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Research Article

Assessing the Causes of Time Overrun in Building and Road Construction Projects: The Case of Addis Ababa City, Ethiopia

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In recent years, the majority of the construction projects executed in Addis Ababa city experienced a varying magnitude of time overrun in which the projects become late in their completion. Due to different problems encountered during the inception, design, and implementation phases, the projects are exposed to unexpected time overruns that in turn affect the overall performance of the projects. It is hence very essential to identify the actual causes of delay in order to minimize or avoid the corresponding adverse impacts. Therefore, this study primarily aimed at investigating and scrutinizing the potential factors causing project time overrun in the city so that the influential factors can be identified and the applicable remedial measures can possibly be forwarded. For the purpose of data collection, the study applied a semistructured questionnaire survey. The questionnaire was distributed to 121 respondents comprising practitioners and professionals actively working in the construction industry. Fifty-four delay-causing factors were identified and grouped under ten categories according to the similarity of their origin. In order to identify the most significant factors, severity analysis based on the principle of relative importance index was carried out. Accordingly, the top most significant and least significant factors were identified. The top four most influential factors identified were reluctance of consultants, inaccurate estimation of contract duration, delay in approvals and late decision making, and slow mobilization of labor whereas inadequacy of allocated funds, low motivation, and absence of incentives to contractors were the three least significant causes identified. So as to curb the adverse impact of the factors, the application of a detailed work breakdown structure, proper responsibility assignment, earned value principle, and project software were proposed as remedial measures to be implemented. The finding of the study will alarm the key players and practitioners engaging in the city's construction industry to focus on managing the severe factors.

1. Introduction

Time overrun is a situation in which projects due to some factors related to contractors, clients, consultants, and others fail to be completed in the contractual or agreed period. Time overrun is insidious often resulting in cost overrun, disputes, and complete abandonment of projects [1–3]. Construction delay occurs when the progress of a contract falls behind its scheduled program. It may be caused by any party to the contract, perhaps a direct result of one or more circumstances [4, 5]. Time performance is one of the key measures of project success [6, 7]. As some of the causes of construction delays can be controlled during the life cycle of projects, significant resource savings can be achieved by identifying and managing them well [8, 9].

The study conducted by Ashraf and Ghanim [10] indicated that construction delays result in cost overrun, dispute, arbitration, and abandonment. Patel et al. [11] also reported that approximately 70% of large construction projects experienced time overruns. The exposure of these construction projects to time delay leads to further disturbance and inconvenience in completing projects as per their plan.

Different factors that are related to the project environment, consultant, contractor, employer, budget, design, construction material, and construction equipment can

significantly affect the schedule of the projects and hence obstruct their completion within their set time frame time. Delay of construction projects due to those factors leads to the overall increase in construction cost. In fact, the realization of the present complex construction projects involves the cooperation and coordination of various parties including clients, consultants, contractors, subcontractors, and suppliers to bring a successful project which is completed on time without delay [12, 13].

Similarly, it is frequently observed that many of the construction projects in Addis Ababa city are currently facing a problem of time overrun because of known and unknown reasons. Construction delay has adverse effects on both the owner and contractor (either in the form of lost revenues or extra expenses), and it often raises the contentious issues of delay responsibility, which may result in dispute [14, 15]. More than 82.3% of the road and building construction projects executed in Addis Ababa city fall behind the contractual schedule [16]. According to the study conducted by Solomon et al. [17], the building and road construction projects executed in the city experience an average time delay of 175% and 110%, respectively.

Many studies were conducted on construction-related aspects of the country. However, the studies conducted did not sufficiently deal with and included some key factors causing time overrun of construction projects in Addis Ababa city. Besides, the studies conducted by researchers like Shambel and Dixit [18] did not address the adverse impact of some newly emerging challenges and causes of construction projects' delay as a result of rapid change in the dynamics of the city's growth in recent years.

Shambel and Dixit [18] in the study on Assessment of Time Overruns in Construction Projects in the city identified twenty-one factors causing time delay under four different groups (contractor, consultant, client, and external environment-related factors) according to their similarity in origin. However, not all factors encountered in the study domain were dealt with in the study and hence there were so many factors that remained not accessed. For instance, he did not consider the material-, labor-, equipment-, financial-, government authorities-, and social and economic-related factors despite their adverse impact on influencing projects' time performance.

Besides, the study conducted by Siraw [19] accessed only about twenty-nine factors causing project time delay, the factors were not screened according to their similarity, and hence, it was difficult to know the group-wise severity of the factors. Like the study conducted by Shambel and Dixit [18], which was carried out on construction projects in the city, the work of Siraw [19] lacked inclusiveness.

Hence, the current study aimed at identifying both the existing and newly emerging factors potentially causing time overrun of construction projects in the city. The most influential factors contributing to the stated problem are also identified and ranked based on their severity level. Lastly, applicable and feasible remedial measures are proposed so as to lessen the precarious consequences of time overrun on the overall performance of construction projects in the city.

2. Literature Review

2.1. The Ethiopian Construction Industry. The Ethiopian Construction Industry is one of the engines of the country's economy. It has significant impacts on the efficiency and productivity of various sectors. The country's construction industry is booming with the rising need for public facilities [20]. However, the practice of the construction industry faces a lot of problems from time and cost overruns. The construction projects fail to go in line with the original contract duration and contract amount due to different known and unknown factors [21]. According to the study conducted by Solomon et al. [17], infrastructure projects constructed in Ethiopia having contract amounts above 100 million Ethiopian birr are exposed to a time delay of 175% on average. Some projects even experience time overrun up to 327% which in turn has a considerable cost implication. Similarly, building projects with contract amounts ranging from 50 million to 100 million fall behind the contract period by 300%.

2.2. Causes of Project Delay. Many factors are commonly responsible for time overrun of construction projects which include underestimation of project costs, the addition of scope during later stages, and changed conditions [22]. Gajewska and Ropel [23] stated that the delay in projects is primarily caused by miscalculations and the inability to find the right contractor. In addition, Toh et al. [24], Abd-Karim et al. [25], and Aftab et al. [26] reported that requirements of clients on quality, poor design, unrealistic estimation of the contract period, lack of experience, late delivery of equipment and materials, management labor relationship, fluctuation of prices of materials, and financial difficulties and material shortage are some of the influential factors causing a delay in construction projects. The study conducted by Abd El et al. [27] revealed that financing by the contractor during construction, delays in payment, design changes, and poor contract management are the most important causes of delay in Egypt. Doli et al. [28] in the study on analysis of factors affecting delays in Indian construction projects explored the potential causes of construction delay in projects executed in India. Accordingly, seven critical factors causing time overrun were identified; these include lack of commitment, communication and clarity in project scope, inefficiency in site management, improper planning, poor site coordination, and substandard contracts.

