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# DETERMINANTS OF PROJECT SCHEDULE DELIVERY IN CONSTRUCTION PROJECTS IN RWANDA. CASE OF KISIMA APARTMENTS CONSTRUCTION PROJECT IN RWANDA

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**ABSTRACT:** *The construction industry is characterized by frequent problems like insufficient quality, time overruns, and poor safety. The construction industry is constantly facing serious concerns of delays, which are a chronic problem that has negative effects on projects, especially in developing countries. The study aimed to investigate the determinants of project schedule delivery in construction projects in Rwanda.*

*In line with maintaining the success in a construction project, this study describes how owner changes on project schedule delivery, site conditions on the project schedule delivery, and budget inaccuracies on project schedule delivery and resources on project schedule delivery in construction projects in Kisima apartments Construction Project in Rwanda. The study was conducted at Kisima apartments Construction Project with sample size is 102 respondents who were selected from stakeholders where descriptive statistics, regression and coefficient analysis was used to test the hypothesis. The researcher hopes that study gives some main understanding on the usefulness of owner changes on project schedule delivery, site conditions on the project schedule delivery, budget inaccuracies on project schedule delivery and resources on project schedule delivery in construction projects in Kisima apartments Construction Project in Rwanda.*

**Key words**: Constraints, Contractor, construction project, Delay, Project delivery, Project, Project schedule.

## INTRODUCTION:

The construction industry is characterized by frequent problems like insufficient quality, time overruns, and poor safety. These characteristics limit value delivered to customers [1]. The construction industry is constantly facing serious concerns of delays, which are a chronic problem that has negative effects on projects, especially in developing countries [2]. Despite new and advanced technologies such as Building Information Modelling, lean construction, modular construction [3] applied in the construction industry, the efficiency has remained quite low [4]. It is observed from studies by previous scholars [5] that the construction industry has always had challenges, despite continuous attempts by participants in the industry to find remedies and improve performance.

In European countries, conducted a study of delay and their remedies in Norwegian projects,

identified sponsor/owner/ client, lack of commitment and or clear demands (goals and objectives) as a major cause of delay and added to those found in the above-developed countries. In their studies of construction cost and time attributes in the U.K., also identified project characteristics and contract procedures as new categories of delay causative factors [6].

ank and Adwoa found the main delay causes in building construction in Ghana to be financial group factors, which included delays in honoring payment certificates, and difficulty in accessing credit, and fluctuation in prices [7]. Material group factors are second followed by Managerial factors in Uganda [8]. [9] in Tanzania, and [10] in Nigeria added in their study's managerial factors in the area of delays when assessing work's changes and as inadequate site investigation by the consultants, design-related factors including design errors by designers and information related factors, and resource supply-related factors as major construction delay factors in those countries, respectively.

The construction sector has had phenomenal growth in Rwanda. It has been responsible for the continued growth in GDP over the past 10 years. There is no sector of the Rwandan economy that shows more promise than the construction sector and associated industries. To this end, the government of Rwanda seeks to extend a welcoming hand to local and foreign investors seeking to capitalize on the vast opportunities present. Rwanda's building and construction industry today is rapidly growing and has seen a boom in the past couple of years from 2006 - 2007 as it is being transformed from being state-funded to private funding More private real estate developers have come on board to develop housing estates on a commercial basis [11].

**STATEMENT OF THE PROBLEM**

Delays are among the most frustrating issues in a construction project. They not only cause your company to incur more costs but also affect your reputation by giving a perception that you can't deliver projects on time. More to that, untimely completion of the project likely leads to contractual penalties if the delay caused your client to lose money. The issue of construction project schedule delivery is an occurrence that can bring about undesirable happenings in the entire project delivery process. As a matter of significance and hence concern a lot of construction projects face the major problem of project schedule delivery delay [12]. A global analysis of construction projects has been conducted to review the main factors of delays in Rwanda. Statistical analysis was conducted on commercial building projects from 2010 to 2020 for 15 projects conducted; none of them meet the deadline as per the schedule. It was observed that 15% of these projects were canceled and 75 % needed more time to be added for the project to be completed [13].

