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Analysis of Moderating effect of Performance Based contracting on the relationship between Road Assets Management and Performance of Road Agencies in Kenya

Dr. Henry Kipkurui Mutai

Kenya Urban Roads Authority, Kenya

Andolo Dan Ojijo

Research Scholar, Department of Management Science, Maseno University, Kenya

andolo3000@gmail.com

Abstract

Road asset management (RAM) is a comprehensive approach that harmonizes engineering principles, sound business practices, and economic rationality to achieve desired outcomes at the most cost-effective whole-of-life cost. Typically, road agencies (RAs) bear the responsibility of RAM. A substantial portion of Kenya's road network is in a poor or failed condition and necessitates urgent reconstruction. The government and the public are putting more pressure on RAs to boost the productivity of RAM. RAs in Kenya are deliberately transitioning away from traditional engineering approaches towards a collaborative RAM to meet the growing demand for improved road conditions. The aim of this study was to determine the moderating impact of performance-based contracting (PBC) on the relationship between RAM and RA performance. A correlation survey design was adopted, with a study population of 120 purposively selected employees directly engaged in project implementation. The findings indicated that the R² for the RAM was 0.839 demonstrating that road assets management is responsible for 83.9% of road agency performance. The R² for the impact of PBC on RA performance was 83.2, indicating that PBC accounts for 83.2% of RA

performance. The R² change was statistically significant at 0.161 (P=0.00), demonstrating a moderation effect of PBC. Overall, the findings imply that RAM and PBC make a substantial contribution to the performance of road agencies. Therefore, the study recommends that road agencies should include RAM and PBC in their road maintenance policy to improve overall road quality and meet stakeholder expectations.

Keywords: Road network, Performance Based Contracting, Road agencies, Road asset management (RAM), Performance-based contracting (PBC).

Introduction

Performance-based contracting (PBC) according to (Stankevic, Qureshi and Queiroz, 2005) is a type of contract in which payment for output is expressly aligned to the contractor's successfully meeting or surpassing certain clearly defined performance metrics.

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It involves an important shift away from more traditional approaches to the delivery and maintenance of road infrastructure and associated services by a shift from the situation where the client has responsibility for the design and supervision of construction and maintenance activities, to a focus upon the key outcomes that the client wishes to achieve and incentivizing the achievement of those outcomes.

Payments paid to the contractors are based on measurable "outputs" that represent the stated and goal conditions of the roads covered by the contract, not on amounts of work measured by unit pricing for work "inputs" or physical works. Nevertheless, Sultana (2013) argued that the conventional approach of maintenance contracts has long been understood to be inefficient and costly because a customer (the road authority) is required to manage and compensate both the consultant and the contractor. Sultana (2013) outlined the drawbacks of the conventional approach, such as the rising costs and length of the project, the subpar quality of the work and low motivation of the contractors, the lack of a clear risk-sharing agreement between the contractor and the road agency, and the delay in project completion.

According to Anastasopoulos et al. (2009) in the conventional method-based contracts, the road agency specifies techniques, materials, procedures, quantities, as well as the duration of the contract, but under PBC, however, the road agency defines minimum performance standards that must be met or exceeded during the duration of the contract. The key feature of PBC is that contractors are paid for the results

obtained rather than by carrying out the work according to a predetermined methodology. As a result, contractors are compensated according to how successfully they achieve the established performance goals.

Contrary to conventional methods of contracting out road maintenance, which focus more on work procedures and materials to be employed than results, new technology adoption by the contractor is severely constrained (Zietlow, 2005). Contractors are paid in installments, typically per month. Increases or decreases in a payment can be used as incentives or penalties for meeting or failing to meet the set performance target (Ozbek et al.; 2011). As a result, PBC gauges a contractor's success based on how effectively they achieve their performance targets. Through promoting value engineering and greater efficiency, PBC seeks to promote contractor innovation and increase quality (Gupta et al.; 2011). By giving the contractor enough time to implement new technology and recoup research costs, it allows for long-term planning.

