

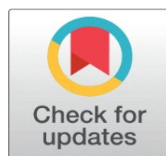
## REVIEW FOR TIMELY COMPLETION OF INFRASTRUCTURE PROJECTS

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### ABSTRACT

Timely completion is main concern for any project though it is a global issue basically for infrastructure construction projects. It is keen area of interest for Local and International professional and Researchers still it is a problem yet to overcome. The study confined to the Literature review followed by key informant experience through discussion with a view to strengthen the depth analysis of existing knowledge in the area to produce contextual content for smooth operation of infrastructure construction projects.

The study revealed that the uniqueness of projects is the main cause of projects delay. We are attempting to reach at society 5.0 where machine will be molding our activities. Our needs and wants would be cared by machine through data produced and sensitized. In this regard, the uniqueness of projects should be decoded after knowing the exact distribution of data on the basis of long-term data assessment. Still, it is one area where several research are needed to convert uncertainty into risk through appropriate risk probability allocation. Archivals of projects should be systematically stored in project bank for future utilization. This research draws the attention for further empirical research and share solution on similarity of problems existing in infrastructure projects.

**Keywords:** Time, Cost, Quality, Risk, Projects, Developed, Developing

## 1. INTRODUCTION

The civil engineering construction started thousands of years back and was in the Phase of development for the betterment of the livelihood of the mankind. Infrastructures were built with naturally available materials adopting the existing art and science through imagination, arranging materials, required manpower and money, and finally giving shape to the imagination to a physical form a structure. The increase in population created growing demand of housing market and the extension of urbanization demanded growth of basic civil engineering infrastructures such as roads, highways, waterways, and airports for transportation; infrastructures for reliable electricity generation; water supply

system for potable drinking water; irrigation facility for growing demand of agriculture and so on for the transformation of better living standards as well as creating opportunities for business. Use of heavy equipment/machinery and autonomous vehicles along with the integration of artificial intelligence has resulted in the increase of production and supported the growth in construction industry. The share of construction in Asia Pacific region is expected to be 41% of the total global construction demand [Exactitude Consultancy UK. \(2022\)](#).

Construction industry generates employment opportunities in the field of material production, equipment / machinery production as well as skilled and unskilled labors. The transportation sector also gets benefitted in terms of delivering the materials and labors to and from the construction sites and thus creating job opportunities for a small to medium sized projects. Investment interest in the construction industry gets boosted with contractors seeking to bid in public as well as private sector and thus creating an environment of competition for enhancing the performance level by completing the projects within the planned time schedule, budget, and quality. Use of advanced autonomous equipment and machinery in large projects yield increased

profits, efficiency, and safety standards of the project thus providing an opportunity to research and seek time and cost minimization techniques. Infrastructural development of a rural community boosts the socio-economy and business opportunities of the region thus creating an impact on the improved health, education, and transport condition.

A huge amount of money has been spent for the construction of these infrastructures and there is still a growing demand of construction worldwide especially in the developing economies. The global construction industry will grow at a pace of 3.9% which amounts to US\$ 3.7 trillion per year by 2030. It is creating 100 million jobs worldwide and contributing about 6% of the global Gross Domestic Product (GDP).

Similarly, the contribution of construction towards GDP is 4.1% in USA, 4.84% in EU and 5.7% in Japan in the year 2017/2018. Likewise, Chinese construction market is expected to have an increase of more than US\$ 3 trillion per year [source: [bg.qianzhan.com, 2021](#)]. The growth in the revenue of the global construction is expected to reach US\$ 14.4 trillion by the year 2030, more than twice the value of US\$ 6.4 trillion in 2020 [Statista Research Department. \(2022\)](#).

