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# Correlation Between Potential Strategies to Minimize Road Construction Delay in Tanzania

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**ABSTRACT:** The construction sector, one of the fastest-growing and globally recognized sectors, significantly contributes to the development of other numerous sectors of the economy including in multiple nations including Tanzania. Despite its importance, the industry has repeatedly been tremendously overwhelmed with countless challenges, including the inability to finish construction projects within a given schedule. Hence, the objective of this paper was to evaluate the potential strategies and examine the correlation between strategies as a measure to reduce construction project delays in Tanzania using appropriate standard procedure. The study adopted the questionnaire tool and the survey interview to collect the respondent's opinion from 208 respondents, including contractors (59.13%), clients (15.87%), suppliers (12.98%) and consultants (10.10%) obtained through stratified sampling. The relative importance index (RII) of the data was computed using a Statistical Package for Social Science (SPSS 24) software tool to obtain the descriptive information and inferential statistics. The findings have revealed seven potential strategies for reducing construction project delays. However, the finding has determined and recognized a positively significant correlation between strategies towards minimizing the construction project delays. The strategies were categorized in six clusters, namely effective project management, procurement and supply; resource adequacy, monetary or financial, design or technical, information and communication, as well as external strategies.

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The construction industry is a crucial sector for a nation's development, with many developing nations investing heavily in infrastructure development. It contributes to sustainable growth and shared benefits, but it is facing challenges such as construction project delay (CPD) during project execution (Suphian, 2009). The construction sector has been noted to stimulate various sectors of the economy by providing shelters, modern and efficient transport, and communication infrastructure. It offers an adequate level of physical infrastructure needed to cope with the requirements of the vision in all sectors. It stimulates and provides employment that eventually boosts the domestic consumption (Giang; Sui-Pheng, , 2011) Additionally, the sector facilitates the acceleration and promotion of income distribution and hence poverty minimization (Anugwo *et al.*, 2018). Moreover, the sector has been critically

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viewed as facilitating urbanization and industrial development; it brings advancement of civilization as well as raising of the Gross Domestic Product (GDP) and easing the raising of living standards (Tunji-Olayeni *et al.*, 2017). However, the construction industry faces numerous problems, including CPD, which have negatively impacted its image and led to the implementation of various measures. Delays in construction project is defined as the incapability of attaining the schedule goals causing increased cost, interruption of work, loss of productivity, being behind schedule; leading to disputes, third-party claims, termination of contracts and dissatisfaction of the primary stakeholders (Gündüz et al., 2013). Delays exists in various types such as excusable that are caused by the reasonably unforeseen conditions that are not within the contractor's control such as labor strikes, most natural disasters (fires, floods, earthquakes), errors in the plans and design docs, differing site conditions, lack of action by oversight bodies to mention a few; non-excusable delays exemplified to the inefficiency of contractor to manage the construction site, the contractor's financial muscle, labor lack, failure to supervise and manage the work as per contract schedule and failure to meet owner's specification. These non-excusable delays are believed to be within owners or contractor's control and is fully responsible for the activity delays (Danish; Khursheed, 2019).