Amandin and Kule researched project delays on cost overrun risks in Gasabo district, one of the 30 districts in Rwanda using an open-ended questionnaire. They found that the top five causes of delays for public construction projects from 2012 to 2019 were delayed payment, financial deficiencies on the part of the client and contractor, material procurement, and poor supervision [14]. According to Rwanda's annual report in 2017, building projects were one of the project types subject to significant delays in Rwanda. If these projects are delayed, it will increase government expenditure as well as slow down the urbanization of the country, which is one of the main goals of vision 2020 in Rwanda. Besides, the delay would give investors a negative perception of the country, which may result in making investors reluctant and reducing competition in the local construction industry [15]. As in many developing nations, construction project delay has been an ongoing issue in Rwanda, with proposed and current projects either delayed or postponed. Rwanda is a developing country located in East Africa, which began to develop its economy following the genocide in 1994. Although Rwanda's construction industry is expected to account for the majority of its gross domestic product (GDP) growth at an average annual growth of almost 4% since 2020 (Business Sweden in Eastern Africa, 2017). Many construction projects are posing delay-related risks such as cost

overruns and conflicts or claims. According to the findings of Amandin and Julius [16], 65,7% of public construction projects in just one district of Rwanda were delayed during 2012-2015. An example of the delayed projects is the Kigali convention center, which was initially scheduled to be completed in 2011 but was postponed until 2016. Another example is the Bugesera international airport construction project of Rwanda, which was expected to be completed by 2016, whose ground has not been broken [17].

All these are serious problems that hard-pressed the researcher to do a study on the implementation and compliance of construction project delivery and look at determinants of project schedule delivery in construction projects in Rwanda. Therefore, this Research was built on past studies by investigating determinants of project schedule delivery in construction projects and their impact on the success of the project. This work examined different determinants of project schedule delivery in an integrated fashion to determine which factors are most influential in avoiding particular critical time delays. This provided organizations involved in construction projects with the foundation on which such strategies; on how project schedules can be developed in the future. This researcher was focused on building construction projects in Rwanda, which was assessed for different factors, and examines their impact on the building's construction projects delivery.

## OBJECTIVES OF STUDY

The following are the specific objectives of the research:

i. To establish the effect of owner changes on project schedule delivery in construction projects in Rwanda.
ii. To assess the effect of site conditions on the project schedule delivery in construction projects in Rwanda.
iii. To establish the effect of budget inaccuracies on project schedule delivery in construction projects in Rwanda.
iv. To establish the effect of resources on project schedule delivery in construction projects in Rwanda.

## EMPIRICAL REVIEW

In the study of Manavazhia and Adhikarib done in 2002, delays in the delivery of materials and equipment to construction sites are often a contributory cause to cost overruns in construction projects in developing countries. The actual impact of these delays on project costs was found to be on average, only about 0.5 percent of the total budgeted cost of the projects. When a construction delay occurs, there is no question that the Owner suffers financially. But the extent to which an Owner can recover its loss of income from the Contractor, and more importantly minimize the risk that such delays will occur, depends largely on how the construction contract was drawn up [18].

In the study undertaken by Assaf, et al. in 1995 on causes of delay in large building construction crojects, the largest number of causes of delay (56 causes) was listed and the respondents were asked to point out their degree of importance. The authors grouped the delay factors into nine major groups: financing, materials, contractual relationships, project changes, government relations, manpower, scheduling and control, equipment, and environmental factors. The financing group of delay factors was selected as the most significant delay factor by all parties and that environment group was selected as least significant. It should be observed that each of the above factors often leads to serious consequences and often direct financial constraints to the contractor more than any other player [19].