Furthermore, Owolabi et al. [29] reported that lack of funds, changes in drawings, ineffective communication among parties, lack of adequate information from consultants, slow decision making, contractor's insolvency, variations, poor project management, construction errors, bad weather, prices fluctuation, inappropriate organizational structure, and labor strike are the potential factors contributing to time overrun in construction projects in Nigeria.

Merid [30] in the study on assessment of time and cost overrun in the construction project of defense construction enterprise in Ethiopia identified fifteen factors of time overrun which include less emphasis on planning, poor

contract management, poor per planning process, lack of timely decision, changes in design, failure to update schedule on time, slow approval of drawings, incomplete drawing, frequent breakdown of construction plants and equipment, excessive change orders, inadequate early planning of the project, setting unrealistic, contractual claim, delay in site mobilization, and rework due to wrong work.

2.3. Effects of Construction Project Delays. Time overrun is one of the serious challenges construction projects face and it is the source of many problems in the construction industry. Delay in projects results in an increase in the financial cost of projects, wastage and underutilization of human resources and materials, disagreement among contracting parties, abandonment of projects, and poor quality in completed works [4, 21]. Owolabi et al. [29] pointed out that project delay leads to adverse consequences on the construction industry and the economy at large. These include time overrun, increase in cost overrun, wastage and reduction in labor efficiency, tying down of clients' capital, dispute between parties, profit loss, litigation or arbitration, unanticipated costs, demoralizing practitioners, slow development of the construction industry, environmental and safety issues, and public dissatisfaction. Above all, it impairs economic growth and devalues the efforts of innovators and experts in the construction industry.

2.4. Description of the Case Study City. Addis Ababa is one of the cities in Africa where the construction of small and multipurpose mega projects is widely executed with the booming need of the economy. According to the data obtained from the Addis Ababa city roads authority, over the last ten years, almost 84% are behind their actual deadline. Many foreign and domestic construction companies operate in Addis Ababa on real estate projects. However, the majority of the projects face critical problems of time and overrun. Especially, the time and cost performance of the projects executed by domestic companies is seriously low [31, 32]. According to Engidawork [32], 90.6% of the real estate projects executed in the city fall behind their actual schedule in their accomplishment. The study also indicated that only 42.9% of foreign contractors and 17.9% of local contractors accomplish their projects within the planned project duration.

3. Methodology

3.1. Research Design and Approach. A research approach is a procedure implemented to collect, analyze, and interpret data. A quantitative research approach was implemented to support the method and process of data collection and analysis employed in the study. The set objective of the study also calls for a quantitative study to be carried out. The study can be categorized as a diagnostic type in its design. It is a research design in which the study primarily aims at examining the underlying causes of a certain situation[33]. It helps to find out the factors that lead to specific challenges. A diagnostic research design consists of problem inception, diagnosis of its causes, formulation of remedial measures, and recommendation for possible solutions [34]. Similarly, the factors causing time delays in road and building construction projects in the study area were identified via the distributed questionnaire survey. The applicable remedial measures and recommendations were also formulated in the current study.

3.2. Sampling Method. Both primary and secondary data were used for analysis in the study. The secondary data required as inputs for the study were the projects' design data, progress reports and payment certificates, and other analogous project records. The primary data used for the study were gathered from the key players of construction projects (owners, consultants, and contractors) actively engaging in the construction of road and building projects in the city. The purposive sampling method was hence adopted in selecting the key personnel of project consultants, contractors, and clients to respond to the questionnaire. This was because similar previously conducted studies by researchers like William [35] confirmed that more reliable and organized data could be obtained if professionals working in well-experienced and high-grade companies (client, contractors, and consultants) fill the questionnaire. It is a sampling method in which the researcher chooses the most relevant parts of the population that can provide adequate data for the required analysis without worrying about statistical issues [36]. The purposive sampling technique is a deliberate selection of participants due to the better qualities participants possess [37]. Unlike random sampling, purposive sampling deliberately includes a diverse cross section of demographies and the idea behind purposive sampling is to concentrate on people or entities with particular features who will assist better in providing the relevant information [33, 38].

In the city, there are so many construction companies actively involved in the construction activities of various projects. In the current study, however, only well-experienced professionals working in Grade I construction companies were purposely selected to fill the questionnaire. It is because individuals or groups of individuals working in high-profile companies are believed to be proficient and well informed with the subject matter. In purposive sampling, the selected samples of the population are those the researcher believes that they know well about the problem of interest [39]. Accordingly, the questionnaire was filled by the key project personnel such as project managers, site engineers, office engineers, resident engineers, assistant resident engineers, counterpart engineers, material engineers, drafts person, and quantity surveyors of the selected parties. Only one respondent from one company was selected to fill the questionnaire and the sampling process by its design is so diverse. Hence, the total number of respondents is equal to the number of construction companies contacted.

There were 52 Grade I general contractors identified by Addis Ababa City Construction Office as top-performing firms and actively taking part in the country's construction industry by the time the study was underway. Similarly, a

total of 63 grade I engineering consultants were identified as having a good track record among the many consultants registered as a member of the Ethiopian Association of Consultants and Architects. These two numbers were considered as the available population of the study from the contractor and consultant sides. The sample size was determined after calculating the number of samples required from the contractors, consultants, and clients separately, and then, the values were summed up.

The sample size of the study was determined by using the simplified Taro [40] formula considering a 95% confidence level and ±5% level of precision (equation (1)).

$$n = \frac{N}{1 + N(e)^2}, \quad (1)$$

where n is the sample size, N is the population size, and e is the level of precision.

By using equation (1), sample sizes from the contractors and consultant sides were calculated. Accordingly, the sample sizes of 47 and 54 were used from engineering contractors and consultants, respectively. Twenty owners were selected to fill the questionnaire among many owners (government sectors) who got good experience of administrating construction projects. Therefore, the total number of sample size of the study became 121. Hence, the primary data required for the study was collected via the one hundred twenty-one (121) distributed questionnaires to the same number of mentioned construction stake holders engaging in the construction industry.

