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AN ASSESSMENT OF FACTORS LEADING TO TIME OVERRUNS IN THE ROAD CONSTRUCTION PROJECTS AT NYUNGWE BELT ROADS CONSTRUCTION PROJECT, WESTERN PROVINCE, RWANDA

Sempundu Theogene, Dr. Sanja Micheal, PhD

Author Details:
Sempundu Theogene is currently pursuing masters program in Project Management at University of Kigali, Rwanda. E-mail:sempundu2016@gmail.com
Dr. Sanja Micheal, PhD, is a Senior Lecturer at the University of Kigali, Rwanda. E-mail:sempundu2016@gmail.com

KeyWords
Agency Theory, factors of delay, client, contractors, consultant, Nyungwe Belt Roads construction Project, Rwanda, Time overruns

ABSTRACT

The importance of roads network in the economic growth of any country is generally recognized. However, according to several researchers, most road construction projects are not completed on time and time overrun is seen as a global common problem in roads construction projects.The purpose of this study was to assess factors leading to time overruns in the road construction projects at Nyungwe belt roads construction project, western province, Rwanda. This study was guided by the theory of constraints and the Agency theory. It employed descriptive research design and explanatory research design. The study targeted key employees whose positions included project managers, site engineers, project engineers, team leader's supervision, site supervisors, work conductors who actively were involved in the execution of the case study roads works. The study adopted a purposive sampling technique and the sample size was 46 respondents. Structured questionnaires on 5-points Likert scale were used to collect data and data analysis employed descriptive statistic and bivariate correlation analysis, where r the coefficient was extracted to establish relationship between the variables.The results posted a correlation coefficient r = 0.443 and ***p*** **=** 0.004 < .05) which designated a positive and significant relationship between the factors of delay from the contractor's side and time overruns in road construction projects. The results for the factors of delay from the client's side and time overruns in road construction projects had r = .336 and P = .020 < .05 which indicated a positive and significant relationship.The results posted a correlation coefficient r = 0.482 and *p* = 0.002 < .05) which designated a positive relationship, significant, strong relationship between the factors of delay from the consultant's side and time overruns in road construction projects. The external factors of delays and time overruns in road construction projects had *r = .456* and p=*.003 < .05* which designated a positive, strong and significant relationship. The resulsults show that the factors of delay from the four sides have a significant contribution to time overruns in road construction projects in Rwanda. The contractors, client and consultant should put much effort in avoiding those limiting factors of delay from their side in order to avoid or limit the time overruns in road construction project in Rwanda. The researcher recommends that a study should be carried out to assess the recommended measures to avoid or limit the impact of the contractor's side, clients' side, consultants' side, and external factors leading to time overruns towards the timely completion of roads construction project in Rwanda.

1 INTRODUCTION

GLOBALLY, infrastructure is an important factor in the development of a nation through its direct and indirect contributions to economic growth of a country [1]–[3]. In fact, roads infrastructure directly or indirectly reduces costs in the production process, roads induce structural change which influences production , consumption trends and contributes to sources of income and better income levels [2], [4]–[6]. Most construction projects are not completed on time and within their budget. [7][7] identified time and cost overruns as common problems in the construction sector and even recognized as endemic around the world [8]. Narrowing our view to time overruns, the former have been observed in many infrastructure projects and were recognized as a global phenomenon[9] , [10] even as a worldwide problem [11] , and also as a common problem in developing countries [12].

More studies in Iraq [13], in Thailand [14], in India [15], in China[16], in Italy[17] have reported that several road construction projects face time overruns .According to studies, Time overruns in road construction projects are prevalent also in Egypt [18], in Ghana [19], in Zambia[20], in Libya [21], in Sudan[12], in Kenya[22],[23],etc.

Moreover, the literature review revealed existence of numerous factors of delay and their grouping in roads construction projects. According to table here below, twenty-one papers from sixteen countries were reviewed by the researcher. They include 13 papers related road construction projects, 1 paper related dam construction project, and 7 papers related to infrastructure and general construction projects. The table below shows that the investigated factors of delay and the related categorization differed from one author to another and from a country to country. For instance,[9] followed by [22] examined the highest number of factors of delays and related grouping in road construction projects (293 and 141 factors of delays grouped in 15 and 25 categories successively). [24] Investigated the lowest number of factors of delays (14 factors of delays) in roads construction projects. Furthermore, the top important factors of delay ranged from four[25] to twenty [9] factors of delay depending on the study objectives.