When used in the roads sector, road asset management is a systematic approach for maintaining, improving, and managing roads that combines engineering principles with good business practice and economic principles. It also provides tools to enable a more structured and flexible approach to decision-making so that the public's expectations are met (OECD, 2001). Road asset management refers to the management of road agency resources more like an enterprise. The requirement for road agency managers to establish a common language with budget holders is a crucial component of this, as it will give them the crucial capacity to illustrate the ramifications of

investment options. Estimating the value of road assets is necessary for this practical approach to managing road assets, as this value is a key determinant of the priorities for future investment in road assets (New York State Department of Transportation, 1998).

The valuation process, which places a strong emphasis on economics or finance, marks a change in mindset from the conventional engineering approach to developing transport programs. Values of road assets can be stated in a number of different ways. For instance, the intrinsic economic value of each road asset to the transportation system as a whole, or the value of the effective movement of people and products. The cost of restoring each road asset to its "as built" condition or the cost of replacing it in kind might, instead, be used to determine the capital value of each asset. The use of such accounting words to convey the worth of road assets is a crucial step in creating a shared vocabulary between engineers, finance management, and road boards (OECD,2001).

According to Transport Association of Canada (TAC, 1999), integration is one of the most important components of managing road assets. The Road Asset Management System (RAMS) uses existing administrative data sources to provide an integrated approach to all administrative costs, including road user, works administration, environmental, and social costs. It combines the management systems that are now in place for certain assets, such as the management systems for roads, bridges, traffic, and safety. This unification gives the road agency consistent data across the whole system, enabling the distribution of funding resources among competing needs for pavement, structures, and other types of

infrastructure. Community engagement, according to OECD (2001), is a crucial component of managing road assets since it helps to understand stakeholder demands and public expectations.

Monitoring the performance of the road asset against specified needed outcomes or performance targets is another crucial component of using road asset management systems (OECD,1997). Using performance indicators to track advancement toward fulfilling the goals of the road agency is one strategy for doing this. The straightforward recording of the road asset's condition over time is one of the easier methods. The percentage of condition level, effects on users, levels of safety, effects on the environment, and financial aspects of the road network are only a few of the various ways that performance can be represented.

Even though Kenya has long used a traditional approach to managing and maintaining its roads, the majority of its highways have potholes, which frequently result in fatal car accidents every year. As a result, the general condition of Kenya's paved and earth roads falls short of what is expected by road users.

This is a result of Kenyan road agencies' failure to carry out their primary duty of managing and maintaining road assets. Since blame is deflected to the government, which provides funding from the fuel fee to the road agencies for the maintenance of roads, studies examined have revealed conflicting findings regarding the impact of RAM on road agency (RA) performance. For example, Nyandika & Ngugi (2014) discovered that stakeholder involvement significantly affects the

performance of road projects in Kenya. This finding was supported by Njogu (2016) and Wairimu (2016), but Ruwa (2016) found different results regarding the impact of stakeholder participation on the performance of donor-funded projects. According to the study, there was a negative correlation between project performance and stakeholder involvement in planning. These conflicting findings indicate the presence of a third component in the link between RAM and RA performance, which, when introduced, can alter the relationship between RAM and RA performance's direction.

Literature review

Theoretical Literature Review

This review explores the theory/ies that the study is anchored on. The main theory identified that covers the variable dimensions of the study is the goal setting theory.

Goal Setting Theory

According to goal-setting theory, which was created by Latham and Locke (1994), motivation and performance are higher when people have explicit goals, when those goals are challenging but accepted, and when they receive performance feedback (Armstrong, 2005). This goal-setting theory only asserts that the intention and desire to achieve a goal serve as the source of motivation (PSU WC, 2015). Individuals or teams are generally inspired to increase effort or adjust their approach when they discover that their current performance is not leading to the desired goals.