There is a high demand of infrastructure construction in the developing countries of Asia to meet the expectation and will need an estimated investment of US\$ 1.7 trillion per year which amounts to US\$ 26 trillion by 2030. The major sector is for power generation and up gradation which requires US\$ 14.7 trillion followed by transportation sector (US\$ 8.4 trillion), telecommunications (US\$ 2.3 trillion) and water and sanitation (US\$ 0.8 trillion). The infrastructure investment by 2030 is expected to be US\$ 5.15 trillion and US\$ 15.27 trillion for India and China respectively. It means that India requires 8.5% of GDP as investments to meet the infrastructure demand [Asian Development Bank \(2017\)](#).

Infrastructure construction is considered to be one of the largest among the other global economy because of the approximate annual investment of around US\$ 10 trillion in the field of construction materials, equipment / machinery, and the services. Regardless of the investment, the growth in the labor-productivity level in this sector is about 1% in comparison to 2.8% and 3.6% in the overall global economy and manufacturing sector respectively over the last 20 years. It is to be noted that the opportunity of US\$ 1.6 trillion needs to be tapped for closing the gap in the

productivity. Construction companies which achieved the level of other economies are below 25% as studied on sampled countries over a period of 10 years. Hence, productivity in the global construction sector needs to be increased to match the requirement of ever-increasing demand of dwellings and other civil engineering infrastructures and the overall economy to increase the global GDP [Mckinsey Global Institute Report. \(2017\)](#).

## 2. OBJECTIVES

To access the existing literature supporting timely completion of infrastructure projects for smooth construction project operation.

## 3. METHODOLOGY

It is a review article. The review is done on the basis of global literature by separating the issues of developed and developing countries followed by local issues through regional and national literature using content analysis and validated through expert discussion. Based on Experience and academic contribution using snowball sampling experts were identified. Using personal meetings regarding each author's contribution information was given and their opinion was taken informally. It was tough to get their time at a point. So, researcher conveyed communication of one to another in case of different interpretation.

## 4. REVIEW AND ANALYSIS

### 4.1. TIMELINESS OF PROJECTS FROM DEVELOPED COUNTRIES PERSPECTIVES

Study conducted by [Steininger et al. \(2020\)](#) for the Stuttgart 21 railway project regarding the factors responsible for the delay and cost overrun and to estimate beforehand the cost and time at completion found out that modification after the start of the project, the earth's structural state, inclination towards doing things that have uncertain outcomes, additional time taken for bringing about the construction, cost hike, involvement in unethical personal benefit from business, absence of public involvement.

[Maksim Pyataev \(2021\)](#), [Statista Research Department. \(2022\)](#) compared the cost as planned with the cost at completion for several completed Russian megaprojects and found out that lack of certainty and adopting deficient ways of reaching decision as well as demand and supply, incompatible attributes of human acts and intuition of people taking interest in the execution of such projects, alteration in governmental power, modification in the way of achieving technical job, human population and their social behaviors affect the cost overrun of large projects. Researcher also concluded that it is not imperative to judge the efficaciousness on the basis of system analysis as they are not well organized to consider the analysis of amount and identity characteristics of projects.

[Gao and Touran \(2020\)](#), [Asian Development Bank \(2017\)](#) studied information gathered related to the 81 railway transportation projects undertaken in the previous 40 years of United States in order to ascertain whether the risk assessment criteria mandated by Federal Transit Administration ameliorated the cost estimation exactness. The study revealed that the exactness in the estimation of project cost in the budgetary phase has ameliorated and it has been also found that percentage difference in planned cost and cost at completion is more in big projects

than the smaller one. In addition to that the exactness gets reduced as the time duration for completion go up.

Information collected from 96 projects funded by Norwegian government projects shows that one fourth of them registered increased cost at completion. The study found that possibility of increased cost at completion can be minimized by adopting better techniques of calculating amount of money required at the time of budgetary phase and system of excellent assessment techniques from external sources during the implementation of the projects [Welde and Klakegg \(2022\)](#) [Mckinsey Global Institute Report. \(2017\)](#).

[Shrestha et al. \(2013\)](#), [Steininger et al. \(2020\)](#) conducted research on the determination of price of construction and additional time taken for 363 CCDPW projects that were built between 1991 and 2008 and made one-factor ANOVA test. It was revealed from the study that 50% of the factors had noticeable relationship with price of construction and extended duration. Projects that are big in nature with lengthy construction period exhibit more possibility of prolonged time and increased cost at completion than the projects that are smaller in size with little construction period.