3.3. Data Collection. A semistructured questionnaire survey was used for the purpose of data collection. A questionnaire survey is the most widely used technique of data collection [41]. The questionnaire containing three main parts (Part A, Part B, and Part C) was distributed to the respondents by hand. Part A asks the respondents about their background and organization's information. Similarly, Part B asks the respondents about the potential factors causing time overrun in road and building construction projects. The third part, Part C, contains a list of questions regarding the remedial measures to be taken to reduce the adverse impact of time overrun.

The data collection process was executed in two phases of the survey. In the first phase of the survey, the questionnaire which asks respondents about their general background (educational status, experience, field of specialization, and responsibility (title) in the organization) was distributed. This phase also aimed at identifying the potential factors causing time overrun in the city. Accordingly, 54 factors under ten different categories were identified via the distributed questionnaire. The factors found in the same category are those that originate from similar sources. Likewise, factors related to clients, consultants, contractors, labor, equipment, material, financial, external environment, social and economic, and government authorities were identified. During the second phase of the survey, the questionnaire containing a list of the 54 identified factors was redistributed to the respondents. The main intention of the second phase of the questionnaire was to rate the factors based on their frequency of occurrence and to investigate the remedial measures that should be taken. The background information of the respondents, work experience, educational status, and work responsibility was summarized in Tables 1–3, respectively. As indicated in Table 1, about 83% of the respondents have been working in the construction industry for more than five years. Similarly, 88% of them got a bachelor's degree and above in their educational status (Table 2).

3.4. Data Processing and Analysis. The objective of the study calls for a quantitative research design to be conducted, and the study is typically categorized as an applied type. It is applied because the study was initiated from practical problems of time overrun in construction projects. The questionnaire was distributed to different professionals working on the side of selected Grade I contractors and consultants, and clients headquartered in the city. Accordingly, the questionnaire was filled by the key personnel of construction projects like project managers, site engineers, office engineers, resident engineers, assistant resident engineers, counterpart engineers, material engineers, drafts person, and quantity surveyors. In conducting the study, 121 questionnaires were distributed, out of which 117 were returned. Hence, 96.69% of the respondents returned the questionnaire whereas 3.30% of them did not. No respondent jumped the questions by the time of filling the questionnaire, and there was no missing data at all.

Fifty-four (54) delay-causing factors were selected and identified. So as to identify the top most severe factors in each group, ranking based on the relative importance index (RII) was carried out. Accordingly, a ranking of the factors categorized under each group was carried out to indicate their degree of severity. Besides, to identify the top most influential factors causing time overrun among the selected fifty-four, an overall ranking was done based on the calculated relative importance index (RII) values. With the increase in values of the RII, the severity of the factors will also increase. The questionnaire was carefully designed from priority scaling (1 = No Significance, 2 = Slightly Significant, 3 = Moderately Significant, 4 = Very Significant, and 5 = Extremely Significant) to rate the significance of the factors. The frequency of the factors for each weight was calculated by summing up scores assigned by respondents. Therefore, the level of importance as indicated by the owners, consultants, and contractors was used to measure the relative weight of each factor.

In order to select the appropriate method of analysis, the level of measurement has to be understood. Accordingly, ordinal scales were used in this study. An ordinal scale is ranking or rating data that normally use integers in ascending or descending order [34]. The numbers assigned to the agreement or degree of influence (1, 2, 3, 4, and 5) do not indicate that the interval between scales is equal, nor do they indicate absolute quantities. They are merely numerical labels based on the Likert scale. The data entered into a computer spreadsheet program was used to analyze the data, and the relative importance index was used to rank the factors.

Table 1: Respondents' Work Experience in the industry.

Experience (years)	Frequency	Percent
Less than 5 years	20	17.09
From 5 to 10 years	24	20.51
From 10 to 15 years	33	28.20
From 15 to 20 years	22	18.80
Above 20 years	18	15.38

Table 2: Respondents' educational status.

Qualification	Frequency	Percent
Diploma	14	11.97
Bachelor's degree	47	40.17
Master's degree	49	41.88
Doctor of Philosophy	7	5.98

Table 3: Title/responsibility of the respondents in companies.

Title/Responsibility	Frequency	Percent
Project manager	29	24.78
Resident engineer	22	18.80
Site engineer	20	17.09
Office engineer	16	13.67
Counterpart engineer	19	16.23
Material engineer	6	5.13
Drafts person	2	1.70
Quantity surveyor	3	2.56

3.4.1. Severity Analysis of the Factors. The severity analysis of time overrun-causing factors was conducted by using the relative importance index (RII). Accordingly, the relative importance index for all factors under each category was calculated in order to assess the severity of the factors, and then, ranking of the factors was done based on the calculated relative importance index (RII) values. The relative importance index (RII) was calculated by using equation (2) which was adopted from Muhammad et al. [42] as RII is one of the suitably used methods to undertake ranking analysis.

$$\text{RII} = \frac{\sum_{i=1}^{5} W * X}{A * N}, \tag{2}$$

where RII is the relative importance index, and W is the weighting given to each factor by respondents and it ranges from 1 to 5. X is the frequency of the responses given for each factor. A is the highest weight in the scale (i.e., 5 in case). N is the total number of participants (respondents).

From RII results, the ranking for different factors was determined to figure out the influencing factors causing time overrun in the construction projects.

The severity analysis was undertaken by using Sigma plot software. First, the frequencies of all factors for all the numerical labels (1, 2, 3, 4, and 5) on the Likert scale were summed up. Next, the frequencies of the factors were summarized in tabular form along with the weightings given to each factor. The summation of the product of weightings and frequency of the factors was divided by the product of the highest weight on the scale (5) and the total number of respondents (117). The division of the two gives a relative importance index (equation (2)). After calculating RII for each factor, the factors were ranked based on their RII value. The factor with the largest RII value is the most influential factor causing time overrun in construction projects and vice versa.