Literatures have documented various effects of delays including a construction cost escalation, increased construction project resources, a source of claim and disputes among project participants, arbitration or litigation, delayed payments and cash flow problems, construction project time extension, greatly reduced contractor's profit, reduced or productivity losses, mistrust among project participants, poor quality of work, difficult to advance the contractor's business market value, destructive and reduced firms reputation and eventually abandonment of the projects (Danish; Khursheed, 2019). To mitigate road construction delays, attention is paid to various efforts and strategies imposed on-site and off-site throughout the whole construction project life cycle. Numerous strategies have been itemized to lessen CPD including engaging competent, experienced and capable contractors, consultants and suppliers, early identifying and assessment of risks, appropriate and effective construction planning beginning from project commencement, design phases to execution, mapping and timely availability of quality resources, adoption and application of the knowledge and experience gained from preceding projects and accurately established user and client requirement to mention a few (Abdu-Saeed, 2009). Additional strategies to reduce CPD embraces a collaborative working between the design and construction teams throughout the construction project lifecycle, undertaking regular site meetings to recognize and discuss various challenges facing the project and the plans to mitigate them together with adoption of interactive planning and scheduling which entails an integrated program that defines the project key milestones, constraints and identifies the major issues observed to affect the project (Hasan *et al.*, 2014). Moreover, two latent strategies includes adoption of new technologies such as Business Information Modeling (BIM) and embracing construction project management training to project participants to support rising skills, knowledge and competence for recognizing the challenges facing the project and finding the instantaneous resolution for the challenges (Rivera *et al.*, 2020). Furthermore, developing the detailed project execution schedule, the contractor's accurately computation of the actual project cost before construction initiation to avoid payment delay for project participants. Also, use of current technology, absence or less bureaucracy, establish a clear information and communication channels, establish a comprehensive contract documentation, enforcing liquidated damage clauses, offer an incentives for timely completion (Fashina *et al.*, 2020), guaranteeing timely, effective and well-organized procurement systems for the required resources as well as allocating adequate and appropriate funds to subsidize an increased cost caused by several features for example inflation of material (Saiful-Islam; Trigunarsyah, 2017).

Despite of various strategies imposed the effects of delays still persist that have upraised and compelled the necessity for the research. Hence, the objective of this paper was to evaluate the potential strategies and examine the correlation between strategies as a measure to reduce construction project delays in Tanzania.

## MATERIALS AND METHODS

*Questionnaire design.* A questionnaire tool contained two main parts namely respondents' characteristics information and the construction project strategies to minimize construction delays. The Relative Importance Index (RII) method was used to indicate the order of important contribution of strategies and hence ranking them. To translate the findings easily, the continuous average rating of the proposed ordinal values on a five-point Likert scale with following point values was used: (0.0 to ≤1.5 Represent Strongly Agree); (1.51 to ≤2.5 represent Agree); (2.51 to ≤3.5 represent Moderate); (3.51 to ≤4.5

represent Disagree) and (4.51≤5 represent Strongly Disagree).

*Analysis methods.* The collected data were scrutinized, coded, edited and descriptively analyzed to check for a construct validity and reliability using SPSS 24 and AMOS statistical software. The construct validity was performed to measure the extent to which all items on a 5-Likely-Likert scale measure the same construct. Data reliability was examined to test the internal reliability of the 5-point Likert scale. The scrutiny envisioned to test if the questionnaire tool provides equivalent results when tested at different Moreover, the mean was computed using the relativie importance index (RII) as of equation 1. Further, SPSS-AMOS was used to perform the Confirmatory Factor Analysis (CFA) that facilitated to test for a convergent and discriminant validity. However, a structural Equation Modelling (SEM) was drawn and used to indicate the correlation between strategies in reducing the construction project delays.

$$RII = \frac{\Sigma W}{A} * N \qquad (0 \leq RII \leq 1) \quad (1)$$

Where: RII = relative importance index; W = Is the weight given to each factor by the respondents and ranges from 1 to 5 (where "1" is "strongly disagree" and "5" is "strongly agree"); A = Is the highest weight (i.e., 5 in this case); N = Is the total number of respondents.

*Data collection.* A structured questionnaire tool was disseminated and an interview conducted from October 2023 to February 2024 to capture all necessary information as respondent's opinions for the study within the selected case study areas. Before data collection, the pre-test for the prepared questionnaire was conducted using twenty-five (25) registered professionals randomly sampled while considering to have attained more than five years of working experience to test for errors, mistakes, blunders, incorrect, unnecessary and confusing wordy that could confuse the respondents. The evaluation and rating part inserted at the end of the questionnaire enabled the findings of the pre-test that made a review for the questionnaire and gave a clear, comprehensive, and elaborative questionnaire before it is distributed for data collection.

