within the allocated budget and time frame, and improving quality. Time overrun occurs when projects are not completed within the time the project plan specifies due to many reasons [4]. Cost overrun is defined as excess of actual cost over budget. The research ranked factors such as less emphasis on planning, poor contract management, and poor pre-planning process as the top three factors with an impact on the projects [5].

Design change, price fluctuations, and poor economic conditions are key factors having the most significant effect on the schedule/cost performance [6] and the major factors affecting time and cost performance are design and documentation issues, financial resource management, project management and contract administration, contractor's site management, information and communication technology, material and machinery resource, labor (human) resource and other external factors. Various factors that lead to unmet cost and time goals affecting the project performance were identified. It was further defined that the responsibility of origin of impact factors are related to the groups involved in the construction which are the client, the consultant, the contractors, or the donors and finally other factors [7].

In the projects funded by donors, the initial phase of the project always encounter delays, therefore affecting implementation phase. The insufficient skills of the implementation unit, delay in the supply of materials, voluminous paperwork, delay in the provision of project funds and the long supply process are some of cause of poor execution of donor funded projects [8]. The errors and omissions in detailed design, changes in specifications, and scope are the most common causes of delayed achievement of performance goals. The deficiencies in contract documents and approvals from the relevant authorities, inadequate feasibility studies, errors and omissions in detail design, improperly harmonized procurement documents shortcomings in contract documents, stakeholder identification and management issues, variations and scope changes, land acquisition and resettlement, Extreme weather and shortage of materials are found to be major causes of delays [9].

In the project related to land pooling in Kathmandu valley, the project being carried out by KVDA, it was found that the factors such as change of schedule, client's financial problems/ delay in payment of the bill, impediment in the prompt decision-making process, change in design by the consultant/ errors and omissions in design, conflicts between contract documents, the inadequate scope of work for the contractor, lack of coordination/ communication, design complexity, inadequate working drawing details, consultant's lack of judgment and experience, non-compliant design with government regulations, unavailability of equipment, and unavailability of skills were among the factors that had highest impacts on the project performance [10]. There are several other studies based on time and cost overrun in different sectors in Nepal which is studies under various sectors such as road projects, land pooling project, and other general projects

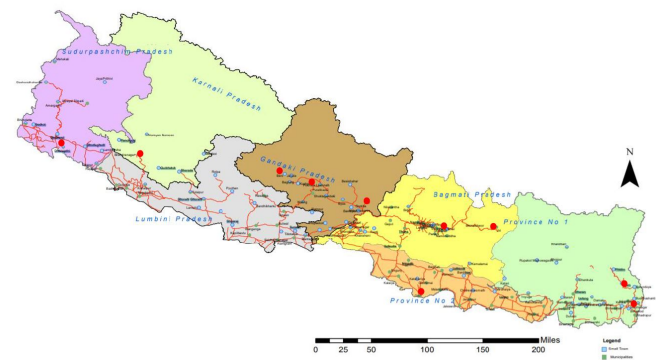


Figure 1: Location of Projects under Study

[11, 12]. Some of the main factors mentioned in the studies are weather, climatic condition, delay in the decision in the relocation of services occupy, poor estimation of project time, land acquisition/ donation, the conflict between joint ownership of the project, civil unrest/ public strikes, insufficient numbers of equipment, inaccurate time estimate, monthly payment difficulties; changes orders inaccurate cost estimate, poor site management and supervision, inadequate modern equipment.

### 3. Methodology

The research is based on quantitative approach. The initial phase included the preliminary identification and definition of the problems to establish research objectives and research plan. Next phase included the study of related works in the literature. The third phase included collecting secondary data from project-related documents, taking interviews of staffs and questionnaire design. The fourth phase of the research was questionnaire preparation and distribution to related population. The fifth phase focused on analysis of results and discussion. The final phase included the conclusions, and recommendations.