Table 1: Factors of delay, their grouping per author, per country

SN	Country	Industry	Authors	Number of factors of delay	Number of Groups	Top important factors
1	Egypt	Road construction	[9]	293	15	20
2	Kenya	Road construction	[22]	141	25	5
3	Ghana	Road construction	[19]	23	4	10
4	Zambia	Road construction	[24]	14	n/a	2
5	Sudan	Road construction	[12]	66	6	10
6	Lybia	Road construction	[39]	39	8	5
7	India	Road construction	[15]	29	7	5
9	Pakistan	Road construction	[26]	26	10	n/a
10	Malawi	Road construction	[36]	72	n/a	10
11	Iraq	Road construction	[35]	64	7	8
12	Plastine	Road construction	[34]	52	8	5
13	Rwanda	Road construction	[1]	16	n/a	16
14	Zambia	General Construction	[20]	25	n/a	n/a
15	Egypt	General Construction	[18]	99	9	10
16	Vietnam	General Construction	[38]	21	8	n/a
17	Rwanda	General Construction	[25]	0	n/a	4
18	USA	General Construction	[27]	30	n/a	10
19	India	General Construction	[28]	59	9	n/a
20	Global	Infrastructure	[29]	76	8	n/a
21	Rwanda	Dam construction	[30]	29	4	8

Source: Researcher, (2020)

Many projects are not implemented within their time schedule. In fact, [31]reported that time overruns are among the key contributor to the low levels of achievement of the upgrading, rehabilitation and periodic maintenance of roads projects and [32], reported that “roads amounting to Frw 19.56 billion led the list of delayed projects” in the fiscal year 2017/2018. This problem still manifests in Rwanda [33],[31] and is coupled with the lack of an assessment of factors leading to time overruns in the road construction projects in roads construction projects in Rwanda. If nothing is done to urgently solve the problem of schedule delays in road construction projects, the economic growth of Rwanda will be affected as the production processes costs will increase, production and consumption trends and the sources of income will suffer.

Therefore, the study aimed to conduct an assessment of factors leading to time overruns in the road construction projects at Nyungwe belt unpaved roads construction project, western province, Rwanda. The specific objectives are as follows:

(i) To determine the correlation between the factors of delay from the contractor’s side and time overruns at Nyungwe belt unpaved roads construction project, western province, Rwanda;
(ii) To evaluate the link between the factors of delay from the client’s side and time overruns at Nyungwe belt unpaved roads construction project, western province, Rwanda;
(iii) To identify the relationship between the factors of delay from the consultant’s side and time overruns at Nyungwe belt unpaved roads construction project, western province, Rwanda;
(iv) To evaluate the association between the external factors of delay and time overruns at Nyungwe belt unpaved roads construction project, western province, Rwanda?

In line with the study objectives, the researcher evaluated : (1) the relationship between the factors from the contractor’s side name-

ly (i) Contractor's cash-flow problem during construction, (ii) Slow mobilisation of equipment, (iii) Delay in preparation of execution drawings and (iv) Submission of exaggerated revised BoQ proposal and time overruns in road construction project in Rwanda; (2) the link between the four factors from the client's side namely (a) delayed expropriation, (b) delays in payment of contractor's invoices, (c) lack of or incomplete detailed feasibility studies and (d) preparation of unrealistic initial works timelines and time overruns in road construction projects; (3)the relationship between the three identified major factors of delay from the consultant's side namely (a) very strict supervision firm, (b) delayed review and approval of execution drawings and (c) delay in approving major changes during works execution and time overruns in road construction projects and (4)the the link between the following identified major external factors : (i) Excessive rain, (ii) infectious disease-Covid 19, (iii) excessive landslides and time overruns in road construction projects.