The goal setting theory, according to Locke and Latham, is founded on the idea that a lot of human conduct is purposeful because it is motivated by conscious aims. Setting a goal is

a response to dissatisfaction with one's present performance levels. Establishing a target should also involve creating a framework for the actions and behaviors that will be used to enhance the subpar performance. When heads negotiate and set goals for their particular sections with top managers of local authorities under performance contracts, the theory is put into practice. Road maintenance contracts are intended to be awarded to contractors who are able to satisfy certain performance goals as a result, cascading down through the various levels of road agency hierarchies. The road agency offers the contractor with road performance targets, which they must reach in order to be paid, and this study draws on goal setting theory to explain this. No matter how much time and effort they put into building and maintaining the roads, the contractors forfeit their payment if they don't keep them up to the required standards.

The Concept of Moderation

A moderator variable is a third variable that affects the strength of the relationship between a dependent and independent variable in correlation. A basic moderator effect can be represented as an interaction between a focal independent variable and a factor that specifies the appropriate conditions for its operation. Evidence of moderation exists when interaction terms account for significant incremental variances in a dependent variable, either individually, signified by the values of the betas, or collectively, signified by the values of the incremental F-statistic (Dean and Snell, 1991).

The purpose of moderation analysis is to discover hidden effects in relationships. In this study moderation is hypothesized. Performance

based contracting (PBC) is a moderator in the relationship between road assets management and performance of road agencies. In this study, PBC was chosen as a moderating variable as suggested by Greenwood, Porter, & Henning (2012) who did a review paper of how performance-based contracting delivers good asset management in Auckland, New Zealand that performance-based contracting is a better way of delivering good road asset management though this has not been empirically tested.

Road Agency Performance

Salih et al. (2016) contend that regardless of how much progress has been made toward the goal, performance indicators in roadways are crucial for gauging the agency's output. However, Suslo and Hartano (2001) underlined that the use of performance indicators in roads could be divided into monitoring, diagnosis, management, prognosis, effectiveness, and efficiency, as well as comparisons that road users may employ.

The effectiveness, relevance, efficiency, and financial viability of a road agency are all balanced on a multidimensional scale, according to Pinard (2015). According to Marcelino, Lurdes Antunes, & Fortunato, (2018) assessment of performance indicators for road pavement condition, quantitative comparisons between administrations are only really helpful if they are done in conjunction with a careful analysis of the underlying causes of any disparities. Road user costs, travel time, risk to road users, resource allocation for road infrastructure, road roughness, and road user satisfaction were the performance metrics for road assets that they identified.

Conceptual Framework

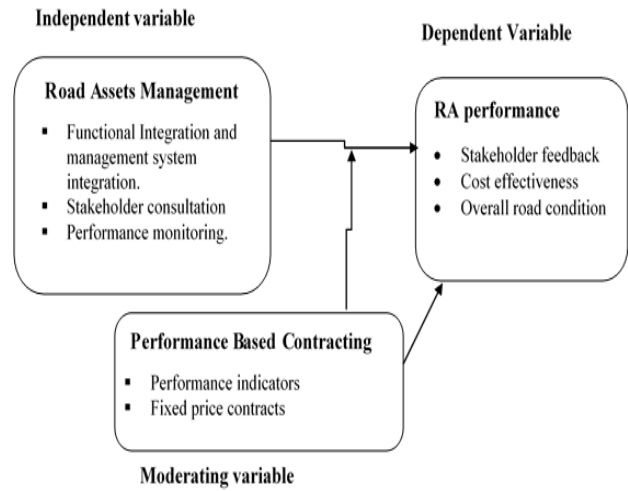


Fig 1: The expected relationship between Performance Based Contracting, Road Assets Management and Performance of Road Agencies in Kenya

Source: Modified from OECD (2012) & Zietlow (2005)

The interaction between the dependent variable, performance, and the moderating factor, performance-based contracting, is shown in the figure for the independent variable, road assets management. When a road agency adopts performance-based contracting for road assets management, it is anticipated that the agency's overall performance will increase in terms of stakeholder satisfaction, cost, and better overall road condition (Greenwood, 2012).