A total of 297 project employees/respondents from class one-three firms considering their working experience in more than five projects (completed and on-going) were purposively sampled for a questionnaire distribution through physical, emails and mobile phone ready for administering and interview. During respondent's selection, one hundred thirty-seven (137) professionals were given the top priority. Over 297 questionnaires distributed, 217 equivalents to 73.06% were returned. After examination, 208 questionnaires equals to 70.03% were considered for data analysis. Lately, Taro Yamane's formula (Equation 2) was used to compute the minimum sample size for the study. It is north worth to not that during computation, the margin of error (e=5%) and the confidence level (95%) were considered (Taherdoost, 2017)

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

Where: (*n)* stands for the sample size; (*N)* represent the total number of populations.

*Questionnaire design.* A structured questionnaire tool divided into four parts was administered to registered professionals to collect an opinion for the study. Section one intended to obtain the respondent's demographic or characteristics information. While section two and three anticipated to collect the views on the causes and factors for construction project delays respectively. Section four was focused to identify the potentials of best practice measures to be used as strategies for reducing the construction project delays. Moreover, a 5-Likert scale ranging from (1= Strongly not influential /Disagree/Not Important to 5= Very strongly influential/very strongly agree/very Important/) were adopted to designate the numerical ranks only. However, it does not represent the absolute quantities nor equality interval between them. A continuous average rating with proposed ordinal values helped to precisely translate the opinion results of respondents as follows: (1 to ≤ 1.8 represented Strongly Disagree); (1.81 to ≤2.6 represented Disagree; [2.61 to ≤3.4 described Moderate; (3.41 to ≤4.2 represented Agree) and (4.21≤5 expressed Strongly Agree) (Ye;Tekka, 2020).

*Data analysis methods.* The collected questionnaire tool was checked for clarity, edited, coded, descriptively analyzed, and checked for a construct validity and reliability. Using statistical Package for Social science (SPSS 24) and AMOS statistical software the construct validity and data reliability were computed. While the construct reliability aimed to measure how accurately the tool measures the same construct, the reliability facilitated to measure the consistent of the method in a 5-point Likert scale and check whether the questionnaire tool provides equivalent outcomes at different sets of tests.

Moreover, the statistical Package for Social science SPSS was used to perform the confirmatory factor analysis (CFA) whose result facilitated to test for a convergent and discriminant validity and develop the structural model using SPSS-AMOS showing the correlation between strategies to facilitate construction project delay.

## RESULTS AND DISCUSSION

*Respondent's Demographic Information.* The respondents' demographic information was presented in (Table 3) below. Respondents of this study composed various educational level such as diploma (11.1%), majority are bachelor degree graduate (54.8%), master's holder (30.8%) and minority were PhD holder (3.4%). Additionally, the respondent's demographic information inhabits the qualified and skilled professionals who have worked for more than ten experienced years comprising ranging from 11-20 years (24.5%), 12-30 years (32.2%), 31-40 years (15.4%) to beyond 40 years (9.1%). Professionally, majority of respondents were engineers (54.3%), surveyors (17.3%), Quantity surveyors (14.9%), and architects (8.2%) whose expert are directly involved in road construction projects. Moreover, the study stakeholder's category comprised participants including contractors (59.13%), clients (15.87%), Supplier (12.98%) and consultant (10.10%) participated in the study to provide their views related to the study. Furthermore, respondents comprised senior experienced leaders such as Directors and General Managers (23.1%), Project Managers (33.4%), Section managers (26.2%) and foremen/supervisor (17.3%). The study participant's qualification has justified that the respondents whose opinion facilitated the findings of the study were professionals, had better education level, with enough experience and highest position in the industry and thus has provided esteemed answers for the study based on their daily best practice. Generally, the analysis of demographic characteristics (table 1) has demonstrated the presence of experienced, skilled, and knowledgeable respondents from small and medium local construction firms registered in the first-class level who have implied to provide reliable information for the study.