A study was conducted by [Albtoush et al. \(2022\)](#), [Pyataev, M. \(2022\)](#) to establish efficient ways to minimize the additional cost incurred during implementation beyond the estimated cost and found out that modifications made often on designs, underdone drawings and design during the tendering phase, lapses in design, construction period planned being utopian, lapses in the completed estimated amount, stake holders not involved in needed discussion at the time of design, mistakes made in the calculation of quantity of items and improper calculation/estimation of the project cost had accounted for the additional cost beyond the contract amount. The study also extracted that soil investigation prior to the design, thoroughness and exactness in design and drawings, arrangement of required financial resources prior to the agreement with the contractor/supplier and during the implementation phase, proper assessment and study of the possibility of success of the project, exactness in the design to avoid variation, arrangement of proper payment options during the initial phase of the project for contractor's interim payments, completion of all the design work prior to the implementation and the exactness and thoroughness in the design during the initial phase are the ways of mitigating the effects of cost overrun.

[Olawale and Sun \(2010\)](#), [Gao and Touran \(2020\)](#) carried on methods examining the opinions of 15 experienced practitioner from a total 250 organizations of UK based on individual interviews regarding factors preventing the competence of the relevant person to efficiently control the projects. The study discovered 90 reducing actions for time and cost control. The 5 important reducing actions from top were modifications in the design, possible adverse event not foreseen, mistakes made in assessing correct time duration of the project, intricate nature of project and failure of performance from the sub-contractors. The actions were categorized as being preventive, predictive, corrective, and organizational and can be adopted through preparing check list to enhance the efficiency of project managers.

## 4.2. COMPLETION OF PROJECTS FROM DEVELOPING COUNTRIES PERSPECTIVES

Important construction projects comprising of 102 numbers in total of different types of railways, roads/highways and infrastructures related to energy were considered for study by [Andrić et al. \(2019\)](#), [Welde and Klakegg \(2022\)](#). The study

also tested the controlling effects of the dimension and type of project, place of project, duration of project, impact of politics, economy, importance from the context of strategy and the level of local expertise to complete the project. The assessment of the data revealed that the tendency of cost overrun mainly differs in the type of construction projects and its average was 9.88% which is far lesser in comparison to the 28% in the context of worldwide scenario. It was noticeably highest (21.11%) in railways and 10.47% in road/highway projects in Asian countries. These values are still lesser than in other parts of the world with Netherlands (10.6%) as exception in case of railway projects.

The findings of the study led by [Heravi and Mohammadian \(2017\)](#), [Shrestha et al. \(2013\)](#) provided the importance of excess of actual cost and time beyond budget or as planned in 72 numbers of construction projects related to city roads and buildings of Karaj, a city of Iran. The projects completed within the planned budget and time constitutes a small part of 7% and 8.5% respectively. The results obtained showed that projects with smaller cost and shorter duration for completion recorded better performance in context of cost and time and the factors that contributed the most were inadequate course of action in the initial phase, lack of enough funds on the part of clients, taking long duration for approval and disturbances due to unexpected circumstances such as encountering existing utilities. It also inferred from the findings that to minimize cost overrun, large projects were broken down into projects with smaller cost and verified it from study conducted by Shehu et.al in Malaysian construction projects of smaller magnitudes.

[Susanti and Nurdiana \(2020\)](#), [Albtoush et al. \(2022\)](#) conducted study in Indonesia from the data collected through questionnaires to determine parameters that contributed for cost exceedance from the perspective of client and contractor. The study established additional time required to obtain site, unfavorable state at site, modifications / additions of work causing variation, correction of work, poor execution of sub-contractors and suppliers, additional time taken for obtaining formal permission, lack of precision in assessing cost, time duration for completion, sources of fund and manpower, variation in prices of materials, existing rules and regulations, additional work from the client, client's inability to pay contractor's / supplier's interim certificates, inadequate funds for payment and unusual weather condition as the guiding factors contributing to cost overrun. Correction of work was identified as the common major factor affecting cost overrun by the client and the contractor.