2 MATERIALS AND METHODS

The study used the mixed method to get the comprehensive understanding of research problem since data from quantitative or qualitative method resource may not be enough alone. The study population was 46 respondent, which were project managers, site engineers, project engineers, team leaders, site supervisor and works' conductor from clients: the public institutions, contractors and consultant who were involved in the construction works of Butare-Bweye and Kitabi- Nshili tea factory roads in South-West of Rwanda. To determine the sample size of this study, the researcher used purposive sampling method. This method is the appropriate method available because there are only limited number of primary data sources which can contribute to the study [41]. Purposive sampling has several types like Maximum variation sampling, Homogeneous sampling, typical case sampling, Extreme case sampling, Critical case sampling, Total population sampling, and Expert sampling. The researcher used the Heterogeneous / maximum variation sampling which relies on researcher's judgment to select participants with diverse characteristics. This is done to ensure the presence of maximum variability within the primary data (Research-methodology, n.d). The sample size of this study or the targeted number of respondents were 46 employees and details are presented below

Table 1 Sample size

Key actors in construction of the roads project	Targeted respondent	Total population	Sample size
Client / Government Institution	Project Manager	12	12
Consultant/ Supervision firm	Site Engineer	4	4
CONTRACTORS	Project Engineer	8	8
	Team Leader Supervision	2	2
	Site supervisors	12	12
	Works' conductor	8	8
TOTAL		46	46

The study used primary data collected using a questionnaire which was answered by the respondents themselves (self-administered). The participants were asked to answer each question by rating each item on a 1-to-5, response Likert scale: (5) Strongly agree, (4) Agree, (3) Neutral, (2) Disagree, and (1) Strongly disagree.

2.1 Validity of the Questionnaire

During questionnaire construction, its validity was determined by crosschecking of the content by two different experts. Moreover, the questionnaire was adapted to the phenomena being investigated i.e., all the questions were directly linked to the research's aim and objectives and covered all aspects of the topic.

2.2 Reliability of the Questionnaire

Reliability analysis was conducted to ensure that the measures of variables are consistency across time and across the various items that measure the same concept or variable. All the questions were worded-written clearly. A pre-test was conducted on twenty roads Engineers and the researcher critically analysed the responses from the questionnaire in terms of their degree of reliability. The Internal consistency was measured using Cronbach's Alpha (α) which ranges from 0 to 1; the researcher obtained a Cronbach's Alpha (α) of 0.847 which indicated a greater internal reliability [40]

2.3 Data Processing, Analysis and Presentation

The data were collected from the questionnaires and were systematically organized in a manner to facilitate analysis. Data analysis

involved the preparation of the collected data, coding, editing and cleaning data using Statistical Package for Social Sciences (SPSS).

To analyze the relationship between the factors from the client, contract, consultant, external factors and time overruns in roads construction projects, the study used the bivariate correlational procedure to compute the pairwise associations of study variables. This analysis helped determining the significance, strength and direction of the association between two ordinal variables .The dependent variables were ordinal. The Spearman's rho statistics was used to measure the rank-order association between two ordinal variables. It works regardless of the distributions of the variables. Correlation Coefficient values can range from +1 to -1, where +1 indicates a perfect positive relationship, -1 indicates a perfect negative relationship, and a 0 indicates no relationship exists.

If the value is near ± 1, then it said to be a perfect correlation: as one variable increases, the other variable tends to also increase (if positive) or decrease (if negative). The P-value commonly used is 0.05, if it is less than 0.05; there is a significant relationship between the variables, if the p-value is greater than 0.05 indicates that there is no significant association between the variables.

3 RESULTS AND DISCUSSION

3.1 Demographic characteristics of the respondents

3.1.1 Gender of the Respondens

From the findings and according to figure and table here below, the majority of the respondents (95%) were male while 5% of the respondents were female. This reflects the little number of women in the Rwandan road construction sector (Table 2).

The study sought to investigate the position held by the respondents during the implementation of the selected roads. From the findings, 30% of the respondents were project managers/Project Engineers, 15%, 20%,10%, 15%, and 10 % of the respondents were site Engineers, Project Engineers, Team Leader, works supervisors and works conductor in the order. This implies that majority of the respondents occupied relevant positions and therefore the information collected from them can be treated as valid (Table 2).

Table 2 . Position of the respondent

Respondent position	Frequency	Percent
Project Manager	12	30.0
Site Engineer	6	15.0
Project Engineer	8	20.0
Team Leader	4	10.0
Site supervisor	6	15.0
Works' conductor	4	10.0
Total	40	100.0

The respondents were requested to indicate their education level. From the findings and according to figure and table herein after, 10% of the respondents had diploma of University level (A1), 70% were Bachelor Degree holders, and 20% having Master's degree level. This education revel is very relevant and therefore the information collected from them can be treated as valid (Table 3).