**Table 1:** Respondent's Characteristics

| Item | Description | Frequency | Response (%) |
|---|---|---|---|
| Education Level | Diploma | 23 | 11.1 |
| | Degree | 114 | 54.8 |
| | Masters | 64 | 30.8 |
| | PhD | 7 | 3.4 |
| Working Experience (Years) | < 10 | 39 | 18.8 |
| | 11-20. | 51 | 24.5 |
| | 21-30 | 67 | 32.2 |
| | 31-40 | 32 | 15.4 |
| | > 40 | 19 | 9.1 |
| Profession | Engineer | 113 | 54.3 |
| | Architects | 17 | 8.2 |
| | QS | 36 | 17.3 |
| | Surveyor | 31 | 14.9 |
| | Procurement officers | 8 | 3.8 |
| | HR | 3 | 1.4 |
| Participant's Category | Clients | 33 | 15.87 |
| | Consultant | 21 | 10.1 |
| | Contractors | 123 | 59.13 |
| | Regulator | 4 | 1.92 |
| | Supplier | 27 | 12.98 |
| Leadership | Directors and GMs | 41 | 23.1 |
| | Project Managers | 51 | 33.4 |
| | Section managers | 47 | 26.2 |
| | Foremen/Supervisor | 69 | 17.3 |

**Table 2:** RII Threshold Level values

| RII Level | Range |
|---|---|
| High (H) | 0.8 < RII < 1.0 |
| High-Medium (H-M) | 0.6 < RII < 0.8 |
| Medium (M) | 0.4 < RII < 0.6 |
| Medium-Low (M-L) | 0.2 < RII < 0.4 |
| Low (L) | 0.0 < RII < 0.2 |
| High (H) | 0.8 < RII < 1.0 |

*Ranking of strategies to minimize delays.* Towards establishment of the correlation between strategies to

reduce construction project delays, it was necessary to recognize the potential strategies from the manifested one sourced from literatures as demonstrated by respondents during questionnaire administering and interview. Ranking of strategies using RII facilitated identification of 9 potential strategies (Table 2). The RII threshold value ranges from 0 to 1 with 0 not inclusive. However, it is important to note the criteria that the higher the RII value, the more important the item is and vice versa. The comparison of RII with the corresponding importance level is considered from the transformation matrix as proposed by Chen *et al.* (2010). Thus, the derived importance levels from RII are as shown in the (Table 2) below. Thus, strategies with higher RII above 0.6 only was considered potential to reduce construction project delay.

**Table 3:** Ranking of Potential Strategies to Reduce CPD

| S/N | Potential Strategies | Respondent's Frequency (N) | | | | | | | RII | Rank | Factor Cluster |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 5 | 4 | 3 | 2 | 1 | Total | ΣW | ΣW/AN | | |
| 1 | Timely payment by each part (client/contractor) | 66 | 63 | 56 | 12 | 11 | 208 | 785 | 0.755 | 7 | MF1 |
| 2 | Necessitate professionalism and experience design teams | 85 | 48 | 25 | 34 | 16 | 208 | 776 | 0.746 | 9 | D4 |
| 3 | Entails motivations and capacity building | 78 | 64 | 45 | 8 | 13 | 208 | 810 | 0.779 | 3 | PM9 |
| 4 | Adequate adoption and use of modern technology | 69 | 50 | 65 | 15 | 9 | 208 | 779 | 0.749 | 8 | R4 |
| 5 | Dictates joint venture with foreign firms | 65 | 48 | 59 | 29 | 7 | 208 | 759 | 0.73 | 11 | PM15 |
| 6 | Timely and enough fund allocation | 63 | 73 | 58 | 6 | 8 | 208 | 801 | 0.77 | 6 | MF3 |
| 7 | Timely delivery and adequate quality construction resources | 79 | 57 | 48 | 15 | 9 | 208 | 806 | 0.775 | 5 | R1 |
| 8 | Enable communication and coordination between parties | 45 | 56 | 64 | 22 | 21 | 208 | 706 | 0.679 | 45 | IC1 |
| 9 | Use of effective planning and monitoring tools/software | 68 | 59 | 29 | 25 | 27 | 208 | 740 | 0.712 | 13 | R5 |
| 10 | Timely inspection and approval of completed design drawing by consultant | 48 | 56 | 58 | 39 | 7 | 208 | 723 | 0.695 | 15 | D6 |
| 11 | Avoiding political interference | 48 | 76 | 23 | 36 | 25 | 208 | 710 | 0.683 | 16 | E3 |
| 12 | Avoid Bullwhip effects during resource ordering | 57 | 54 | 57 | 26 | 14 | 208 | 738 | 0.71 | 14 | IC3 |
| 13 | Effective management and supervision by PM and Foreman | 76 | 73 | 48 | 2 | 9 | 208 | 829 | 0.797 | 2 | PM11 |
| 14 | Strategic planning and scheduling | 59 | 73 | 32 | 27 | 17 | 208 | 754 | 0.725 | 12 | PM1 |
| 15 | Abide to good ethical practices and code of conduct | 58 | 68 | 46 | 34 | 2 | 208 | 770 | 0.74 | 10 | E1 |
| 16 | Effective procurement planning and capable supplier | 75 | 58 | 59 | 7 | 9 | 208 | 807 | 0.776 | 4 | PM14 |
| 17 | Awarding contract to competent and experienced contractor | 87 | 58 | 47 | 8 | 6 | 208 | 830 | 0.798 | 1 | PM10 |