Final reports collected and studied for forty numbers of government funded construction projects constructed between 2000 and 2008 by [Al-Hazim et al. \(2017\)](#) [Olawale and Sun \(2010\)](#) in order to find the factors responsible for time, cost and resource overrun in Amman of Jordan. The most influencing factors for time and cost overrun were determined as features of land condition, meteorological state at the site vicinity, additional orders for modification, non-availability of labor, lapses in the design and underestimation of project cost during budget allocation.

A study conducted for determining the responsible factors contributing to the cost overrun for the projects related to roadworks in Egypt by [Ammar et al. \(2022\)](#) [Andrić et al. \(2019\)](#) revealed that wrong assumptions in formulating less cost/budget at first hand, discrepancies in the design, changes in the design, addition or modification of quantities, addition or modification of items after the start of the work by the client, undue involvement from politicians for design modification, changes in prices of material and labor, modifications in the specifications and addition or modification of the previously defined job were the responsible factors for additional cost beyond planned budget.

[Ahmad et al. \(2018\)](#), [Heravi and Mohammadian \(2017\)](#) researched on determining the distinctive characteristics of projects, related to road construction, that contribute to the cost extension through the study of various related literatures. It was found that road projects are liable to go beyond the planned cost (as extremely as 100%) to a great extent and the reasons of cost overruns differ for all road projects due to its uniqueness such as delays and thus cost going beyond the planned cost are inevitable on rainy seasons, effect of the terrain / area on which it is constructed. It was also found that road projects similar in terms of length and quality may have distinguishable construction cost with different degrees of encountering adverse events.

#### **4.3. TIMELY COMPLETION OF PROJECTS FROM REGIONAL COUNTRIES PERSPECTIVES**

Research undertaken by [Niazi and Painting \(2017\)](#), [Susanti and Nurdiana \(2020\)](#) to study the main factors responsible for construction cost overruns that accounted for low quality of project achievement in Afghanistan. The main factors assessed were contractor's insufficient cash flow, late payment of accomplished work to contractors, condition of safety threat, addition or modification of quantities, addition, or modification of items after the start of the work by the client and escalation of material and labor cost.

A study was conducted to identify the measures to minimize the effect of time overrun and to formulate an ideal categorization of process from 96 questionnaires received from persons involved in the field of construction in Pakistan. The researcher established two types of time overrun namely excusable and non-excusable. The study described time taken for preparing working / shop drawings and samples of material, lack of proper communication among stake holders, more time taken for giving approval by the client and interruption of construction as non-excusable delays which was caused by the owner and contractor gets time extension. On the other hand, inferno, expected alteration of environment, movement of air and falling of snow were categorized as excusable non-compensable delay which accounts for no one's fault in which contractor gets time extension. Similarly, adoption of non-professional method of construction and management, managing the site inferiorly and inadequate monitoring, lack of proper communication by the contractors with other concerned groups, subcontractor's inability to perform the work in time, often modification of design after the start of the work and improper preparation of course of action and it's time as excusable compensable delay which rules contractor to pay compensation in the form of liquidated damages [Akhund et al. \(2017\)](#), [Al-Hazim et al. \(2017\)](#).

[Vaghela et al. \(2021\)](#), [Ammar et al. \(2022\)](#) determined, through collection of data from articles, research papers and interview with field experts, the factors responsible for extension of duration beyond planned in India as unavailability of experienced site workforce, managing the site inferiorly and inadequate monitoring, poor interaction among stake holders, late payment of accomplished work to contractors, client's and contractor's insufficient cash flow, late allocation of construction site to contractor, adoption of non-professional method of construction and management and unavailability of experienced site workforce from the side of contractor and unfavorable meteorological state.

