Value for Money Model for Road Maintenance for the Roads Fund Board in Tanzania

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An Abstract
Permanent road connectivity is a key enabler of economic growth and transition in Tanzania. By providing and maintaining sustainable physical networks and services upon which living society depends for the movement of people and goods, and by connecting areas of economic activities within the economies increase access of businesses and consumers to markets and services, promote economic diversification, regional integration and supporting optimal growth of the wider economies.

The Tanzania Roads Fund Board (RFB) was established by the Road and Fuel Tolls Act Cap 220 in Tanzania to manage the roads' fund that is dedicated to roads maintenance. Pursuant to law, the functions of the board, among others, is to apply the money deposited for the purposes approved by the parliament; to disburse funds from the fund to TANROADS, local authorities and other agencies; to ensure that the operations of TANROADS, local authorities, other road agencies and the fund are technically and financially sound and to monitor the use of the funds disbursed to TANROADS, local government authorities or other agencies for the purposes and objectives of the fund in Tanzania.

The RFB uses an eclectic non-parametric Value for Money (VfM) model to provide in-depth quantitative analysis of roads maintenance projects performance financed by government so as they will be in a position of making some improvements through lesson learnt from the previous projects. Value for Money (VfM) model is a living monitoring and evaluation performance framework whereby the important social economic interdependent variables are used to assess the value for money of public spending; i.e., the optimal use of resources to achieve the intended development outcomes.

This case study attempts to formalize the Value for Money model for the Road Fund Board in Tanzania. The case study provides background, objectives, assumptions / conditions, key variables and basic structural VfM model determination. Also, the case study presents Value for Money Assessment Tool; its application and indicative quantitative data analysis.

Key Words: Value for Money Model, RFB Tanzania

1.0. Introduction
1.1. Background
Permanent road connectivity is a key enabler of economic growth and transition in Tanzania and in the Sub Saharan African region. By providing the sustainable physical networks and services upon which these economies depend for the movement of people and goods, and by connecting areas of economic activities within Tanzania increases the access of businesses and consumers to market and

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services, promotes economic diversification and regional integration, supporting
growth of the wider economies. The Tanzania road network is estimated to be
87,000 km long which includes trunk, regional, district, feeder and urban roads.
Urban, district and feeder roads, which are estimated to be over 52,000 km, are
managed by Local Government Authority (LGAs) while regional trunk roads
(25,000 km) are managed by Tanzania National Roads Agency (TANROADS). In
addition to this, some road networks that are in National Parks and Game Reserve
are managed by the Tanzania National Parks (TANAPA) and other institutions.

Also, the Tanzania network integrates a national and regional series of strategic
trading corridors linking Tanzanian ports such as Dar-es Salaam, Tanga and
Mtwara to the landlocked countries of Zambia, Rwanda, Burundi, Malawi and
eastern part of DRC Congo. The roads are desired to be in good condition, adequate
enough to sustain speeds well in excess of the effective velocity of transit along
these routes, which is rendered pitifully low by administrative bottlenecks at
borders and ports. The main Tanzania road transport challenge is that only about
10% of network is paved and about 90% is unpaved which is susceptible to vagaries
of weather hence more resources are required to keep the network passable all the
year by providing funds for spot improvement and emergencies. The critical
infrastructure policy issue is to maintain the roadway systems at the best possible
condition by investing the minimum amount of money will always keep
transportation agencies searching for innovative approaches that will provide the
most of benefits to taxpayers, (Piñero, 2003 and Mwaipungu and Allopi, 2014).

In accordance with the law which established the Roads Fund CAP 220 of 2006,
into which shall be paid all monies collected as roads and fuel tolls imposed on
diesel and petrol, transit fees, heavy vehicle licenses, vehicle overloading fees, or
from any other source at the rate or rates to be determined by Parliament from
time to time. The law requires at least 90 percent of money deposited in the fund
shall be used for maintenance and emergency repair of classified roads and related
administrative costs in Tanzania Mainland in accordance with approved operation
plans and at least 10% be used for development projects and related administrative
costs 7 percent of funds are allocated to the Ministry of Works to finance
development projects.