#### 3.1 Data Collection

The primary as well as secondary data has been collected to identify the factors having impact on project performance. The high potential causes identified from the literature review were selected. A draft questionnaire was prepared to acquire primary data. Data was collected from factors reviewed from literature study. A case study from the project documents was used in the answers of the questionnaire that was made based on Likert's scale of five point's ordinal measures of agreement towards each statement from 1 for having "no impact" to 5 for "extreme impact". The questionnaire was passed onto four organization groups namely, client, consultants, contractors, and donors for a total population size of 74. After obtaining the results from the case study and questionnaire survey, an interview was taken with the key personnel. Secondary data was collected from various project-related documents. Ten projects were studied under loan components from TDP III projects Location of projects under study is shown by Figure 1. The data was obtained from documents such as project appraisal reports to determine scheduled time and estimated budget of project, contract agreements to determine

contracted cost and duration, project completion reports to determine actual cost and time at completion and occurrences during execution, and letters and minutes exchanged between parties to determine causes of quantity variation and time extensions in project. After obtaining the results from the case study and questionnaire survey, an interview was taken with key personnel which allowed to obtain actual factors having impact on TDP III projects and mitigation measures for future projects.

### 3.2 Tools for Data Analysis

Microsoft Excel and SPSS was used to analyze data calculating Relative Importance Index (RII) for ranking of factors, checked reliability using Cronbach’s Alpha test, and compared means from the responses using one way ANOVA test.

$$RII = \frac{\sum(F \times S)}{N \times A} \tag{1}$$

Where,

S = score given to each variable by the respondents,  
 F = frequency of responses to each score for each variable  
 N = total number of respondents.

## 4. Results and Discussion

Result includes the identification of the existence and impacts of various factors on the project performance. The result of the study is interpreted and presented in this section.

### 4.1 Results of Case Study

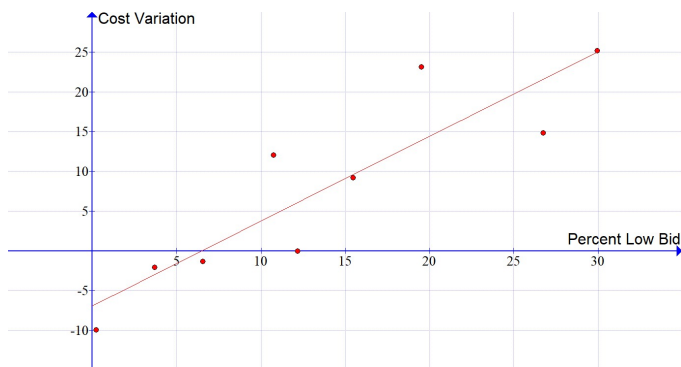


Figure 2: Correlation between percentage of low bid and cost variation

The summary of cost and time related to the estimates and budget with actual at completion has been presented in Table 1. There is no correlation between the percentage of cost variation and percentage of time variation in the projects under study. Also from the data plot between percent low bid and cost variation graphically, Pearson’s coefficient of correlation,  $r = 0.88$  was obtained. There is a high degree of correlation between the percentage of low bid and the percentage of cost variation. The lower the bid amount is from the estimated amount higher is the cost variation from the bid amount.

Table 1: Cost and time variation

SN.	Project name	Percent low bid	Cost Variation	Total EOT		Time variation
1	Kakarvitta Bus Terminal and Pyrivitta Bus Park	0.23%	-9.91%	34	Months	227%
2	Dhangadi Shopping Complex	29.96%	25.18%	38	Months	317%
3	Shopping Complex at Srijana Chowk	24.84%	-33.81%	9	Months	60%
4	Gautam Buddha City Hall	3.69%	-2.07%	28	Months	233%
5	Bus Terminal Gaur	6.54%	-1.33%	21	Months	88%
6	Baglung Bus Park	26.74%	14.81%	20	Months	167%
7	Re-construction of Multipurpose Building with Public Toilet	10.74%	12.03%	13	Months	108%
8	Upgrading Works of Shopping Complex Building	12.16%	-0.04%	9	Months	150%
9	Gorkha Multipurpose Building	19.51%	23.14%	12	Months	150%
10	Birendranagar Bus Park	15.46%	9.21%	17	Months	113%

The factors with most significant impact on the projects were, lack of materials in markets, suspension of work by contractor, delay in decision making in case of variation, client’s untimely decision making, unreliable design, poor scheduling of contractor, unavailability of labor, change in scope and design, Covid-19, and no land acquisition/site verification by client according to the results of case study.