3.5. Ethical Considerations. Regarding the research ethical approval, legal permission was obtained from Addis Ababa City Construction Office through a formally signed letter by the head of the office stating that the collected data should only be used for research purposes. The permission letter was issued by the office after painstakingly checking the validity of the prepared questionnaire. The reviewing team from the concerned unit of the stated office proved that none of the contents of the questionnaire were against the norm and ethical values of the community. In the course of data collection, the participants were contacted and well informed about the purpose and procedure of the study. The researcher (author) then sought the consent of the participants to fill out the prepared survey questionnaire. Accordingly, the required data were collected after informed consent was obtained from all participants and any information related to their identity was kept confidential for the sake of privacy. By the time of data collection, no sensitive data were assessed. Hence, it is believed that the publication of the finding of the study does not impose any negative and direct impact on specific agencies, communities, or individuals.

4. Results

4.1. The Group-Wise Ranking of the Factors. So as to identify the most challenging factors in each group, ranking based on the relative importance index was carried out. Accordingly, the rankings which indicate the degree of severity and adverse impact of the factors were presented in Figures 1–10.

4.1.1. Client-Related Factors. Figure 1 illustrated that among the seven factors classified under the client-related category, "inaccurate estimation of duration of contract period" was identified as the top most significant factor contributing to the time delay of projects with a relative importance index of 0.836 and "delay in approvals and late decision making" was the second severe factor with RII of 0.821 whereas "absence of incentives to contractors for better performance" is the least influential factor with the lowest RII value of 0.501.

4.1.2. Contractor-Related Factors. With regard to contractor-related factors, "some tendering maneuvers by contractors," "poor site management and supervision," and "inadequate contractor experience" are the top three severe factors identified with RII values of 0.749, 0.682, and 0.615, respectively. "Contractor management incompetency in planning and scheduling" was identified as the least significant factor in causing time delay in construction projects in the study area and "dispute with subcontractors and consultants" is the second less significant factor (Figure 2).

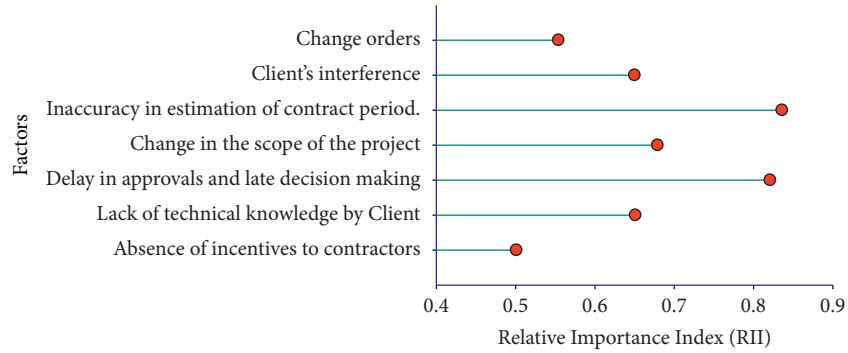

Figure 1: Ranking of client-related factors.

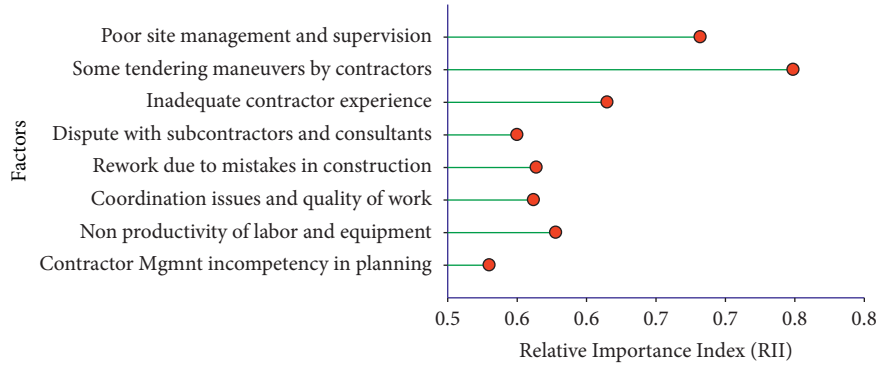

Figure 2: Ranking of contractor-related factors.

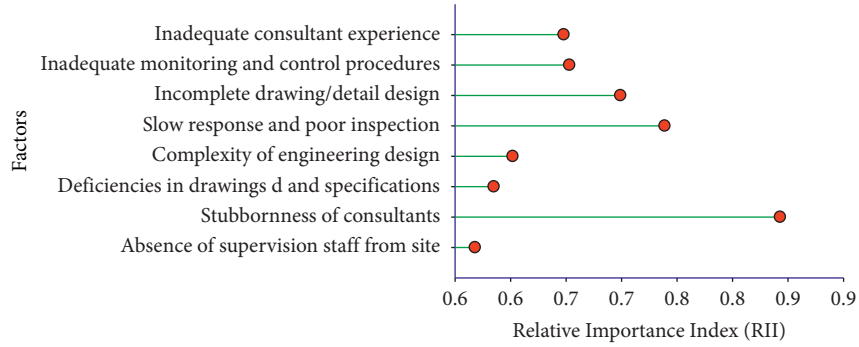

Figure 3: Ranking of consultant-related factors.

4.1.3. Consultant-Related Factors. With regard to the consultant-related factors, be perceived that reluctance of consultants is the most significant factor in affecting time overrun with the highest RII value of 0.843. "Slow response and poor inspection" is the 2nd ranked factor, while among other factors "incomplete drawing/detail design," "inadequate monitoring and control procedures," and "inadequate consultant experience" are the 3rd, 4th, and 5th ranked factors with RII values of 0.699, 0.653, and 0.648, respectively (Figure 3).

4.1.4. Material-Related Factors. Figure 4 revealed that "poor procurement of materials" was ranked first in its effect on the time overrun of projects having the highest RII value from the material-related factors. The other factors like "shortage of construction materials," "escalation of material prices," and "unreliable suppliers" were ranked as the 2nd, 3rd, and 4th influencing factors. It was then noted from the table that "the existence of unreliable suppliers" is the least significant factor identified.

4.1.5. Labor-Related Factors. Among the five selected labor-related time delay-causing factors, "slow mobilization of labor" having an RII value of 0.809 was ranked first. A wider margin is observed between the top-ranked and the least ranked factor which is "shortage of skilled labor" whose relative importance index is 0.526. This implies that the effect of "slow mobilization of labor" comparatively with "shortage of skilled labor" is very significant (Figure 5).