Based on the work done by Fenves in 2016 on the penetration of information technologies into civil and structural engineering design: state-of-the-art and directions toward the future, finds that, fundamental reasons for the existence of the selection of an adequate site location during the early stages of construction project management arise from: specific conditions of the construction industry (final products are inseparable

from the location i.e. location has a strong influence on building design and its structural characteristics as well as the technology which will be used during construction), investors' desires and attitudes, and influence of socio-economic and environmental aspects. Considering all reasons mentioned, one can conclude that the selection of an adequate construction site location for future investment is not only a complex, low structured, and multi-criteria problem but also a group decision-making problem [20].

Assaf, Al-Khalil, and Al-Hazmi, while studying the causes of delay in large building projects in Saudi Arabia and their relative importance reported that among a series of causes of delay which had been included in the survey; the contractors, owners, and architects/engineers interviewed all ranked financing group delay factors the highest. According to the contractors, the most important delay factors were preparation and approval of shop drawings, delays in contractors' progress payment by owners, and design changes by owners. In the opinion of architects and engineers, the most important causes of delay were cash flow problems during the construction phase, the relationship between different subcontractors' schedules in the execution of the project, and the slowness of the owners' decision-making process. Owners, on the other hand, attributed delays in Projects under construction to design errors, excessive bureaucracy in project owner organization, labor shortages, and inadequate labor skills [19b].

## RESEARCH METHODOLOGY

For this study researcher has used both Primary as well as secondary data. A group of target population in this research included a construction contractor company, consultants that operate in Kigali City because they are responsible for construction projects in Rwanda. The total population in this study is 137 respondents. These respondents were selected because they are stakeholders of Kisima apartments Construction Project in Rwanda. Therefore, this facilitated the researcher to access adequate and reliable information from the respondents. Data collected was edited, coded and tabulated. The descriptive statistics method, regression and correlation of coefficient was used for data analysis.

## DATA ANALYSIS:

### Descriptive statistics presentation

Thanks to descriptive statistics, I was able to establish the mean between factors. It is possible to measure the symmetry and check the lack of symmetry in particular. The test for skewness and kurtosis also indicated if the data have been light-tailed or if it also indicated a substantially skewed or peaked distribution.

### Skewness and Kurtosis of Owner changes on project schedule delivery in construction projects

This indicates the descriptive statistics for owner Changes specifically the mean, skewness, and kurtosis tests. Starting with the mean, the range indicated is measured in the range between 4.3 and 5 as the lowest value of the mean is 4.61 while the highest value was 4.67. This indicates that there is a strong range between the factors of owner changes. The test for Skewness also indicated that the range lies between -2.296and -2.41. all values of skewness are therefore negative and less than +1. This project has a substantially skewed distribution that I have in the data. On the side of Kurtosis, the values ranged from 4.06 to 5.49. Since all the values of Kurtosis are always positive, I could say that the distribution is too peaked.

### Skewness and Kurtosis of site conditions on project schedule delivery in construction projects

In these results, the descriptive statistics for site conditions. The main factors tested include "different site conditions affect Kisima apartment project schedule delivery in construction projects" with the mean as 4.43 as the lowest in the means while the factor "poor management affect Kisima apartment project schedule delivery in construction projects had the mean of 4.68. Considering the range, it falls between 4.3 and 5 which is interpreted as a strong range between the factors. The researcher also tested for skewness and kurtosis tests. The test for Skewness also indicated that the range lies

between -1.84 and -2.65. All values of skewness are therefore negative and less than +1 which projects a substantially skewed distribution that I have in the data. On the side of Kurtosis, the values ranged from 2.06 to 7.08. Since all the values of Kurtosis are always positive, I conclude by saying that the distribution is too peaked.

**Skewness and Kurtosis of budget inaccuracies on project schedule delivery in construction projects.**

This indicates the descriptive statistics for budget inaccuracies specifically the mean, skewness, and kurtosis tests. Interpreting the range in the mean gave the lowest mean as 4.29 while the highest mean was 4.68, and this range indicated is measured in the range between 4.3 and 5. To interpret this range, the researcher observes a strong range between the factors of budget inaccuracies. The test for Skewness also indicated that the range lies between -1.602 and -2.755. As it can be seen, all values of skewness are therefore negative. As the rule of thumb, when the values of negative/ simply less than +1, this exhibits that there is a substantially skewed distribution. On the side of Kurtosis, the values ranged from 1.07 to 8.12. All the values of Kurtosis are always positive, and the researcher observes that distribution is too peaked as well.