### 4.2 Results of questionnaire survey

From the response from the questionnaire survey, it was obtained that the Cronbach’s alpha value for the overall response was found to be 0.954, i.e. high internal consistency or reliability within data was found since the value of alpha is greater than 0.700.

Table 2: Rank of Impact Factors from Responses

SN.	Performance Factors	Weighted Mean	RII'	Rank
1	Suspension of work by contractor	4.13	0.83	1
2	Unusually low bid	4.06	0.81	2
3	Contractor’s financial difficulties	3.94	0.79	3
4	Covid-19	3.92	0.78	4
5	No land acquisition/site verification by client	3.92	0.78	5
6	Poor site management and supervision by contractor due to large number of work in hand	3.82	0.76	6
7	Lengthy process to grant project approval	3.82	0.76	6
8	Delay in decision making in case of variation	3.82	0.76	8
9	Less Emphasis to Planning	3.82	0.76	9
10	Faulty premises at the time of designing and starting the projects	3.81	0.76	10
11	Border closures and economic blockade	3.74	0.75	11
12	Lack of materials in markets	3.74	0.75	12
13	Unreliable design	3.73	0.75	13
14	Weak monitoring and supervision system	3.71	0.74	14
15	Strike	3.71	0.74	15

The ranking of response based on RII value is shown in Table2. The result of the overall responses depicted that the Suspension of work by contractor has been marked as the top ranking factor of impactful performance and has highest impacts for the projects under study with RII of 0.83 . Similarly, the factors such as unusually low bid and Contractor’s financial difficulties have been ranked second and third with RII of 0.81 and 0.70 respectively. These factors have highest impacts on the project performance. The factors such as Covid-19 with RII 0.78 have been ranked as forth. No acquisition /site verification by client has been ranked as fifth with RII 0.78. Poor site management and supervision by

contractor due to large number of work in hand, lengthy process to grant project approval, delay in decision making in case of variation, less emphasis to planning and faulty premises at the time of designing and starting the projects have been ranked as sixth to tenth position with respective RII 0.76. Border closure and economic blockade, lack of materials in market and unreliable design have been ranked eleventh to thirteenth with RII of 0.75. Finally, factors such as weak monitoring and supervision system and strike has been ranked as fourteenth and fifteenth factors with RII 0.74.

### 4.3 Results from One Way ANOVA Test

From Table 3, it can be observed that there is significant difference in the results from different groups in the consultant and donor based factors, however there is no significant difference in the results from different groups in the client based factors.

**Table 3:** Results from One Way ANOVA Test

	Group	Mean of Likert's Scale Response	Standard Deviation	ANOVA Test		
				F value	Significance level.	Remarks
Client Based Factors	Client	69.11	10.43	3.321	0.026<0.05	Significant relation between means from responses of various groups
	Consultant	76.36	7.40			
	Contractor	73.33	11.25			
	Donor	66.22	8.72			
Consultant Based Factors	Client	72.59	12.31	0.867	0.464>0.05	No Significant relation between means from responses of various groups
	Consultant	68.74	9.52			
	Contractor	70.28	18.25			
	Donor	66.22	11.31			
Contractor Based Factors	Client	81.29	14.55	1.64	0.190>0.05	No Significant relation between means from responses of various groups
	Consultant	84.36	11.47			
	Contractor	75.91	11.97			
	Donor	75.64	8.71			
Donor Based Factors	Client	72.86	13.05	1.302	0.283>0.05	No Significant relation between means from responses of various groups
	Consultant	75.24	13.39			
	Contractor	71.79	14.44			
	Donor	65.71	15.46			
Other Factors	Client	68.33	12.52	4.617	0.006<0.05	No Significant relation between means from responses of various groups
	Consultant	71.90	12.25			
	Contractor	72.68	16.01			
	Donor	57.14	9.90			

The one way ANOVA test further depicted that the organization group of consultants have given high scale response and marked the factors related to the client, the contractor and the donor as highly impact factors affecting the project performance. Consultants however have given low value to the consultant-related factors. Also, it was found that the client marked the consultant-based factors as high impact having factor and contractor have given moderate response to all the performance factor whereas have given low rank to contractor based factors.