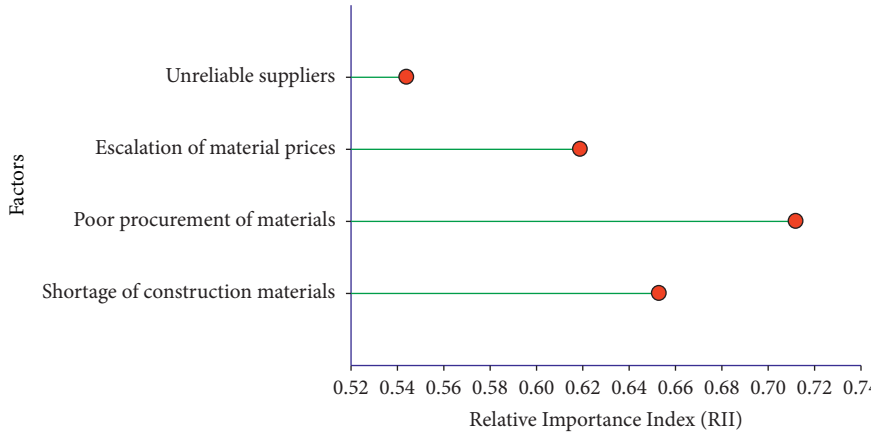

Figure 4: Ranking of material-related factors.

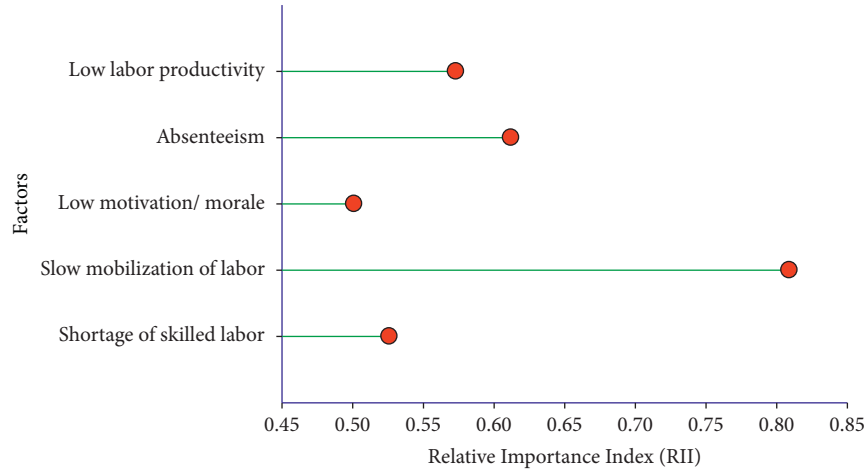

Figure 5: Ranking of labor-related factors.

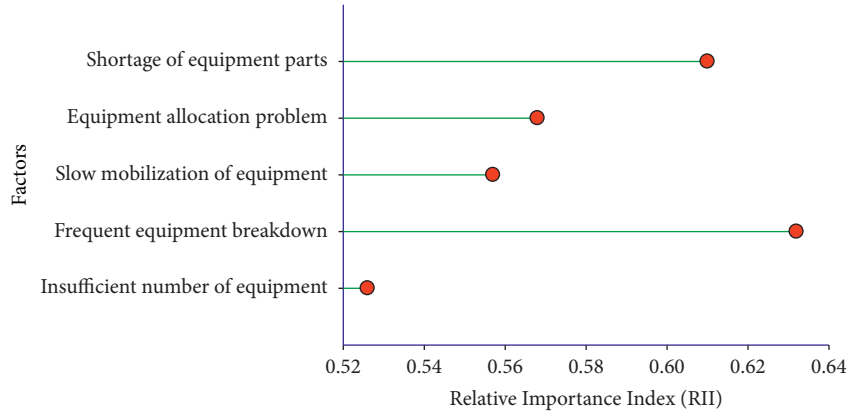

Figure 6: Ranking of equipment-related factors.

4.1.6. Equipment-Related Factors. As depicted in Figure 6, the most influential factor identified among the category of equipment related was "frequent equipment breakdown" with an RII of 0.632. Similarly, "shortage of equipment parts" and "equipment allocation problem" were the second and the third influential factors in causing time delay of projects whereas the least affecting factor from the group was "insufficient number of equipment" having the lowest RII value of 0.526.

4.1.7. Financial-Related Factors. The calculated RII values revealed that "delay in payment to supplier/subcontractor" is the most affecting factor among the factors classified under

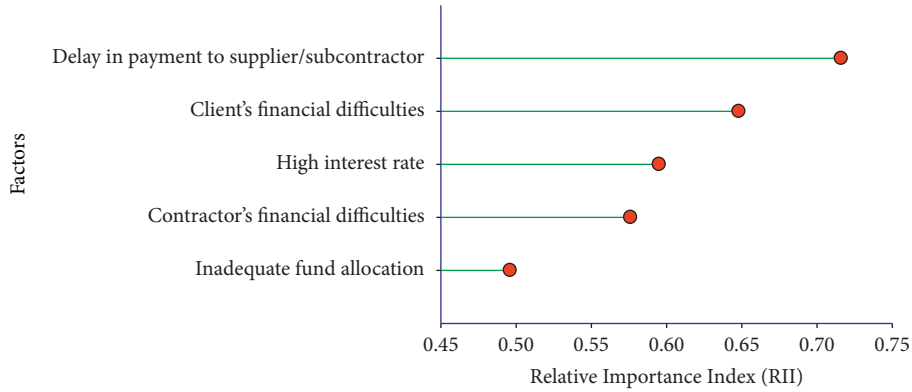

Figure 7: Ranking of financial-related factors.

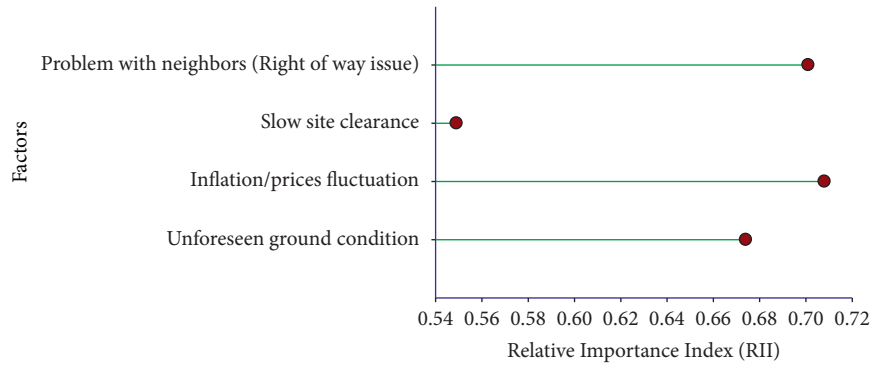

Figure 8: Ranking of external environment-related factors.