About 63 percent is allocated to TANROAD and 30 percent is allocated to PORALG
for road maintenance and development projects, respectively. Road Fund Board
(RFB) is assigned the responsibilities to ensure full collection of funds,
disbursement and to monitor its utilization and the fund are technically and
financially sound and to monitor the use of the funds disbursed to TANROADS,
local government authorities or other agencies for the purposes and objectives of
the fund. The Performance Agreement (or Specifications) stipulates, in Clause 5.3,
that; The quality of all road maintenance works shall be in accordance with the
Maintenance Standards, Relevant Specifications as Agreed and Safety Standards
as per recognized.
Like other road fund boards in the Sub Saharan African countries, the RFB has initiated above mentioned performance-based specifications as a strategy to improve the efficiency of the services given uses of public funds. These initiatives articulate Performance-Based Road Maintenance (PBRM) system to be adopted by RFB in Tanzania. PBRM system calls for performance-based work, in which an optimal or desired outcome is preferable for given inputs, processes and outputs. The PBRM has been an excellent tool to improve government efficiency in maintaining transportation networks in Tanzania. However, without proper effective monitoring, controlling and evaluation (MC&E) system, it will likely yield adverse outcomes. Since PBRM system is relatively new in many developing economies, the availability of reliable and comprehensive sets of MC&E instruments and guidelines for ex-ante (prospective) and ex-post (retrospective) evaluations for the effectiveness and efficiency of these types of specifications in the road maintenance arena have been inadequate, non-tested and ineffective.

We acknowledge existence of a larger body of analytical and operational research issues on evaluations of infrastructure projects recognizing the differences between retrospective and prospective evaluations (Li & Sinha, 2004; Sinha, et al 2009 and Bryce, et al 2014). These are very relevant in decision-making processes in transportation project development and programming, which can help transportation professionals to optimize their investment choices during the design and planning stages. These analytical issues include developing performance measures for evaluation, estimating travel demand, and costing transportation projects; performing an economic efficiency evaluation that accounts for such factors as travel time, safety, and vehicle operating costs; evaluating a project’s impact on economic development and land use as well as its impact on society and culture; assessing a project’s environmental impact, including air quality, noise, ecology, water resources, and aesthetics; evaluating alternative projects on the basis of multiple performance criteria; tradeoffs between costs, condition and energy consumption and programming transportation investments so that resources can be optimally allocated to meet facility-specific and system-wide goals (Li & Sinha, 2004; Sinha, et al 2009 and Bryce, et al 2014).

By design these analytical issues on retrospective and prospective evaluation of infrastructure projects can be categorized either as multiple-criteria (ex-post) evaluation problems or multiple-criteria design (ex-ante) problems. Whether it is an ex-post or retrospective evaluation problem or a design ex-ante problem, preference information of decision-makers (DMs) is required in order to differentiate between solutions. The solution methods for multiple-criteria decision-making (MCDM) or multiple-criteria decision analysis (MCDA) is a sub-discipline of operational research that explicitly evaluates multiple conflicting criteria in decision-making MCDM problems that are commonly classified based on the timing of preference information obtained from the DM.

This case study focuses on the use of retrospective evaluation or ex-post impact evaluation methods which assess the degree to which Performance-Based Road
Maintenance goals are met by RFB in Tanzania. It also considers changes in the road maintenance project environment - administrative, physical, and intellectual resources during implementation phases. An ex-post or retrospective evaluation has been important in both evaluating the impact of unplanned changes and in determining the need for planned changes. This form of evaluation may include inputs/resources, processes and outputs from the quality and project management processes as well as metadata accumulated through the project implementation phases.

The RFB uses an eclectic non-parametric Value for Money (VfM) model to provide in-depth quantitative analysis of roads maintenance projects performance financed by government so as they will be in a position of making some improvements through lesson learnt from the previous projects. Like many other transportation agencies, RFB currently rely on criteria and procedures which have had developed from their ad-hoc and experimentation methods used to evaluate performance (Mwaipungu and Allopi, 2014). Unfortunately, some of these procedures cannot appropriately be justified and improved to cater for dynamic settings for the maintenance of the roadway systems in developing nations (White, 2009).

1.2. Objective of the Paper and Methods

The paper formalizes the Value for Money (VfM) Model used by the Road Fund Board in Tanzania in a logical, readable and operational fashion (Roads Fund Board, 2008). One of the benefits of formalizing an operational model, which has met the test of the second-generation reforms is the opportunity to research and refine the PBRM system (Benmaamar, 2006). The refinement provides for improvement - to delete archaic and install the novel, to introduce more relevant illustrations and to build on an accepted framework of ideas. The level of analysis is tailored for the postgraduate students in policy analysis, planning, project management, performance auditing, monitoring, controlling and evaluation courses. The paper articulates the conceptual framework that can serve as a MC&E system in the implementation and evaluation of performance-based road maintenance systems (Piñero, 2003 and White, 2009).