Summing up, the result from the one way ANOVA test shows that the client and contractor-based factors are the most impacts having factors followed by donors according to the consultant.

## 5. Conclusion and Recommendations

**Conclusions** Summarizing the main features the following conclusions can be drawn-

- Projects under the TDP-III program were studied and the estimated and the actual cost and time after completion of the project were found. The cost variation was done up to 25% of the contract cost

whereas the time extension was done up to 317% of the contract period or the estimated time. The minimum time extension was 60% and an average of 160% of time extension was done in the projects under study.

- The top five causes of variation and time extension are Lack of materials in markets, Suspension of work by contractor, Delay in decision making in case of variation (by donor), Client's untimely decision making, and unreliable design (consultant).
- As per the overall ranking, it was found that suspension of work by the contractor, unusually low bid, contractor's financial difficulties, Covid-19 and, no land acquisition/site verification by client were ranked as highest impact performance factors.
- Comparing the ranks of factors from the case study and the questionnaire survey with the interview data it was found that suspension of work by contractor, no land acquisition/site verification by client, Covid-19 and Delay in decision making in case of Variation (by donor) and faulty design by the consultant are the common performance indicator within top fifteen high impact factors.
- Based on the interview with key informant regarding core problems of TDP III projects, following recommendations as mitigation measures were obtained; encourage effective planning and scheduling by contractor, quick decision making by the client, discourage low bid and verify contractor capacity, discourage study/ planning of the project prior to land verification, ease litigation process of the donor loan process, follow the schedule as per the contract documents, encourage consultant to be dedicated towards output of design.

### Recommendations

- Low bidding system shall be monitored well by the clients and the contractor also should not bid lower than his capacity of project implementation.
- Client and contractor including all other groups should be focused on completing the project within scheduled time and estimated budget only with valid and licit reasons for the extension of time or variation of cost. The performance goals should be major target of the parties within the contract during implementation of the project.

### References

- [1] Town Development Fund. [https://www.tdf.org.np/wp-content/uploads/2021/02/Annual-Report\\_FY-076-77.pdf](https://www.tdf.org.np/wp-content/uploads/2021/02/Annual-Report_FY-076-77.pdf), 2020.
- [2] Town Development Fund. <https://www.tdf.org.np/>, 2021.
- [3] Yakubu Adisa Olawale and Ming Sun. Cost and time control of construction projects: inhibiting factors and mitigating measures in practice. *Construction management and economics*, 28(5):509-526, 2010.



- [4] Poonam Raykar and AN Ghadge. Analyzing the critical factors influencing the time overrun and cost overrun in construction project. *International Journal of Engineering Research*, 5(1):21–25, 2016.
- [5] MERID TAYE. *Assessment of time and cost overruns in construction projects (case study at defense construction enterprise)*. PhD thesis, St. Mary's University, 2016.
- [6] Mohammadreza Habibi and Sharareh Kermanshachi. Phase-based analysis of key cost and schedule performance causes and preventive strategies: Research trends and implications. *Engineering, Construction and Architectural Management*, 2018.
- [7] Adnan Enshassi, Jomah Al-Najjar, and Mohan Kumaraswamy. Delays and cost overruns in the construction projects in the gaza strip. *Journal of Financial Management of property and Construction*, 2009.
- [8] John Oganyo Olima. *Factors influencing implementation of donor funded projects in government ministries: A case of ministry of transport and infrastructure-Kenya*. PhD thesis, University of Nairobi, 2015.
- [9] J Jeyakanthan. *Understanding and mitigating project delays in donor funded road projects in Sri Lanka*. PhD thesis, 2010.
- [10] Aananda Raj Pokharel and Buddhi Raj Joshi. Impact of variation orders on construction project cost: A case study of land pooling project at kathmandu of ichangu narayan, nepal. 2020.
- [11] Dhan Prasad Subedi and Buddhi Raj Joshi. Identification of causes of delay in road projects: Cases in gandaki province, nepal. 2020.
- [12] Ravi Baghel, Lea Stepan, and Joseph KW Hill. Water, knowledge and the environment in asia.