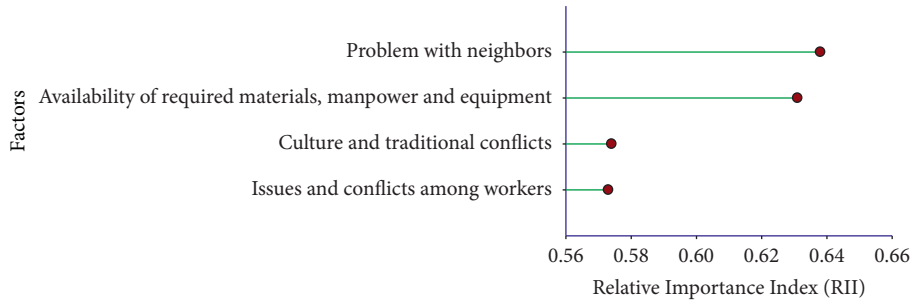

Figure 9: Ranking of external environment-related factors.

the financial-related group. "Client's financial difficulties" is the 2nd ranked factor, while among other factors "high interest rate" and "contractor's financial difficulties" were ranked 3rd and 4th, respectively, whereas "inadequate fund allocation" was known to be the least affecting factor whose RII value is 0.496 (Figure 7).

4.1.8. External Environment-Related Factors. Among the four selected external environment-related factors, "inflation/prices fluctuation" was labeled as the top most affecting factor in the category. The other factors like "problem with neighbors (Right of way issue)," "unforeseen ground condition," and "slow site clearance" were ranked second, third, and fourth, respectively (Figure 8).

4.1.9. Social and Economic-Related Factors. Figure 9 showed that the "problem with neighbors," "availability of required materials, manpower and equipment," "culture and traditional conflicts," and "issues and conflicts among workers" were ranked 1st, 2nd, 3rd, and 4th, respectively, according to the severity in their effect. It implied that "problem with neighbors" is the most affecting factor among the social and economic-related group widely encountered in the study area.

4.1.10. Government Authorities-Related Factors. With regard to government authorities-related factors, "late issuance of required permits to work by authorities," "government authorities and bureaucracy", and "delay in

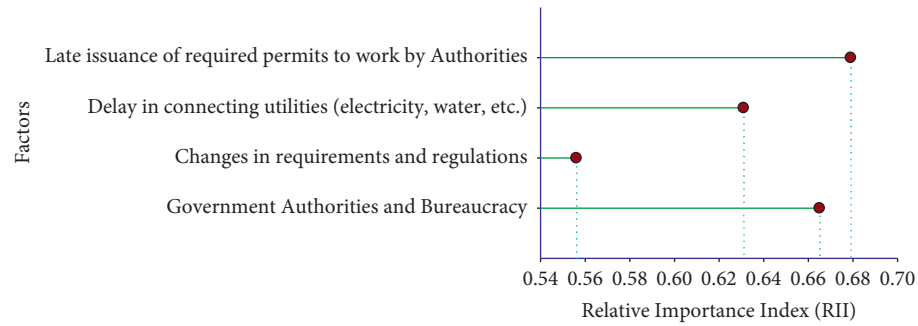

Figure 10: Ranking of Government authorities-related factors.

connecting utilities (electricity, water, etc.)" are the top three severe factors with higher RII value of 0.679, 0.665, and 0.631, respectively, whereas "changes in requirements and regulations" is the factor with the least significance (Figure 10).

4.2. Overall Ranking of the Factors. After ranking the factors in their related category, the overall ranking was carried out in order to identify the top most severe factors contributing to the time overrun of construction projects. Accordingly, a total of fifty-four time overrun-causing factors were ranked in a falling order based on their calculated relative importance index values as depicted in Table 4.

4.3. Reliability Analysis. In order to examine the reliability of the factors, a numerical test was carried out for Cronbach's alpha ($C\alpha$) on each group of factors to indicate their level of integration. The values of Cronbach's alpha should apparently fall between 0 and 1. The lower the value is, the lower its internal consistency would be. It implies that the lower values reveal lower internal consistency whereas larger values represent a greater internal consistency level.

The criterion presented by Jum [43] was considered to rate the reliability of the group of factors and evaluate the results of the analysis. According to the interpretation given by Jum [43], alpha values greater than 0.8 ($C\alpha > 0.8$) are labeled as excellent. For the alpha values falling between 0.7 and 0.8 ($0.8 > C\alpha > 0.7$), the reliability rate is considered as good and satisfactory for the values falling between 0.7 and 0.5 ($0.7 > C\alpha > 0.5$). Lastly, if the calculated alpha value remains below 0.5, the resulting internal reliability is rated as poor. The results of Cronbach alpha for each group of factors were summarized in Table 5.

4.4. The Remedial Measures to be Taken. The proposed remedial actions to be applied to the construction projects carried out in the study area were presented from two perspectives. The first perspective is from the respondents' recommendations viewpoint and the second one is from the analysis result of the study. Respondents were asked if there are any remedial measures and precautionary actions taken so as improve the time performance of construction projects in the city. Accordingly, the responses given indicated that there were no outstandingly taken precautionary actions so as to curb the occurrence and the effect of the project's time delay. No respondent witnessed the application and even the existence of the fundamental and extraordinary measures taken on projects away from the conventionally adapted practices like simple and rough scheduling.

Among the total of one hundred seventeen respondents who returned the questionnaire, only forty of them answered the questions related to the remedial measure. The forty respondents gave an answer to the question of what remedial action has to be taken for the projects constructed in the study area in the coming future so as to reduce the occurrence and adverse impact of projects time overrun. Accordingly, the respondents pointed out four different remedial measures and precautionary actions that should primarily and properly be applied by the contracting parties and the concerned project stakeholders. Ninety percent (90%) of the respondents who gave answers to questions related to remedial action were those who were highly responsible and worked at top project positions having many years of work experiences of above fifteen years. Hence, their responses seem to be sounding enough in recommending the way forward of the projects executed in the study area from the positions held and their experience view point.