The paper has five main sections. Section 1.0 is an introduction consisting of the background, objective and research methods of the paper. Section 2.0 formalizes the Theoretical Value for Money model. This entails specifying scope and uses of value for model, definitions of key variables; major model assumptions and structural Value for Money Model. Section 3.0 derives the Quantitative RFB-VfM model. This includes formal quantitative RFB-VfM Model, RFB-VfM model determination, use and results of the RFB-VfM model. Section 4.0 presents indicative data application and results of the RFB-VfM model. Section 5 is a conclusion.

Based on the study, three independent but complementary methodologies and procedures were used. These included [1] desk study or literature reviews, [2] field research survey - consultations with key informants on the Value for Money model and [3] model drafting, revisions and determinations.
2.0. The Eclectic Value for Money Model

2.1. Scope and Use of Value for Money Model

The traditional problem of the Value of Money has been a special case of the general problem of economic value (Anderson, 1917 and Patnaik, 2009). According to the economic problem, value has been a phenomenon of social psychological nature that has been relevant when the problem of value and price causation is involved. Economic value is a species of the genus, social value, coordinate with social political, legal and moral values. It is part of a system of social motivation and control. Social psychological in character, it none the less presents itself to an individual as an objective, external force, to which he must adapt himself. Individual cost-prices have two cooperating causes: (a) the social economic value of the money-unit, and (b) the social economic value of the unit of the good in question (Anderson, 1917 and Patnaik, 2009).

Founded on the above traditional concept, the Modern and Operational Concept of Value for Money is about forming an objective assessment about whether a programme, project or activity is designed to, or has achieved, the best use of resources to optimize costs and benefits (outputs, outcomes, quality of service and increasingly issues of equity (Bourn, 2007 and Chris Barnett, et al, 2010). Value for money studies typically follow a structure of diagnosis — what is the issue, e.g., under performance or scope for doing things better to arrive at a hypothesis; the second stage is analyzing the underlying data — both quantitative and qualitative to test the hypothesis; the final stage is synthesis, where the data derived from the analysis is triangulated to arrive at well founded conclusions to derive practical recommendations for improvement (Bourn, 2007 and Chris Barnett, et al, 2010). This owes much to the common types of or performance audit or public audit in many developed democratic nations with good governance.

Figure 1 summarizes the Structural Value for Money model. In Tanzania, the use of modern operational Value for Money (VfM) concept has been to provide in-depth analysis of roads maintenance projects performance financed by Roads Fund Board so as to be in a position of making some improvements through lesson learnt from the previous projects (Mwaipungu and Allopi, 2014). The Value for Money (VfM) instrument is a generic monitoring and evaluation system tool whereby the important social economic evaluation interdependent variables are used to assess the value for money of public spending i.e., the optimal use of resources to achieve the intended development outcomes (Bourn, 2007 and Barnett, et al, 2010).

Value for money or performance audit refers to an independent examination of a program, function, operation or the management systems and procedures of a governmental or non state agency entity to assess whether the entity is achieving economy, efficiency and effectiveness in the employment of available resources (Bourn, 2007). This examination is objective and systematic, generally using structured and professionally adopted methodologies. In many cases, performance audits of governmental activities are carried out by the external audit bodies at central or local levels. Many of these audit bodies have well-established guidelines
for conducting performance audits which explain how performance audits are planned, conducted and its results reported (Bourn, 2007 and Mwaipungu and Allopi, 2014).

The scope of performance audits may include the detection of fraud, waste and abuse, although often these are not included in the scope (Bourn, 2007). Prior to engaging in a performance audit, the auditor must have a scope and plan defined which will be used to guide the audit process. Performance auditing differs from performance measurement, the latter being the responsibility of management of the entity. In addition, performance measurement may include a broad variety of activities that do not meet the rigor of an independent external assessment (Bourn, 2007 and Patnaik, 2009).

It is important to ascertain that the VfM is a special tool for retrospective evaluation of road maintenance systems. This involves continuous data gathering and analysis of information on the operational efficiency and effectiveness of, and trends in, e.g., the gravel road performance. Continuous retrospective evaluation provides the motivation for initiating, continuing or changing a course of action or for reviewing policies, objectives or goals at both local and national levels (Mwaipungu and Allopi, 2014). The VfM model provides an incentive to agencies to improve the impact of the resources they expend, much of which comes from taxpayers, donors and sponsors. Used appropriately, VfM frameworks enable agencies to put forward a powerful narrative of the real impacts and value of their work with communities and all stakeholders.