**Skewness and Kurtosis of resources on project schedule delivery in construction projects**

The descriptive statistics especially skewness and kurtosis for resources. The table also included the mean and the range indicated is measured in the range between 4.3 and 5 as the lowest value of the mean was 4.35 while the highest value was 4.80. Simply, this indicates that there is a strong range between the factors of resources. The test for Skewness also indicated that the range lies between -1.64 and -3.04. Note that all values of skewness are therefore negative and less than +1. As a rule of thumb, when the range in the values of skewness are less than +1 they are interpreted as having a substantial distribution. Therefore, in this project that there is a substantially skewed distribution that I have in the data. The researcher also includes the test for Kurtosis, and the values ranged from 1.986 and 11.389. With the above values in mind, Kurtosis is always positive, and I concluded that the distribution is too peaked.

As the researcher concludes, based on the mean given by respondents and skewness or kurtosis measuring the flatness of the data, it is obvious that factors contributed to project schedule delivery in construction projects.

**Testing objectives**

Based on research objectives and research questions, the following are multiple regression models that were developed in answering and finding the effects and relationship between determinants of project schedule and delivery in construction projects. Briefly, the regression model that were used in the study is in this form:

$$\mathbf{Y= \beta_0+\beta_1X_1+ \beta_2X_2+ \beta_3X_3 + \beta_4X_4 +\varepsilon}$$

Where:

Y= Project schedule delivery in construction projects

$X_1$= Owner changes

$X_2$= Site conditions

$X_3$= Budget inaccuracies

$X_4$= Resources

$\beta_1 - \beta_4$ = Slope or coefficient of estimates. $\beta_0$ = constant;

$\varepsilon$ = Error term

**ANOVA table of determinants on project schedule delivery in construction projects**

**Table 5: ANOVA table of determinants of project schedule delivery**

| ANOVA[b] | | | | | | |
|---|---|---|---|---|---|---|
| **Model** | | **Sum of Squares** | **df** | **Mean Square** | **F** | **Sig.** |
| 1 | Regression | 4.151 | 4 | 1.038 | 11.909 | .000[a] |
| | Residual | 7.842 | 90 | .087 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Total | 11.993 | 94 | | | |

**Source: Primary data, (2021)**

The ANOVA table indicates the summarized findings on determinants on project schedule in construction projects. The regression model predicted how the dependent variable (project schedule delivery delays) should be strongly significant and predicted the changes occurring between our variables (independent variables: owner change, site condition, budget inaccuracies, and resources), In fact, the p value as indicated in the sig. column indicated that it was 0.000 and it is still under 0.05. Therefore, the researcher observed that the regression model remained statistically significant and predict the changes occurring in variables as the relationship between them can also be explained.

**Model summary of project schedule delivery in construction projects.**

**Table 6: Model Summary of determinants project schedule delivery in construction projects.**

| Model Summary | | | | |
|---|---|---|---|---|
| **Model** | **R** | **R Square** | **Adjusted R Square** | **Std. Error of the Estimate** |
| 1 | .588[a] | .746 | .317 | .29519 |

**Source: Primary data, (2021)**

As per the model summary for owner changes, site conditions, budget inaccuracies, and resources on project schedule delivery in construction projects is indicated. To interpret the data above, I referred to two main values that is R and R square with R indicating the rate of correlation while R square is the total variation between the variables. The value of R was 0.588 indicating a positive and very high correlation between our variables. The R square was 0.746 indicating that there is a total variation of 74.6% can help to explain the owner changes, site condition, budget inaccuracies, and resources on project schedule delivery in construction projects. As a researcher, I have concluded that there is a relationship between all variables on project schedule delivery and construction project.