The first proposed remedial measure was the proper application and use of "detail work breakdown structure." It is a detailed and clear hierarchical decomposition of the total scope of project works to be carried out by the project team to attain the needed project goal [44]. Work breakdown structure is a visually desired, simple, and powerful project management tool used in defining and tracking project deliverables [45]. The absence of detail of work breakdown with a well-defined time frame and chain of command highly disturbed the workflow and activity precedence, hence unconditionally resulting in the time delay in many projects [46]. Accordingly, 33.33% of the respondents believe that using a detailed work breakdown structure can reduce the occurrence of project time delay if effectively applied.

Similarly, the second remedial measure proposed was "proper responsibility assignment." The Responsibility Assignment Matrix (Accountability Matrix) precisely defines the responsibility of each project staff and details of

Table 4: The overall ranking of the factors.

SN	Influencing factors	RII	Rank	Group/Category
1	Reluctance of consultants	0.843	1	Consultant related
2	Inaccurate estimation of contract period	0.836	2	Client related
3	Delay in approvals and late decision making	0.821	3	Client related
4	Slow mobilization of labor	0.809	4	Labor related
5	Some tendering maneuvers by contractors	0.749	5	Contractor related
6	Slow response and poor inspection	0.739	6	Consultant related
7	Delay in payment to supplier/subcontractor	0.716	7	Financial related
8	Inflation/prices fluctuation	0.708	8	External Env't related
9	Poor procurement of materials	0.703	9	Material related
10	Problem with neighbors (right of way issue)	0.701	10	External Env't related
11	Incomplete drawing/detail design	0.699	11	Consultant related
12	Poor site management and supervision	0.682	12	Contractor related
13	Change in the scope of the project	0.679	13	Client related
14	Late issuance of required permits to work	0.679	13	Gov't authorities related
15	Unforeseen ground condition	0.674	14	External Env't related
16	Government authorities and bureaucracy	0.665	15	Gov't authorities related
17	Inadequate monitoring and control procedures	0.653	16	Consultant related
18	Shortage of construction materials	0.653	16	Material related
19	Lack of technical knowledge by client	0.651	17	Client related
20	Client's interference	0.650	28	Client related
21	Inadequate consultant experience	0.648	19	Consultant related
22	Client's financial difficulties	0.648	19	Financial related
23	Problem with neighbors	0.638	20	Social and economic related
24	Frequent equipment breakdown	0.632	21	Equipment related
25	Availability of required materials, manpower	0.631	22	Social and economic related
26	Delay in connecting utilities	0.631	22	Gov't authorities related
27	Escalation of material prices	0.619	23	Material related
28	Inadequate contractor experience	0.615	24	Contractor related
29	Absenteeism	0.612	25	Labor related
30	Shortage of equipment parts	0.610	26	Equipment related
31	Complexity of engineering design	0.602	27	Consultant related
32	High interest rate	0.595	28	Financial related
33	Deficiencies in drawings and specifications	0.585	29	Consultant related
34	Nonproductivity of labor and equipment	0.578	30	Contractor related
35	Contractor's financial difficulties	0.576	31	Financial related
36	Culture and traditional conflicts	0.574	32	Social and economic related
37	Low labor productivity	0.573	33	Labor related
38	Issues and conflicts among workers	0.573	33	Social and economic related
39	Absence of supervision staff from the site	0.568	34	Consultant related
40	Equipment allocation problem	0.568	34	Equipment related
41	Rework due to mistakes in construction	0.564	35	Contractor related
42	Coordination issues and quality of work	0.562	36	Contractor related
43	Slow mobilization of equipment	0.557	37	Equipment related
44	Changes in requirements and regulations	0.556	38	Gov't authorities related
45	Change orders	0.554	39	Client related
46	Dispute of subcontractors and consultants	0.550	40	Contractor related
47	Slow site clearance	0.549	41	External Env't related
48	Unreliable suppliers	0.544	42	Material related
49	Contractor management incompetency	0.530	43	Contractor related
50	Shortage of skilled labor	0.526	44	Labor related
51	Insufficient number of equipment	0.526	44	Equipment related
52	No incentives to contractors	0.501	45	Client related
53	Low motivation/morale	0.501	45	Labor related
54	Inadequate fund allocation	0.496	46	Financial related

deliverables required at different milestones. It also assists in clarifying the line of communication between various project units so that the information gap can be minimized [47]. The essay type of responses obtained from the respondents revealed that there were no clear responsibility assignments among professionals of the project team on almost all of the projects which made some activities completely dependent on the presence and absence of some individuals. As a result, there was some sort of interference of individuals (workers) just outside the boundary line of

Table 5: Reliability analysis

SN	Group of factors	Cronbach alpha	Reliability rate
1	Consultant related	0.876	Excellent
2	Client related	0.805	Excellent
3	Labor related	0.659	Satisfactory
4	Contractor related	0.814	Excellent
5	Financial related	0.618	Satisfactory
6	External environmental related	0.629	Satisfactory
7	Material related	0.708	Good
8	Equipment related	0.606	Satisfactory
9	Gov't authorities related	0.724	Good
10	Social and economic related	0.712	Good
	Cumulative of all groups	**0.741**	**Good**

their responsibility in the absence of a clear line of responsibility and accountability. So as to curb this problem, it will be better provided that the responsibility assignment matrix is effectively used on construction projects executed in the city because the responsibility matrix clearly defines the role and responsibility limit of each project team in completing project deliverables.

The third proposed measure was "using project software for scheduling and planning." The use of project scheduling tools and software like MS Project and Primavera makes the overall scheduling of projects effective [48]. Proper usage of project software makes the timing and allocation of resources easy and fast (suitable to control and avoid the over or under allocation of resources) [49]. The responses given at the time of the survey revealed that the stated project scheduling software was not even used for scheduling some projects. Accordingly, 86.66% of the respondents proposed effective usage of project software and tools for scheduling and tracking progress. Besides, the respondents believe that the effective use of project software for scheduling can significantly play a role in reducing time delay and hence improving the time-related performance of projects.