2.2. Major Model Conditions, Theoretical and Operational Assumptions
It is noted that the theoretical VfM model requires a comparative analysis of all relevant direct and indirect costs and benefits of each process or stage throughout the whole road maintenance cycle (Anderson, 1917). The VfM model articulates the ‘optimum combination of whole-life cost and quality (or fitness for purpose) to meet the user’s requirement’. The VfM, therefore, entails something other than lowest-cost provision; it must also meet the conditional expectations of the organisation that is expending the resources (Mwaipungu and Allopi, 2014).

2.2.1. Main Model Conditions
The following are main VfM model conditions;

A. Existence of sustainable national development vision, mission and strategic plans on road maintenance as foundation for providing, controlling, effecting and executing road funds.

B. All private consulting firms, construction companies, government ministries, departments and road maintenance agencies have same and consistent development views and interests or at least not conflicting interests concerning use of public money in the road maintenance.
C. Existence of an effective institutional framework or management system with the sole responsibility of managing and coordinating road maintenance activities. The system of road maintenance constitutes an impressive institutional structure through which additional resources can be channeled for sustainable infrastructural road development.

The satisfaction of the above basic system conditions for good governance justifies or ensures a possibility of attaining sustainable road maintenance system, that is, vital for any meaningful contribution of public financing in the road maintenance. The first condition ensures that fungibility may not be an issue, i.e., if there are identical preferences, and then it would not matter if public fund were given to TANROADS or as budgetary support to LGAs.

The second and third conditions suggest that the absorptive capacity, ownership and equity are assumed not to be constraints or limiting factors (Bourn, 2007). When the policy environment is right, when the institutional capacities are no longer a limiting factor, and when the RFB works in partnerships with all stakeholders, the effects of public funds can be positive. These conditions ensure that there are no conflicting interests between government, road maintenance agencies, funding entities on the use of resources in road maintenances for poverty alleviation or/ and optimal wealth creation (Patnaik, 2009; Mwaipungu & Allopi, 2014).

2.2.2. Major Theoretical Assumptions for the Value for Money Model
The major theoretical assumptions for the Value for Money Model are (1) perfect competitive market conditions, (2) applied theory of change and (3), competitive tendering of delivery.

A.1: Perfect Competitive Market Conditions
A competitive market condition exists in the road maintenances, whereby there is very low or no entry and exit barriers and thus there are no restraints on road construction firms, suppliers of services and goods, consultants on entering or exiting the market. Also, there is perfect information and knowledge about all inputs, processes, outputs, quality, prices, incomes and costs. The model on road maintainances as in Figure 1 assumes that the desired objectives/ outcomes are known (or knowable once RFB chooses to undertake such an analysis), measurable, and are able to be linked via a linear ‘results chain’ back to outputs and inputs. Figure 1 suggests a ‘linear’ understanding of causality and VfM underpins most interpretations of VfM found in the model, even those that move beyond a direct focus on road maintenance.

All participating road construction firms and consultants are corporate entities, whereby these businesses operate when the most profit is maximized, where marginal costs meet marginal revenue (Debreu, 1972). These are rationale economic entities whereby all economic transactions that increase their economic utility and make no trades that do not increase their utility. When conditions of perfect competition hold, it has been proven that a market will reach an
equilibrium in which the quantity supplied for every product or service, including labor, equals the quantity demanded at the current price (ibid.). This equilibrium will be a Pareto Optimum, meaning that nobody can be made better off by exchange without making someone else worse off (ibid.). Such markets are allocative efficient, as output will always occur where marginal cost is equal to marginal revenue and thus attaining value for money. The economy will be dynamic, vibrant and changing with technological development (Mwaipungu and Allopi, 2014).

A.2: Applied Theory of Change
The road maintenance processes and activities work from the assumption that the links between inputs, outputs, outcomes and longer-term development impacts are known and, therefore, a linear pathway between the four can be navigated provided the right measurement tools are employed. Figure 1 suggests that VfM presupposes a relatively simple theory of change. The Theory of Change defines long-term goals and then maps backward to identify necessary preconditions (Rogers, 2014 and White 2009). This explains the process of change by outlining causal linkages in an initiative, i.e., its shorter-term, intermediate, and longer-term outcomes.

The identified changes in Figures 1 and 2 are mapped – as the “outcomes pathway” showing each outcome in logical relationship to all the others, as well as chronological flow. Figure 2 suggests that the links between outcomes are explained by “rationales” or statements of why one outcome is thought to be a prerequisite for another. The innovation of Theory of Change lies (1) in making the distinction between desired and actual outcomes and (2) in requiring stakeholders to model their desired outcomes before they decide on forms of intervention to achieve those outcomes (White 2009; Vogel, 2012 and Rogers, 2014).