Table 3. Education level

Level of education	Frequency	Percent
Diploma A1	4	10.0
Ao	28	70.0
MSc	8	20.0
Total	40	100.0

The respondents were requested to indicated the type of organization they were representing during the roads works execution. The study found out that 30% of the respondent were the contractors' employees, 35% were the staff of the consultant and the client. The table and figure below present the results (Table 4).

Table4. Type of the organisation of the respondents

Types of Organisations	Frequency	Percent

Contractor	12	30.0
Consultant	14	35.0
Client	14	35.0
Total	40	100.0

Source: The researcher (2021)

From the findings, 15% of the respondents had 3 to 4 years of experience, 30% of the respondents had 5 to 7 years of experience. 25% of the respondents had 8 to 10 years of experience. 5% of the respondents had 11 to 12 years of experience. 10% of the respondents had 13 to 15 years of experience. 15% of the respondents had relevant experience above 15 years, i.e., 85% of the respondent have been in construction for a long time: had relevant experience above five years road's construction, or was involved in at least 5 roads construction projects. This gives a guarantee that the data they provided is more valuable. Hence, the information collected from them were treated as valid (Table 4).

Table 4. Respondent relevant experience

Relevant working experience (Year)	Frequency	Percent
3-4	6	15.0
5-7	12	30.0
8-10	10	25.0
11-12	2	5.0

3.2 Correlational Analysis

This study used bivariate correlations analysis to established the correlation (determining the significance, strength and direction of the association) between the independent variables: factors from the client side, factors from the contractors' side, factors from the consultant side and external factors and the dependent variable: time overruns in roads construction projects. The results were displayed in a correlation matrix for factors from the client, contractor, consultant, external factors and time overruns in roads construction projects.

3.2.1 Factors of Time overruns in Roads Constructions from the contractor's side

In the benefit to respond to question one on whether factors of delays from the contractor's side are associated to time overruns in roads construction projects, a bivariate correlation procedure was applied to find out existence and significance of correlation, between the two variables, its direction and strength (Table 7). According to the above table, the correlation coefficient value is .443 which designated a positive relationship, strong relationship and a significant relationship (.004<.05) between the factors of delay from the contractor's side and time overruns in road construction projects. The above relationship indicates that the factors of delays from the contractors' side (BoQ review exceeding available budget, delay in mobilization of required resources, contractor's cash-flow problems during construction and delays in preparation of execution drawings) contributed to the time overruns of Nyungwe Belt unpaved roads construction project. This is in agreement with the KII where the experts reported that in Rwanda the contractors delay projects due to mainly the delay in mobilising the required equipment and lack of cashflow, preparation of exaggerated revised bills of Quantities and delay in preparation of execution drawings to guide the works on site. This was consistence with [24] Aamon [37] , [12], [39] land acquisition and [37] findings where the contractors' inadequate financial capacity was ranked first followed by delays in mobilising to project site on second.

Table 7. Correlation matrix between the factors of delay from the contractor's side and time overruns in roads construction projects

		Time overruns in road construction projects	The factors of delay from the contractor's side
Time overruns in road construction projects	Correlation Coefficient	1.000	.443**
	Sig. (2-tailed)	.	.004
	N	40	40
The factors of delay from	Correlation Coefficient	.443**	1.000

the contractor's side	Sig. (2-tailed)	.004	.
	N	40	40

**. Correlation is significant at the 0.01, level (2-tailed).

Source: The researcher (2021)

The inference is that the factors of delay from the contractor's side and the time overruns in road construction projects in Rwanda are associated. This would mean that restraining and avoiding the constraints, those limiting factors from the contractors' side on roads construction project would improve road construction project time performance towards the full completion of the project within the period provided for by the contract.

3.2.2 Factors of Time overruns in Roads Constructions from the client's side

In order to answer question two, on whether the factors of delays from the client's side are associated to time overruns in roads construction projects, a bivariate correlation procedure was applied to find out existence and significance of correlation, between the two variables, its direction and strength(Table 8).