Similarly, the fourth measure proposed was the "application of earned value principle" for project management purposes. Earned value is an effective technique for providing necessary information on the performance of projects, and it gives timely information related to the actual progress of projects [50]. Earned Value Management integrates the three key elements of a project (schedule, scope, and cost) to assess project progress and performance [41, 51]. The project vital information like schedule variance and schedule performance index is accurately obtained from earned value; hence, it enables project managers and stakeholders to make timely decisions based on the actual performance of projects [52]. In relation to this, 87.77% of the respondents considered and proposed the use of earned value principle as an effective tool and mechanism for controlling project performance.

4.5. Discussion of the Results. The majority of the top-ranked factors summarized in Table 4 frequently appeared in plenty of previously conducted studies. Among the top ten significant factors, almost all of them were similarly identified by researchers as root causes of project delay [17, 20, 21, 30]. The finding of the study revealed that the first most critical and important cause of time delay among the total of 54 factors was the reluctance of consultants which is from the consultant-related category. This type of cause is strong enough to make long delays in any construction project. Even though not ranked first, it is evident in various studies that the reluctance of consultants is one of the significant factors known [29].

Inaccurate estimation of duration of contract period is the second ranked factor while delay in approvals and late decision making is the third ranked cause that is from the same category as the first ranked factor. This implies that two out of the top ten critical factors belong to the client-related category. Slow mobilization of labor was the fourth most severe and most frequently encountered factor in projects in the study area.

Reference [30] reported that unrealistic estimation of contract period and delay in approvals disturb the work schedule and sequence of project activities resulting in unexpected time overrun which may sometimes extend beyond the initial contract duration. Likewise, tendering maneuvers by contractors, such as front-loading of rates, ranked fifth based on the calculated relative importance index value. Unlike other factors, this factor typically appeared influential in construction projects executed in Ethiopia [18, 19]. Tendering maneuvers by contractors is the most common contractor-related factor causing project delays in Ethiopia and in the city [21, 32]. It is the case in which contractors during the procurement process overload the rates of some items in the bill of quantity, and the overloaded items are those according to the terms of reference planned to be accomplished during the initial phases of the project duration [18]. The contractors after paying for the executed front-loaded activities fail to committedly accomplish the remaining project activities having low weight. They rather search for another project and mobilize their resources fully or partially on the new projects [17, 53].

Slow response and poor inspection was the sixth critical factor affecting the timing of projects with an RII of 0.739. Slow response and poor inspection emanated from the carelessness and incompetence of consultants to manage and supervise the project activities. Further, it was reported that delay in payment to supplier/subcontractor (relative importance index of 0.716) and inflation/prices fluctuation (relative importance index of 0.708) were ranked seventh and eighth, respectively. Similarly, poor procurement of materials (RII of 0.703) and the problem with neighbors (Right of way issue) (RII of 0.701) were identified to be the ninth and the tenth influential factors causing time delays in projects.

In this study, the least insignificant factors were also identified. Based on the calculated relative importance index, the ten least influential factors were identified. Contrarily, some factors categorized as least significant in the current study were reported as the common challenges in many existing studies. These factors have low significance in affecting the time performance of the construction projects in

the study area. These factors are those found in the bottom rows of Table 4. Accordingly, the top most insignificant factor identified was "inadequate fund allocation" with an RII of 0.496 (the lowest value). According to the finding of the study, this factor is not frequently encountered in the selected study area, and hence, it was considered the least significant one among the fifty-four identified factors. However, in many studies conducted in other countries, it is one of the widely known delay-causing factors. In relation to this, Abd El et al. [27] reported that "inadequate fund allocation" is one of the most common challenges of construction projects in Egypt. Similarly, the adverse impact of the stated factor is so precarious in the construction of Nigeria [29]. Furthermore, "low motivation/morale," "no incentives to contractors for better performance," "insufficient number of equipment," "shortage of skilled labor," "contractor management incompetency in planning and scheduling," "unreliable suppliers," "slow site clearance," "dispute of with subcontractors and consultants," and "change orders" were ranked from second to tenth according to their of insignificance. Like "inadequate fund allocation," "change orders" is also the commonly known factor for its influential impact as documented in literature such as [30]. In the current study, however, it was one of the insignificant factors in causing time overrun in the study area.

As indicated in Table 4, the top ten most critical causes that impact the time of the projects arise from consultant-, client-, external environmental-, contractor-, material-, labor-, and financial-related categories. Accordingly, the first and sixth ranked factors are from the consultant-related category whereas the second and third ranked factors are from the client-related category. Similarly, both the eighth and tenth critical factors belong to the external environment-related group. Generally, the consultant-, client-, and external environment-related groups contributed two factors each to the top ten critical causes whereas contractor-, material-, labor-, and financial-related categories contributed one factor each.

5. Conclusions

The number of factors causing time overrun in the study area is not limited to those stated in the previously conducted studies. Even though their order of ranking varies, the identified top seven influential factors repeatedly appeared in the findings of many studies previously conducted. Some factors which even have not been mentioned as potential agents causing project delay in the previous studies appeared to be influential in the current study. In relation to this, the top three influential factors identified in the current study were rated as the influential factors in none of the studies conducted in the city within the last ten years. This implies that the dynamics of the factors' nature and influence change over time due to technological advancements and the emergence of new factors. It can hence be inferred that the significance and impact of the studies conducted on the subject matter do not seem long-lasting. Hence, similar studies have to be continuously conducted on regular basis. To effectively control the probable occurrence of the incident and its adverse impact, four remedial measures were proposed. It was observed that there was no good culture of properly implementing the proposed measures or any other visible precautionary measures in construction projects to lessen the occurrence of time overrun. The measures identified to be taken are proper responsibility assignment, application of earned value principle for controlling project performances, using detailed work breakdown structure, and using project software for effective scheduling and tracking of project performance. The careful application of these measures significantly mitigates the time performance of the projects.

Based on the finding of the study, the following recommendations were made.

(i) The practitioners and key players of the industry have to give due attention to the top ranked factors as their effect is more significant than the others. The construction stakeholders need to carefully and flexibly manage the factors during the design, implementation, and monitoring phase of projects for the purpose of minimizing both the occurrence and the resulting adverse impacts of the factors.

(ii) Since the dynamics and number of the factors change from time to time, it is recommended that further studies on similar case studies are conducted in the future.

Data Availability

All data used to support the finding of the study were included in the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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