Also, this would assist the road agency in carrying out their primary responsibility. The paradigm was modified from Zietlow's (2005) argument that performance-based management reduces costs and improves road quality, which in turn satisfies the stakeholders in the road system. On the other hand, OECD (2012) in their report stated that the functional integration

and management system are the primary components of road asset management.

Empirical Literature Review

At the Kenya National Roads Authority (KeNHA), Nyandika & Ngugi (2014) examined the impact of stakeholders' involvement on the execution of road projects. This study set out to discover how stakeholders' involvement affected how well road improvements in KeNHA were carried out. The goal of the study was to ascertain how resources, top management support, technology, and user involvement impacted stakeholders' participation in the execution of road projects funded by KeNHA. The study indicated that user involvement conferences and seminars had a significant favorable impact on the execution of road construction. In addition, IT skills, computer aided designs, use of intranet and internet and IT policies were found to influence the execution of road projects to a large extent.

Njogu (2016) looked into how the National Environment Management Authority's projects performed when stakeholders were involved (NEMA). The research design used in the study was a descriptive survey. The findings showed that project performance for automobile emission control projects is significantly influenced by stakeholder involvement in project identification. Further research revealed that the performance of the automobile emission control project was significantly and positively impacted by stakeholder involvement in project planning. The results also showed that the performance of the automobile emission reduction project is positively and significantly influenced by

stakeholder involvement in project implementation.

Kinango Integrated Food Security and Livelihood Project (Kifslp), Kwale County, Kenya, was the focus of a study done by Ruwa (2016) on the impact of stakeholder involvement on the performance of donor-funded initiatives. Initiation, planning, implementation, monitoring, and evaluation are the four (4) phases of the project cycle that the study took into account. According to the study, there was a negative correlation between project performance and stakeholder involvement in planning.

The sample method for performance-based road maintenance evaluations was examined by De la Garza, Piero, and Ozbek (2008). The purpose of the article was to explain why it can be difficult for many transportation authorities to keep the road infrastructure at a high level of condition while having access to relatively restricted resources. The study produced a presentation of a three-stage and seven-step statistical sampling process designed to guarantee that field inspection results were accurate and representative of the true condition of asset items across the board. In circumstances where sampling needs to be done more than once during the course of a performance-based road maintenance contract, three alternate methodologies were also offered.

Wirahadikusumah, Susanti, Coffey, and Adighibe (2015) conducted a study on performance-based contracting (PBC) for roads in Australia and Indonesia. The study focused on relevant PBC case studies from Australia and analyzed the contracts' scope, bidding



procedures, risk distribution, and significant factors. The research revealed that the implementation of PBC led to additional benefits for the government and public, such as cost savings and improved road asset conditions.

A study was conducted by Wairimu (2016) in Embakasi, Nairobi County, Kenya, to determine the variables that impact the completion of road construction projects. The study focused on identifying factors that affect the success of road improvements, specifically how resources, personnel competency, stakeholder participation, procurement practices, and project completion influence the outcome of road constructions. The research design utilized was descriptive. The findings revealed that staff competency has a positive correlation with the completion of road building projects, as possessing the necessary knowledge, experience, and skills in the field enables staff to perform their assigned tasks effectively. Additionally, the study established that stakeholder participation positively and significantly contributes to the success of road construction projects, and thus they should be motivated to participate actively.