Table 8. Correlation matrix between the factors of delay from the client's side and time overruns in roads construction projects

		Time overruns in road construction projects	Client related factors of delay
Time overruns in road construction projects	Correlation Coefficient	1.000	.366*
	Sig. (2-tailed)	.	.020
	N	40	40
Client related factors of delay	Correlation Coefficient	.366*	1.0
	Sig. (2-tailed)	.020	.
	N	40	40

*. Correlation is significant at the 0.05 level (2-tailed).

Source: The researcher (2021)

According to the above table, the correlation coefficient value is .366 which designated a positive relationship, strong relationship and significant relationship (P = .02 < .05) between the factors of delay from the client's side and time overruns in road construction projects. The above relationship indicated that the factors of delays from the client' side: Delays in payment of contractor's invoices, preparation of unrealistic initial works schedules, lack of detailed feasibility studies, and delayed expropriation contributed to the time overruns on Nyungwe Belt roads construction project.

This is in agreement with the KII where the experts reported that in Rwanda the client may delay projects mainly due to: delays in payment of contractor's invoices, preparation of unrealistic initial works schedules, lack of detailed feasibility studies, and delayed site possession due to uncompleted expropriation. This was consistence with other research findings where the delays in processing payments for contractors, design changes by clients during construction were ranked as most important factors of delays from the client side.[9] ,[22] , [19].

This infers that the factors of delay from the client's side and the time overruns in road construction projects in Rwanda are associated. This would mean that restraining and avoiding the constraints, those limiting factors of delay from the client' side on roads construction project would improve road construction project time performance towards the full completion of the project within the period provided for by the contract.

3.2.3 Factors of Time overruns in Roads Constructions from the consultant's side

In order to answer question three, on whether the factors of delays from the consultant (works supervisor) side are associated to time overruns in roads construction projects, a bivariate correlation procedure was applied to find out the correlation between the

two variables: its significance, direction and strength (Table 9).

Table 9. Correlation matrix between the factors of delay from the consultant's side and time overruns in roads construction projects

		Time overruns in road construction projects	Factors of delay from the consultant's side
Time overruns in road construction projects	Correlation Coefficient	1.000	.482**
	Sig. (2-tailed)	.	.002
	N	40	40
Factors of delay from the consultant's side	Correlation Coefficient	.482**	1.000
	Sig. (2-tailed)	.002	.
	N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).
Source: The researcher (2021)

According to the above table, the correlation coefficient value is .482 which designated a positive relationship, almost weak but significant relationship (.002 < .05) between the factors of delay from the contractor's side and time overruns in road construction projects. The above link indicated that the factors of delays from the consultant' side (Inflexibility of Supervising firm, late in reviewing and approving the execution drawings) contributed to the time overruns on Nyungwe Belt roads construction project.

This was consistence with [24] , [11] study results that delays in approving major changes in the scope of works as the major cause of delays in roads construction projects in Malawi.

This infers that the factors of delay from the consultant's side have a significant link with the time overruns in road construction projects in Rwanda. This would mean that restraining and avoiding those limiting factors from the consultant' side on roads construction project would improve road construction project time performance i.e., full completion of the project within the period provided for by the contract.

3.2.4 The External factors of delay and time overruns in roads construction projects

In order to answer question four, on whether the external factors of delays are linked to time overruns in roads construction projects, a bivariate correlation procedure was applied to find out the correlation between the two variables: its significance, direction and strength (Table 10).

Table 10. Correlation matrix between the external factors of delays and time overruns in roads construction projects

		Time overruns in road construction projects	External factors of delay
Time overruns in road construction projects	Correlation Coefficient	1.000	.456**
	Sig. (2-tailed)	.	.003
	N	40	40
External factors of delay	Correlation Coefficient	.456**	1.000
	Sig. (2-tailed)	.003	.
	N	40	40

**. Correlation is significant at the 0.01 level (2-tailed).
Source: The researcher (2021)

According to the above table, the correlation coefficient value is .456 which designated a positive relationship, strong and significant relationship (P=.003<.05) between the external factors of delays and time overruns in road construction projects. The above relationship indicated that the external factors of delays: Excessive rain, infectious disease - COVID 19and excessive landslides contributed to the time overruns on Nyungwe Belt roads construction project.