**Correlation analysis**

Correlation analysis in research is a statistical method used to measure the strength of the linear relationship between two variables and compute their association. Simply put - correlation analysis calculates the level of change in one variable due to the change in the other. A high correlation points to a strong relationship between the two variables, while a low correlation means that the variables are weakly related (mark, 2020).

**Table 7: Correlations Analysis of determinants project schedule delivery in construction projects**

| Correlations | | | | | | |
|---|---|---|---|---|---|---|
| | | **OwnerChange** | **SiteCondition** | **Budget** | **Resources** | **Delays** |
| OwnerChange | Pearson Correlation | 1 | .155 | .104 | .206* | .202* |
| | Sig. (2-tailed) | | .134 | .315 | .046 | .049 |
| | N | 95 | 95 | 95 | 95 | 95 |
| SiteCondition | Pearson Correlation | .155 | 1 | .087 | .055 | .365** |
| | Sig. (2-tailed) | .134 | | .401 | .598 | .000 |
| | N | 95 | 95 | 95 | 95 | 95 |
| Budget | Pearson Correlation | .104 | .087 | 1 | .171 | .161 |
| | Sig. (2-tailed) | .315 | .401 | | .098 | .118 |
| | N | 95 | 95 | 95 | 95 | 95 |
| Resources | Pearson Correlation | .206* | .055 | .171 | 1 | -.341** |
| | Sig. (2-tailed) | .046 | .598 | .098 | | .001 |
| | N | 95 | 95 | 95 | 95 | 95 |
| Delays | Pearson Correlation | .202* | .365** | .161 | -.341** | 1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Sig. (2-tailed) | .049 | .000 | .118 | .001 | |
| | N | 95 | 95 | 95 | 95 | 95 |

**Source: Primary data, (2021)**

The correlation table indicates the summarized findings on determinants on project schedule in construction projects. The correlation model predicted how the dependent variable (project schedule delivery delays) should be strongly positive correlation between our variables (independent variables: owner change, site condition, budget inaccuracies, and resources), In fact, the Pearson's r varies between +1 and -1, where +1 is a perfect positive correlation, and -1 is a perfect negative correlation where by in our finding it varies between 0.161 ana-0.341. Therefore, our figure of 0.202 ;0.365; 0.161 and 0.341 indicates a very strong positive correlation. The more the owner initiate changes, budget inaccuracies, site conditions, and resources the more it affects project schedule delivery delay of Kisima apartments.

**Predicting the Effect of Objectives**

**Table 8: Predicting the Effect of Objectives**

| Coefficients[a] | | | | | | |
|---|---|---|---|---|---|---|
| **Model** | | **Unstandardized Coefficients** | | **Standardized Coefficients** | **t** | **Sig.** |
| | | **B** | **Std. Error** | **Beta** | | |
| 1 | (Constant) | 2.024 | .530 | | 3.819 | .000 |
| | Owner Change | .153 | .061 | .220 | 2.499 | .014 |
| | Site Condition | .240 | .061 | .339 | 3.913 | .000 |
| | Budget inaccuracies | .165 | .078 | .183 | 2.107 | .038 |
| | Resources | -.379 | .077 | -.436 | -4.945 | .000 |

**Source: Primary data, (2021)**

The table above the test for Unstandardized and Standardized Coefficients for the owner changes, sited conditions, budget inaccuracies, and resources.

**Effect of owner changes on project schedule delivery in construction projects**

The information displayed above shows that beta = 0.220 as well as the p values were 0.014 and t is 2.499. To conclude, the p-value is less than 0.05 and the researcher maintained the positive hypothesis saying that Owner changes affect project schedule delivery in construction projects.

**Effect of site conditions on project schedule delivery in construction projects**

The table above displayed beta = 0.339 as well as the p values were 0.000 and t is 3.913. I have concluded that since the p-value is less than 0.05, site conditions affect project schedule delivery in construction projects.

**Effect of budget inaccuracies on project schedule delivery in construction projects**

The information displayed above shows that beta = 1.83 as well as the p values were 0.038 and t is 2.107. To conclude, the p-value was less than 0.05 and the researcher maintained the positive hypothesis saying that budget inaccuracies affect project schedule delivery in construction projects.