The study conducted by Sultana, Rahman, and Chowdhury (2013) reviewed the concept of performance-based maintenance of road infrastructure through contracting. They focused on identifying relevant topics that could potentially reduce maintenance costs and effectively manage contracting timeframes for road authorities. The main objective of the paper was to assess recent literature studies on PBMC, citing developed and developing nations that have successfully maintained their road network systems through this method of

contracting. The authors concluded from their study that the challenging aspects of PBMC that require further attention include its ability to lower maintenance costs, improve work quality, and decrease the likelihood of corruption in developing nations.

Summary of Literature and Gaps

Mixed findings from research on the relationship between RAM and RA performance suggest the presence of a third component (moderator) that, when included, has the potential to completely alter the relationship. While Wirahadikusumah, Susanti, Coffey, and Adighibe (2015) found that implementing PBC offers additional benefits for the government, such as cost savings and improved conditions of contracted road assets, they disagreed with Piero & de la Garza's (2008) assertion that PBC promises to be an excellent tool to improve government efficiency in maintaining transportation networks. These results point to a potential moderating influence of PBC on road maintenance.

Moreover, Sultana et al. (2013) assert that the absence of PBC may prevent road asset management from meeting performance goals. Hence, according to Gupta et al. (2011), PBC defines success in terms of how effectively the contractor meets the stated performance targets. Through promoting value engineering and increased efficiency in road asset management, PBC seeks to promote contractor innovation and enhance quality. So, it follows that PBC must be included in road asset management in order for contractors to fulfill and even surpass the specified performance standards. The moderation has not yet been scientifically tested.

Methodology

Research Design

The study used a correlational survey design. According to Fife-Schaw, Breakwell, and Hammond (1995), correlation design is a tool that enables measurements of two or more variables at about the same or concomitant times and provides appropriate ground for the investigation of the relationship between the variables. The formation of associations utilizing regression techniques would be improved by a correlation study design, resulting in the intended outcome of the research objectives.

Population

Study population as defined by Cooper & Schindler (2003) refers to the collection of elements about which we wish to make some inferences. The population of this study comprised of 250 employees drawn from procurement, Finance and engineering departments of Kenya National Highways Authority (KeNHA), Kenya Rural Roads Authority (KeRRA), and Kenya Urban Roads Authority (KURA) who are involved in project implementation. This included resident engineers, procurement officers and finance officers in every region and the headquarters. The staff selected were expected to be best placed to articulate issues in the study as they have the conceptual view of their respective organizations (Elbanna and Child, 2007), a view supported by Hambrick and Mason (1984) who argued that that organization strategy is shaped by perceptions and opinions of its leadership.

Reliability Test

Reliability refers to the extent to which an experiment, test, or any measuring process

provides the same results on repeated trials. The ideal motive is to test stability by administering the instrument to the survey respondents twice. Cronbach's Alpha was employed in this study to examine the instrument's reliability (Cronbach, 1951).Hair et al,(1998) recommendations state that a reliability test coefficient of 0.7 is acceptable.

Regression Model

$$Y = \beta_0 + \beta_1 X_{1i} + \beta_2 Z_{1i} + \beta_3 (X_{1Z1} X_{2Z2})_i + \epsilon$$

Where:

Y= Dependent variable (Operational Performance)

X = Independent variable (Road Assets management)

Z = the moderator variable (performance-based contracting)

i = the number of units under investigation

ϵ = errors in the equation.

β_0 = is the Y-intercept showing the operational performance without the effect of other variables. (When the other variables are 0).

β_1 = is the coefficient relating the independent variable when the moderators are 0.

β_2 = is the coefficient relating to the moderator variables, when independent variables are equal to zero (X=0).

β_3 = is the regression coefficient for the interaction terms. It is an estimate of the moderation effect. If β_3 is statistically different from 0, indicated the presence of significant moderation of road assets management on operational performance.