A.3: Competitive Tendering of Delivery
In order to ensure that VfM is achieved, competitive tendering of delivery operationalizes perfect competitive market system. The idea behind competitive tendering is that it forces suppliers to compete and (so the theory goes) consequently the purchaser and taxpayer will gain better “value for money” (Carnaghan and Bracewell-Milnes, 1993; Domberger and Hall, 1991). Road Maintenance-focused VfM model also prioritizes the expression of inputs, outputs and outcomes in monetary terms in order to ensure like-for-like comparison between service and good providers at all stages. In some cases, a form of transaction cost analysis (which also monetizes inputs and outputs) is undertaken to determine whether in-house providers should also, in effect, be bidders.

2.2.3. Operational Assumptions
The following are main operational assumptions:

OA.1: Road Fund Board
Tanzania has a Road Fund Board (RFB) as “a second generation” road fund which has an effective structure, with sound financial management systems, lean efficient administrative structure (Benmaamar, 2006). There are clearly defined responsibilities based on sound legal system – separate road fund administration, clear rules and regulations. RFB as an agency is a purchaser not a provider of road maintenance services. There is a strong oversight – broad based private/public board with regular technical and financial audits.

**OA.2: Sustainable Road Maintenance Funds**
Sustainable Road Maintenance Funds refers to adequacy and reliability of funding to meet planned current and future needs of the roads infrastructure. Sustainability requires that the fund must meet all costs for maintenance of current needs of network, extension / quality improvement, asset replacement; the costs for maintenance must be recovered fully from road users with no subvention from central government and there must be efficient and effective use of resources, i.e., the value for money. Revenues incremental to the budget, coming from charges related to road use and channeled directly to the Road Fund bank account. The road network is extremely valuable and thus RFB is expected to invest maintenance funding in a way that returns maximum benefit to road users (Olson, 2002 and Benmaamar, 2006).

**OA.3: Performance-based Management and Maintenance of Roads**
RFB incorporates a Performance-based Management and Maintenance of Roads (PMMR) system as a new way of effectively and efficiently preserving road asset that is rapidly evolving around the world (Piñero, 2003 and Bourn, 2007). It replaces the traditional method-based contracting of road maintenance. The use of performance-based specifications promise to be an excellent tool to improve government efficiency in maintaining the roadway system. Benefits of implemented performance-based road maintenance system include: 1) Reducing maintenance costs through the application of more effective and efficient, technologies and work procedures; 2) Providing transparency for road users, road administrators and contractors with regards to the conditions at which the roads must be maintained; 3) Improving overall road condition; 4) Improving control and enforcement of quality standards (Piñero, 2003 and Olsson, 2002).

**2.2.4. Optimal Model Solutions for Design and Planning Problems**
The above assumptions guarantee attainment of a unique optimal or non-dominated solution to an MCDM problem during the design and planning stages. The set of non-dominated solutions is unique and RFB management as the decision-maker has made final choices of quantity and quality of roads for maintenances. Much of the discussions on road maintenance management system assume that the desired outcomes are known (or knowable once RFB chooses to undertake such an analysis) measurable, and are able to be linked via a linear ‘results chain’ back to outputs and inputs. This ‘linear’ understanding of causality and VfM underpins most interpretations of VfM found in the literature, even those that move beyond a direct focus on procurement (Bourn, 2007). Comparing VfM
requires establishing methods whereby like-for-like comparisons between activities or providers can be made. Operational VfM model focuses on employing methods that can robustly connect the findings of effectiveness evaluations with costs, e.g., cost-benefit analysis, social return on investment analysis, or any other method whereby ‘robust quantitative and qualitative evidence of outcomes and impact [are combined with] strong evidence of economy and efficiency on the cost side (Domberger and Hall, 1991).

2.3. Definitions of Variables

Figure 1 suggests that the value for money model is based on the optimum combination of whole-life cost and quality (or fitness for purpose) to meet the user’s requirement. It can be assessed using the criteria of economy \((E_1)\), efficiency \((E_2)\), and effectiveness \((E_3)\). Value for Money \((VfM)\) is about striking the best balance between the “three E’s” – economy, efficiency and effectiveness. The following are definitions of these main economic variables:

2.3.1. Economy

An economy is defined as an area of the production (e.g., road construction), distribution, trade, consumption, savings, and investments of goods and services by different agents. Economic agents can be individuals, firms, businesses, organizations, or governments (Smith, 1776). Economic transactions occur when two parties agree to the value or price of the transacted good or service, commonly expressed in a certain currency (Rothbard, 1962). A given economy is the result of a set of processes that involves its culture, values, education, technological evolution, social organization, and legal systems, as well as its geography, natural resource endowment, and ecology, as main factors (Smith, 1776 and Rothbard, 1962). These factors give context, content, and set the conditions and parameters in which an economy functions. Figure 1 summarizes the economic solution as the situation whereby minimization of the cost of resources used for an activity, while having regard to appropriate quality.