This is in agreement with the KII where the experts reported that in Rwanda COVID-19 consequences delayed roads constructions projects. This was consistent also with [39] study results that effects of adverse weather (rain) delayed roads construction projects.

This infers that the external factors of delay have a significant link with the time overruns in road construction projects in Rwanda. This would mean that mitigating the impact of those limiting factors on roads construction project would improve road construction project time performance i.e., full completion of the project within the period provided for by the contract.

Having found that the factors from client, contractor, client and external factors lead to time overruns in roads construction projects in Rwanda, the researcher established the ranks of the study factors according to the respondent and the results are presented in table below (Table 11).

Table 11. Overall ranking of the factors leading to time overruns

Factor description	Source of factor	Mean	Rank
Preparation of unrealistic initial works timelines	Client related factor	4.67	1
Delay in preparation of execution drawings	Contractor related factor	4.66	2
Excessive Landslides during construction	External related factor	4.65	3
Delayed expropriation	Client related factor	4.60	4
Contractor's Cash- flow problems during construction	Contractor related factor	4.55	5
Delays in payment of contractor's invoices	Client related factor	4.45	6
Infectious disease: COVID -19	External related factor	4.25	7
Lack of or Incomplete detailed feasibility studies/detailed design	Client related factor	4.25	8
Excessive Rain	External related factor	4.15	9
Delayed review and approval of execution drawings	Consultant related factor	4.12	10
Submission of exaggerated revised BoQ proposal	Contractor related factor	4.11	11
Very strict supervision firm	Consultant related factor	4.10	12
Slow mobilization of equipment	Contractor related factor	3.85	13
Delay in approving major changes during works execution	Consultant related factor	3.85	14

Source: The researcher (2021)

According to the above table, preparation of unrealistic initial works timelines was ranked as the 1st factor leading to time overruns followed by delay in preparation of execution drawings whereas, delay in approving major changes during works execution is the ranked the last.

4 CONCLUSION

There is a positive, strong relationship and a significant relationship between the factors of delay from the contractor's side and time overruns in road construction projects. This relationship indicates that the factors of delays from the contractors' side: BoQ review exceeding available budget, Delay in mobilization of required resources, Contractor's Cash-flow problems during construction and delays in preparation of execution drawings contributed to the time overruns of Nyungwe Belt roads construction project. This infers that the factors of delay from the contractor's side have a significant impact on the time overruns in road construction projects in Rwanda. This would mean that contractors should put much effort in restraining and avoiding those limiting factors on roads construction project in order to improve road construction project time performance i.e., the full completion of the project within the period provided for by the contract.

There is also a strong connection between the factors of delay from the client's side and time overruns in road construction projects. This relationship means that the factors of delays from the client' side: Delays in payment of contractor's invoices, preparation of

unrealistic initial works schedules, lack of detailed feasibility studies, and delayed expropriation contributed to the time overruns on Nyungwe Belt roads construction project. This infers that the factors of delay from the client's side have a significant influence on the time overruns in road construction projects in Rwanda. This would mean the client or government entities should put much attention on those factors in bid to restrain and avoid those constraints in roads construction project to improve road construction project time performance towards the full completion of the project within the period provided for by the contract.

There is likewise a positive influence of factors from the supervisory team side, which contribute to roads construction projects time overruns which means that the factors of delays from the consultant' side: Inflexibility of Supervising firm, late in reviewing and approving the execution drawings) contributed to the time overruns on Nyungwe Belt roads construction project. This infers that the factors of delay from the consultant's side have a significant link with the time overruns in road construction projects in Rwanda. This would mean that restraining and avoiding those limiting factors from the consultant' side on roads construction project would improve road construction project time performance i.e., full completion of the project within the period provided for by the contract.

There is also a strong connection between the external factors of delays and time overruns in road construction projects. The relationship indicates that the external factors of delays: Excessive rain, infectious disease - COVID 19 and excessive landslides contributed to the time overruns on Nyungwe Belt roads construction project. This infers that the external factors of delay have a significant link with the time overruns in road construction projects in Rwanda. This would mean those limiting factors of delays in roads construction project should be given much attention by the client, contractors and consultant to guarantee a high probability of full completion of the project within the period provided for by the contract.

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