**Effect of resources on project schedule delivery in construction projects**

The table above displayed that beta = 0.436, as well as the p-values, was 0.000 and t 4.945. To conclude, the p-value is less than 0.05 and the researcher maintained the positive hypothesis saying that resources affect project schedule delivery in construction projects.

**CONCLUSION:**

The information displayed has shown that beta = 0.220, as well as the p values, was 0.014 and t is 2.499. One sample test for the owner change on project schedule delivery in the construction project is displayed through the first research question saying "What is the effect of owner change on project schedule delivery in construction projects in Rwanda?". The t statistics gave out the value of 55.973 with the degree of freedom of 94 for the factor "owner-initiated changes affect Kisima apartment project schedule delivery in construction projects in any way" using the significance level was 5%. P-value was 0.000 and it is less than 0.05. The researcher maintained the positive hypothesis saying that Owner changes affect project schedule delivery in construction projects.

The table displayed beta = 0.339, as well as the p-values, was 0.000, and the t value is 3.913. The table above tested for the second research question saying "What is the effect of site conditions on project schedule delivery in construction projects in Rwanda?" one sample test for the site condition on project schedule delivery in construction project was indicated. The t statistics gave out the value of 50.641 with the degree of freedom of 94 for the factor "Site condition such as external factors affect Kisima apartment project schedule delivery in construction projects". Note that the significance level was 5. I have concluded that since the p-value is less than 0.05, site conditions affect project schedule delivery in construction projects.

The information displayed has shown that beta = 0.183, as well as the p values, was 0.038 and t value of 2.107. One sample test for the budget inaccuracy on project schedule delivery in the construction projects is displayed. The t statistics gave out the value of 64.502 with the degree of freedom of 94 for the factor "Budget inaccuracies affect Kisima apartment project schedule delivery in construction projects". Note that the significance level was 5%, and P-value was 0.000 (2-tailed). To conclude, the p-value was less than 0.05 and the researcher maintained the positive hypothesis saying that budget inaccuracies affect project schedule delivery in construction projects.

Lastly, beta = 0.436, as well as the p-values, were 0.000 and the t value was 4.945. the fourth research question says "What is the effect of resources on project schedule delivery in construction projects in Rwanda? To answer this question, a one-sample test for the resources on project schedule delivery in the construction project is displayed. The t statistics gave out the value of 52.061 with the degree of freedom of 94 for the factor "Resources such as labor, materials, and equipment affect Kisima apartment project schedule delivery in construction projects" and the significance level was 5% with a P-value of 0.000. To conclude, the p-value is less than 0.05 and the researcher maintained the positive hypothesis saying that resources affect project schedule delivery in construction projects.

**RECOMMENDATIONS:**

There is still a need for increasing innovations for the project owners. For instance, most of the construction projects start without a success plan from the owner of the project. This can be handled simply by proving the project from the beginning and make sure that the owner has all requirements to complete the project so that he/she may not tend to change halfway. The construction should be given a completion time by the owner due to the set strategies so that there is a quick delivery and no delay is faced.

Depending on the nature of the project, the location of resources on sites needs to be carefully observed. With this in mind, I suggest that supervisors should make sure that sites are equipped with enough materials and enable communication between different sites. This will ease the management of the sites and in

case of emergency and need of materials, it will be able to displace materials from one site to another and this exactly will limit the problem of project delaying and lack of enough material due to improper site positioning.

They are some materials that are not easily to be produced in Rwanda. For instance, companies need to find a way of delivering enough resources and plan how long it will take to deliver them to their sites. This will also facilitate the quick and completion of projects successfully. Due to budgets which are often limited as constructions are costly, owners should hire professional management teams to coordinate finance throughout the construction. They should separate finance from supervisors because it might lead to poor distribution of finances. Companies should also collaborate with financial institutions and request loans before starting their project in case they find it necessary and the government should give input when it comes to improving construction in Rwanda.

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