2.3.2. Efficiency

Efficiency is defined as the \((often measurable)\) ability to avoid wasting inputs, resources, efforts, money, and time in doing something such as road maintenance a desired result (Barr, 2004). In a more general sense, it is the ability to do things well, successfully, and without waste. It is a relative measure of the extent to which input is well used for an intended task or function (output). It often specifically comprises the capability of a specific application of effort to produce a specific outcome with a minimum amount or quantity of waste, expense or unnecessary effort (Sen, 1993). Efficiency, of course, refers to very different inputs and outputs in different fields and industries. Figure 1 summarizes efficiency as a relationship between outputs, in terms of goods, services or other results, and the resources used to produce them. An efficient activity maximizes output for a given input, or minimizes input for a given output and, in so doing, pays due regard to appropriate quality (Sen, 1993 and Barr 2004).
2.3.3. Effectiveness
Effectiveness is defined as the capability of producing a desired result or the ability to produce desired output (Drucker 1963 and 2006). When something is deemed effective, it means it has an intended or expected outcome. In management, effectiveness relates to getting the right things done (Drucker 1963 and 2006). In strategic planning, effectiveness is a criterion used to assess changes determined in the target system, in its behavior, capability, or assets, tied to the attainment of an end state, achievement of an objective. Figure 1 summarizes effectiveness as the extent to which objectives have been achieved and the relationship between the intended impacts and actual impacts of an activity achieved.

2.3.4. Equity
Another relevant policy variable is equity but not included in Figure 1. Equity in social economic political sense, is the concept of fairness. Equity is based on the idea of moral equality (Atkinson and Stiglitz 1980). Equity looks at the distribution of capital, goods, and access to services throughout an economy. More specifically, it may refer to equal life chances regardless of identity, to provide all citizens with a basic and equal minimum of goods, and services or to increase efforts and commitment for redistribution (Peyton, 1994). Low levels of equity are associated with life chances based on inherited wealth, social exclusion and the resulting poor access to basic services and intergenerational poverty resulting in a negative effect on growth, governance instability and increasing political instability, (Atkinson and Stiglitz, 1980; Peyton, 1994). A fourth “E” – equity – may be integrated to ensure that value-for-money analysis accounts for the importance of reaching different social economic and political groups (World Bank, 2006).

2.4. The Structural Value for Money Model
The structural VfM model in Figure 1 has these three evaluation measures of performances, namely economy, efficiency and effectiveness. The Economy variable, \( E_1 \), relates to minimizing the cost of resources used or required (inputs) – spending less. The Efficiency variable, \( E_2 \), evaluates the relationship between the output from goods or services and the resources to produce them – i.e., spending well. The Effectiveness variable, \( E_3 \), evaluates the relationship between the intended and actual results of public spending (outcomes) – spending wisely. The best performances for the Value for money (VfM) is attained by determining the best balance between the above “three E’s” – Economy, Efficiency and Effectiveness variables. It is a way of thinking about using resources well (Bourn, 2007).

The operational model solution is attained when the government aims to continually assess opportunities to optimize public services to citizens, stakeholders and actively controlling all implementing institutions and beneficiaries to achieve best value for money. All implementing institutions continually search for the best value for money by sourcing the best materials at the best price. And, they are always looking for efficient ways and means to make...
public works more effectively (Bourn, 2007). This model solution suggests that there must a social economic culture of “do the right things” and “do things right”, helping ensure public service delivery is efficient, effective and economical (Barnett, et al, 2010).

Figure 1: Value for Money Model

3.0. Quantitative Value For Money Models
3.1. Assessment Tools
3.1.1. General Assessment Tools
A range of assessment tools are available to provide quantitative analysis and information to operationalize above VfM model and support good judgment in decision-making. These quantitative VfM model assessment tools include, comparisons with other activities; programme logic analysis; cost-effectiveness analysis; financial viability or cost-benefit analysis; economic cost-benefit analysis (CBA); opportunity cost analysis; multi-criteria ranking and programme quality assurance controls (Barnett, et al, 2010). The use of such generic assessment methods in the maintenance management sector are increasing (Olsson, 2002).