The findings of the study have recognized seventeen potential strategies for reducing the road construction project delay. As of table 3, The first top four ranked strategies are related to management, procurement and supply (PM) category. They include awarding contract to competent and experienced contractor, effective management and supervision by project manager and foreman, motivations and capacity building for the employees as well as effective procurement planning and capable supplier to ensure adequate availability of resources at construction site. The findings of the study correlated that of Al Jashaami (2021) who recognized that the construction management and procurement knowledge is a fundamental tool every construction project towards reducing project delay (Al-Jashaami, 2021). More of the mentioned strategies in the same category include: the use of joint venture with foreign firms and Strategic planning and scheduling.

Other acknowledged potential strategies involve resource related strategies such as (timely delivery and adequate quality construction resources, adequate adoption and use of modern technology, use of

effective planning and monitoring tools/software); fund related strategies (timely and enough fund allocation and timely payment by each part (client/contractor); technical or design related strategies including (necessitate professionalism and experience design teams and timely inspection and approval of completed design drawing by consultant); information and communication related strategy (avoid bullwhip effects during resource ordering and enable communication and coordination between parties) as well as external related strategies including abiding to good ethical practices and code of conduct as well as avoiding political interference. the results found in the present study showed that there is a clear similarity between some of strategies identified in previous studies. however, two strategies have neither being mentioned in previous studies including the capable supplier and bullwhip effects (information distortion during resource ordering that the two always frustrate the construction process, procedure that led to delays.

*The correlation between strategies to minimize delays.* The structural equation modelling (SEM) was built based on literature and opted to show the model relationship between relative observed and latent variables of a construct towards reducing road construction delay. All observed variables were drawn during data manipulation and processing using SPSS-AMOS 24 (figure 1).