Research led by [Mansur et al. \(2019\)](#), [Ahmad et al. \(2018\)](#) on the reasons for price going beyond the budget at completion in Chinese construction sector through two sets of questionnaires, first being intended for establishing seriousness of

influence for each part of cost and second for establishing apportionments of each part of cost and the important ten reasons found out that site worker's inefficiency to perform the work in time, inappropriate schedule of plan, unavailability of experienced site workforce, insufficient number of experienced manpower at project location and lack of proper communication among workforce were among the factors related to labor. Likewise, price hike of materials, debated good worth of material, managing the site inferiorly and inadequate monitoring, insufficient construction materials at project location, problems related to the material supply by few limited suppliers were the factors related to material. Similarly, factors related to equipment were elevated price of equipment, doing the work again due to construction error, unavailability of experience and qualified equipment operators and failure of equipment. In addition, Insufficient fund and cash flow, improper administration of fund, lack of proper communication and information sharing among related sub-contractors falls under the category of sub-contractor related factors. In short, the result of investigation shows elevated price of equipment and inefficient administration of fund contributes the most for cost overrun in China.

Research led by [Pokhrel et al. \(2021\)](#), [Niazi and Painting \(2017\)](#) focused on determining a mathematical relationship between cost and time on the basis of information collected from projects related to 83 bridges and 78 road construction, completed in the last five years, through regression analysis as time overrun issues constitute a lot in context of Nepalese construction industry. Browmillow's model for time and cost were considered for fitting the gathered information. In addition, factors that take part in the project duration were included in the developed expression of time-cost model in the form of coefficients and it is valid for contract amount exceeding NRs. 20 million. Expression for time and cost bridge construction projects was determined as  $T = I / (I_0 * 0.64) * C_1 * C_2 * 111.018 * C_0.215$ . Similarly for road construction project it was determined as  $T = I / (I_0 * 0.64) * C_1 * C_2 * 92.482 * C_0.2159$ . where, T stands for contract duration in calendar days, I for Latest Nepal Rastra Bank (NRB) Index value,  $I_0$  for NRB index value of F/Y 2019/20 (February),  $C_1$  for coefficient for vehicle accessibility and construction environment,  $C_2$  for coefficient for complexity of work and C stands for cost of construction work in NRs. hundred thousand.

[Rekha and Sebastian \(2016\)](#), [Akhund et al. \(2017\)](#) identified, analysed, and ranked the different factors contributing to the extension of project time through the literature review, developing questionnaire and categorizing them in relation to the owner, consultant, contractor, labor, and external factors. The number of factors established from literature review were 35 and the questionnaire were dispensed to 40 firms related to construction industry. The information obtained were examined using statistical methods such as RII for determining the ranking of important factors contributing to time overrun. It was established that insufficient construction materials near the project location, time consuming process of receiving permits from authorizing agencies, escalation of material price, delay in the delivering of construction materials and late payment of accomplished work to contractors were the most important factors contributing to time overrun.

[Stojcetovic et al. \(2014\)](#), [Vaghela et al. \(2021\)](#) studied the existing concept of time, cost and quality on the basis of iron triangle, as the sides can become shorter or longer, but the triangle is unbreakable. The outcome of the study states that the general idea among project managers that iron triangle is the only way for measurement of project success, quality in projects will yield rise in clients fulfillment of need, lessening of amount of money, increment in yielding good results, greater capability of competence level. Similarly, to achieve the best quality

will have increased effect on cost and time, existing trends of minimizing time and cost overrun could lead to the drop in quality which will eventually have negative impact on the gratification of client.

[Malkanthi et al. \(2017\)](#), [Mansur et al. \(2019\)](#) studied through the information gathered from distributed questionnaires to five grades of contractors namely, C1 to C5. The collected information was examined on the basis of percentage and weighted score analysis and found out that measures of cost control, that are in repeated practices, were responsible for reduction of cost overruns by reducing over budget and indirect expenses although achieving expected profits. It also revealed necessity of regular training and wakefulness programs by the contractors to control the cost through standard defined techniques of preparing daily, weekly, and monthly sheets related to labor, material and machinery expenses.