Some of these quantitative VfM models focus almost exclusively on establishing monetary value for all outcomes and impacts, while others attempt to establish other quantitative measures. A common theme running through all is that they attempt to enable comparisons within the activity domains of projects, programs,
and potentially, organizations. Another theme, which is most strongly expressed in analyses that attempt to establish social benefit, is the importance of establishing counterfactual scenarios as a way of improving measures of impact in complex cases (Barnett, et al., 2010). Interest in using these tools is increasing among road administrators worldwide. However, they all agree that assessing the benefits and costs accrued as a result of implementing this type of VfM approach is a very complex and challenging task.

As a caveat, it is important to note that what is being described here is not the wide range of quantitative and qualitative evaluation tools (Vogel, 2012 and Olsson, 2002). VfM assessment has considerable overlaps with evaluation methods – with implications for the practical incorporation of VfM in monitoring and evaluation frameworks – but in seeking less to establish what is the most effective form of development, irrespective of cost, than to determine which development approach achieves the most for the cost inputs provided. In other words, the issue of 'spillage' of resources is a core focus for these modes of analysis.

3.1.2. Evaluative Scoring Method
To help transportation agencies with these challenges, the RFB has adopted a simple framework that has been developed to provide guidelines for conducting a comprehensive and reliable evaluation of the VfM model. The paper formalizes this framework of quantifying a VfM Model using an evaluative scoring method. Evaluative scoring is the process of combined evaluation research and awarding numbers (usually), or symbols to represent the level of performing entities (e.g., construction firms performances at different stages) (Swift, 2006). The most common method is by adding up the number of correct answers on an evaluation, and assigning a number that correlates to respective performances. Higher numbers reflect better quality work performances. As a rule, marking applies to entity level of performance in assessment tasks, not to overall achievement in a course (Swift, 2006).

Grading and judging is the grouping of entity performances into bands of achievements. Grading usually occurs at a larger level, for example: significant assessment tasks, entire tasks, processes or levels and again is represented by a symbol. The most common grading symbols are A, B, C, D etc and 1, 2, 3, 4, and 5 (Very Bad=1, Bad=2, Satisfactory=3, Good=4 and Very Good=5 etc). Grades are commonly determined by adding up the raw data of marks or scores, and converting this to a range or band of achievement. Both marks and grades are symbolic representations that summaries the quality of entity performances and level of achievement. For any assessment task, entities deserve to know what is expected of them and how the decisions about the quality of their work will be made i.e. how their work will be marked and graded.

Monetization, usually via market pricing, is only one way of assigning a numerical value to outcomes and impacts. Stakeholder perceptions can also be quantified, such as with a Likert scale, and peer or expert assessments can likewise be
recorded through ratings or scores. Objectives need to be disaggregated into activities and behaviours that can be scored by stakeholders, peers and experts, with agreed upon values of ‘good’ and ‘bad’ determined prior to the scoring. The scores can then be aggregated, and differentially weighted depending on the pre-determined criteria. Comparisons between activities, projects, programs and agencies may then be made on the basis of the aggregated total scores.

As we will note later, this approach is used by RFB in assessing their funding of road maintenance. The issue of weighting scores may be of relevance to many who are interested in incorporating an assessment of equity in their VfM measures, and wish that assessment to reflect the centrality of equity/social justice concerns to their agency’s values. The level of weighting requires, however, a clear assessment of the comparative importance of equity against the other VfM elements.

3.2. The Formal Quantitative RFB-VfM Model

At this point, the term ‘Value for Money’ is used to mean the quality and quantity of works done are in good accordance with what are stipulated in the contract, for which the money is paid. Thus the objective of the technical audit is to assure the quality and quantity of the works are in accordance with the conditions set forth in the contract (Road Fund Board, 2008). Figure 2 summarizes the quantitative model framework of achieving the Value for Money (VfM) throughout the road maintenance processes financed by the RFB in Tanzania. The section formalizes the concept of value for money for the purpose of quantitative data and information evaluation. The formalized quantitative RFB-VfM model in Figure 2 will be able to assess the value of a standalone program or comparing a number of projects at a particular point in time.