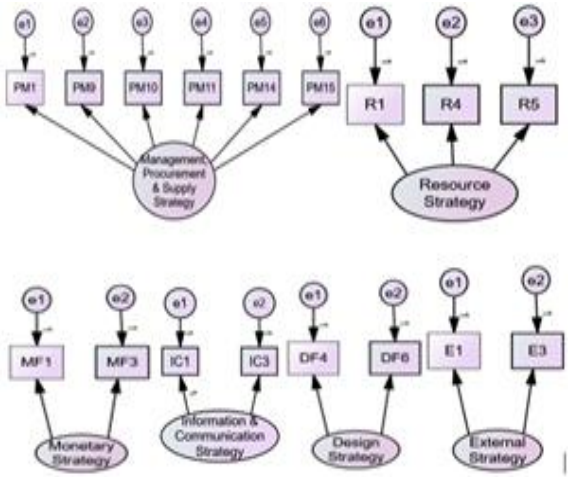


**Fig. 1:** Schematic Potential Strategic Variables to Reduce Construction Delay

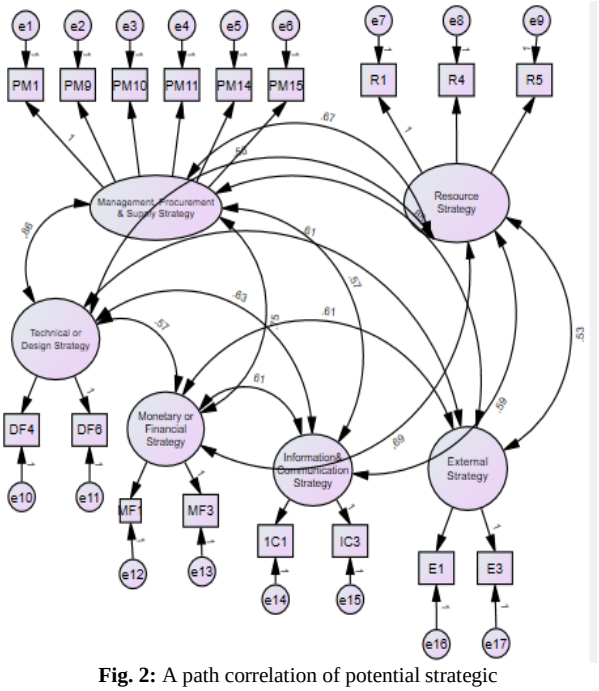


**Fig. 2:** A path correlation of potential strategic

The path coefficient showing the correlation of a presented potential strategies was drawn with associated errors established followed by determining the correlation covariance. The path diagram (Figure 2) is presented to indicate the positive relationships between strategies that have predicted a significance (highly correlated) towards minimizing the construction project delays.

The assessment of path coefficients intended to indicate the strength and direction of relationships between latent variables within the model. The coefficients were therefore carefully examined to check the statistical significance to ascertain if the data show relationships (Mohamed *et al*., 2018). Each path linking two latent variables within the structural model represented a distinct relationship. It is stated that, the path coefficients from 0.5 or higher indicate a large effect size, while values around 0.3 indicate a medium effect size. Values close to or below 0.1 signify a small effect size. Thus, the interpretations of path coefficients were applied in this study. The evaluation of the drawn structural model involved a comprehensive examination of the relationships among latent variables (strategies) and the overall model fit (Hair *et al.,* 2014) including structural parameter estimates and path coefficients (Koh, 2007).

The overall model assessment has shown a significant correlation between strategies with a minimum structural estimate value of 0.53 between resource strategy and external strategy. The computed goodness-of-fit indices intended to assess the appropriateness and acceptability of the model and its ability to represent the underlying idea of the collected data. The findings acknowledged that the final structural model has achieved adequate fit indices across various measures (Table 4) signifying that the model has captured a significant correlation between strategies towards minimization of construction project delays.

**Table 4:** Fit indices of the final structural model

| Measure Type | Fit Measure | Acceptable Fit | Attained Value | Observations |
|---|---|---|---|---|
| Absolute fit measures | $\chi^2$ p-value | 0.000 | 0.000 | Realized |
| | $\chi^2$/df | < 2 or 3 | 1.938 | Realized |
| | SRMR | < 0.05 | 0.037 | Realized |
| | RMSEA | < 0.07 | 0.068 | Realized |
| Incremental fit measures | TLI | >0.90 | 0.971 | Realized |
| | CFI | >0.90 | 0.983 | Realized |
| Parsimonious fit measures | PNFI | >0.50 | 0.597 | Realized |
| | PCFI | >0.50 | 0.761 | Realized |

*Conclusion:* The findings of the study have documented seventeen potential strategies for delay. Among the identified strategies, the two have never being acknowledged in previous studies including the capability of supplier and the bullwhip effects encompassing information distortion during resource ordering that were noted to frustrate the construction process, procedure and thus led to construction project delays. The key contribution of the study is identification of a potential and comprehensive correlation between strategies delays for reducing the construction projects delays. The implication of the study to the world of practitioners is to give and gain access knowledge to a comprehensive potential strategy that could be adopted to minimize construction projects delays problems. Thus, considering that the delay factors have a overlapping effect in various construction projects, this study suggest a study on assessment and or analysis of the identified factors relatively to their consequence on project achievement.

Declaration of Conflict of Interest: The authors declare that there is no any conflict of interest.

Data Availability Statement: Authors declare the availability of research data from corresponding author or any of the other authors upon request.

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