Results and Discussion

Testing the Moderating effect of PBC on the Relationship between Performance Based Contracting and Performance of Road agencies

The study tested the interaction between road asset management, performance based contracting and road agency performance. Hierarchical regression was used by first entering road asset management in the first step followed by entering the interaction variable which is a product of standardized RAM and PBC in the second step. The standardized values were used for the interaction variable so as to reduce threats of multicollinearity by reducing the size of any high correlation of RAM and PBC with the new interaction variable. The results were shown below:

Table1: Moderating effect of PBC on the Relationship between Performance Based Contracting and Performance of Road agencies.

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	β			Tolerance	VIF
1	(Constant)	0.143	0.134		10.532	0	
	Road assets management	0.373	0.193	0.561	1.933	0.056	0.992
	Performance based contracting	0.199	0.166	0.347	1.196	0.235	0.993
2	(Constant)	7.207	0.297		24.264	0.000	
	Road assets management	1.893	0.081	2.847	23.305	0.000	0.983
	Performance based contracting	3.393	0.121	5.917	27.926	0.000	0.993
	Interaction	0.626	0.021	7.849	29.339	0.000	0.981
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
1	.906 ^a	0.82	0.817	0.19283	R ² Change	F Change	df1
2	.991 ^b	0.981	0.981	0.06252	0.161	860.79	1

- a.Predictors: (Constant), Road assets management, performance based contracting
- b.Predictors: (Constant), Road assets management, performance based contracting, Interaction
- c.Dependent Variable, Road agency performance

The Change in R2 was assessed such that if R2 was found to be significant, then moderating effect was confirmed. Results above shows that R2 change was significant and positive at 0.161 (p < 0.01) when the interaction variable was added to the predictor and moderator variables. This means that the interaction term brings a positive change in performance by 16.1%. The model (b) was found to be significant meaning that it can predict variance of performance. The significant interaction indicates that the presumed moderator (PBC) does actually moderate the effect of the predictor (RAM) on the outcome variable (Road agency performance). The hypothesis that PBC does not have a moderating effect on the relationship between road assets management and road agency performance is therefore rejected.

The adjusted R2 of model (a) is 0.817 and its R2 is 0.820. For the model (b), R2 0.981 while adjusted R2 is 0.981. The difference in the two cases of R2 for each model are less than a ceiling of 0.5 that was suggested by Field (2005). This small change implies that the models are valid and are stable for prediction of dependent variable, road agency performance at 83.9% and 96.7% variance respectively. According to Fairchild and Mackinnon (2009), the interaction effect in this case is 98.1% - 82.0% = 16.1% which is low but never the less confirm moderation.

The significant interuaction is an indicator that the presumed moderator (performance based contracting) does actually moderate the effect of the predictor(Road assets management) on the outcome variable which is road agency performance. The hypothesis that RAM moderates the relationship between road assets management and performance of road agencies

in Kenya was rejected. As a result, the hypothesized moderation model was therefore confirmed to be:

$$Y = 7.207 + 2.847X + 5.917Z + 7.849XZ$$

The model implies that a unit change in standard deviation of the interaction will result in 7.849 standard deviation variance in road agency performance this applies to performance based contracting and the interaction term. The study recognized the earlier suggestion by Greenwood, Porter, & Henning (2012) that performance based contracting in road contracts moderates the relationship between road assets management and road agency performance.

Conclusions and Recommendation

From the findings of this study, it can be concluded that performance based contracting moderates the relationship between road assets management and performance of road agencies. However, the study recommends that the road agencies in Kenya should give higher priority to road maintenance just as road building. Similarly, stakeholders should be consulted in making decisions about the roads to be built and maintained. Moreover, for effective road agency performance, there should be a team approach to RAM and regular performance monitoring of the contractors to ensure that they meet performance targets. The road agencies should also emphasize pegging payments to contractors' successfully meeting clearly defined performance indicators. This will encourage road contractors to seek innovative ways to meet the performance targets.

Similarly, it is recommended that future research endeavors to interrogate other possible

moderator variables apart from PBC on the relationship between RAM and road agency performance. This will help clarify theory particularly goal setting and stakeholder theories that this study is based on.

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