[Dlamini and Cumberlege \(2021\)](#), [Pokhrel et al. \(2021\)](#) studied the means of controlling time and cost overrun through quantitative analysis of organized questionnaires. The study deduced that the key competencies required for mitigating cost overruns were similar to the main competency required to manage time overrun and Project Manager should have the acquired knowledge / skill to complete the project well within the budget and planned duration by properly managing the readily obtainable sum of money. Monitoring finances, planning, proper use of project budget through well-defined methods, managing the flow of cash and plan of action during construction were found to be key competency required for the mitigating cost overruns. Similarly, preparing well planned action and sequence of operation, managing the time properly, adopting well defined process of construction, giving approval as soon as possible and managing the possible risk well in time were key competency required for the mitigating time overrun. Contractor must select Project Manager with these capabilities as their previous experience would result in the timely completion of project within the planned budget.

#### **4.4. TIMELY COMPLETION OF PROJECTS FROM THE PERSPECTIVES OF NEPAL**

Different articles were reviewed regarding issues of projects timely completion of projects in Nepal. Budget is a constraint in amount and schedule in Nepal as the credit is expanding in the economy of Nepal and timing of budget is not favorable as of weather condition and seasonality effects. This condition likewise demonstrates that in future obligation trouble in monetary framework is straightforwardly lessening the advancement use which diminishes the progression of spending plan in destitution decrease areas [Mishra et al. \(2021\)](#), [Rekha and Sebastian \(2016\)](#), [Stojcetovic et al. \(2014\)](#). Procurement acts are found to be also problematic for smooth project construction as Low bidding causes ineffective construction [Mishra and Bhandari \(2018\)](#): [Mishra \(2019\)](#): [Bista and Mishra \(2019\)](#), [Malkanthi et al. \(2017\)](#) [Dlamini and Cumberlege \(2021\)](#), [Mishra and Magar \(2017\)](#), [Mishra and Bhandari \(2018\)](#). [Mishra and Magar \(2017\)](#), [Mishra and Singh \(2018\)](#) also assured the issues of implementation due to budget gap. Several causes were identified in Nepali construction assessment [Ghimire and Mishra \(2019\)](#): [Yadav and Mishra \(2019\)](#), [Mishra \(2019\)](#), [Mishra \(2019\)](#). which resulted into an empirical relation of time and cost in terms formulae also [Mishra and Aithal \(2020\)](#), [Bista and Mishra \(2019\)](#). Studies by [Sharma et al. \(2022\)](#), [Mishra \(2022\)](#) and [Mishra and Aithal \(2022\)](#) conforms the issues in depth. Zero delay projects might be possible with effective data management system with a view to avoid risk using analogy technique as of society 5.0 concept. The required components like utility reallocation seem



new concern which must be focused for further research. Material management aspects should be studied to develop a framework for timely completion of projects. Existing research in the area conducted in national context can be refereed from [Mishra and Aithal \(2020\)](#): [Mishra \(2019\)](#): [Mishra et al. \(2018\)](#): [Mishra and Bhandari \(2018\)](#).

## 5. CONCLUSION

The main causes of the untimely completion of the construction projects are yet to be specified through empirical study by considering contracts to assess the status of construction progress of projects including the consequences of utility relocation contrasting effective material management to search pragmatic solution for overcoming the issues of delay in construction project through possible framework in connection with institutional gap, rules and regulation gap, policy gap, culture gap and practice gap. The uniqueness of projects is the main cause of projects delay. We are attempting to reach at society 5.0 where machine will be molding our activities. Our needs and wants would be cared by machine through data produced and sensitized. In this regard, the uniqueness of projects should be decoded after knowing the exact distribution of data on the basis of long-term data assessment. Still, it is one area where several research are needed to convert uncertainty into risk through appropriate risk probability allocation. Archivals of projects should be systematically stored in project bank for future utilization.

## CONFLICT OF INTERESTS

None.

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