We will denote Value, \( V \), as a variable defined by RFB and measured using the Value for Money model. Let us define \( V \) as a target policy variable for VfM model and is a complex function of five interdependent stages or major process variables, namely, [1] Planning, Designing and Tender documentation, \( (V_1) \), [2] Procurement, \( (V_2) \), [3] Construction, \( (V_3) \), [4] Project Completion and Closure \( (V_4) \) and [5] Executed Works, \( (V_5) \). We formalize the RFB-VfM model whereby we define \( V \) variable is a simple linear function of \( (V_1), (V_2), (V_3), (V_4) \) and \( (V_5) \) variables. These stages or processes are complex functions of interdependent exogenous factors and serious of pre-outcomes (Roads Fund Board, 2008). Figure 2 suggests optimal outcomes pathway as a set of needed conditions relevant to a given field of action, which are placed diagrammatically in logical relationship to one another and connected with arrows that posit causality. Outcomes along the pathway are also preconditions to outcomes above them. Thus, early outcomes must be in place for intermediate outcomes to be achieved; intermediate outcomes must be in place for the next set of outcomes to be achieved; and so on (Patnaik, 2009 and Olsson, 2002). An outcomes pathway therefore represents the change
logic and its underlying set of conditions and assumptions, which are spelled out in the rationales given for why specific connections exist between outcomes and in the theory narrative:

\[ V = \sigma_1 V_1 + \sigma_2 V_2 + \sigma_3 V_3 + \sigma_4 V_4 + \sigma_5 V_5 \]

Whereby we define,

- Planning, Design and Tender Documentation \( V_1 \)
- Procurement \( V_2 \)
- Construction \( V_3 \)
- Project completion and closure \( V_4 \)
- Executed works \( V_5 \)

Whereby the overall weights are defined and restricted as follows:

\[ 0 \leq \sigma_i \leq 1 \quad \text{whereby} \quad \sum_{i=1}^{n} \sigma_i = 1 \]

### 3.2.1. Planning, Design and Tender Documentation, \( V_1 \)

Planning, design and tender documentation is the first stage in the road maintenance projects. We define \( V_1 \) as the first important evaluation variable in the RFB-VfM model. This is in turn formalized as follows:

\[ V_1 = \omega_{11} V_{11} + \omega_{12} V_{12} + \omega_{13} V_{13} + \omega_{14} V_{14} + \omega_{15} V_{15} + \omega_{16} V_{16} + \omega_{17} V_{17} \]

Whereby this first specific stage include;

- Compliance of project planning with requirements of the PA \( V_{11} \)
- Accuracy and completeness of the design calculations and technical drawings \( V_{12} \)
- Accuracy, appropriateness and completeness of technical specifications \( V_{13} \)
- Overall appropriateness of the design (economy and function) \( V_{14} \)
- Accuracy and completeness of the design of BOQs \( V_{15} \)
- Accuracy of the engineers’ estimates \( V_{16} \)
- Accuracy and completeness of the design of tender documents \( V_{17} \)

The specific weights for this variable are defined and restricted as follows
Value for Money Model for Road Maintenance

\[ 0 \leq \sigma_{ij} \leq 1 \quad \text{whereby} \quad \sum_{i=1}^{n} \sigma_{ij} = 1 \]

3.2.2. Procurement \( V_2 \)

Procurement entails buying, purchasing, renting, leasing or otherwise acquiring any goods, works or services by a procuring entity and includes all functions that pertain to the obtaining of any goods, works or services, including description of requirements, selection and invitation of tenderers, preparation and award of contracts. In the context of road projects, this is the second stage and it is formed by several parameters.

\[ V_2 = \omega_{21}V_{21} + \omega_{22}V_{22} + \omega_{23}V_{23} + \omega_{24}V_{24} + \omega_{25}V_{25} + \omega_{26}V_{26} \]

Whereby, this second variable consists of:

- Appropriateness of method of procurement \( V_{21} \)
- Compliance of procurement process with PPA 2004 \( V_{22} \)
- Evaluation process and award of contract \( V_{23} \)
- Competitiveness of rates quoted for major items of construction \( V_{24} \)
- Overall competitiveness of most economic tender compared with market price \( V_{25} \)
- Capacity and competence of selected contractor in relation to project size and complexity \( V_{26} \)

Also, the specific weights for this variable are defined and restricted as follows:

\[ 0 \leq \sigma_{ij} \leq 1 \quad \text{whereby} \quad \sum_{i=1}^{n} \sigma_{ij} = 1 \]

3.2.3. Construction \( V_3 \)

Construction, \( V_3 \) is the process of preparing for and forming buildings/structures roads budgets etc. \( V_3 \) starts with planning, designing, financing and continues until the structure is ready for occupancy. Based on road maintenance project guidelines, this is the third project stage and it comprises of thirteen weighted variables/parameters. \( V_3 \) is formalized as follows;

\[ V_{i} = \omega_{31}V_{i1} + \omega_{32}V_{i2} + \omega_{33}V_{i3} + \omega_{34}V_{i4} + \omega_{35}V_{i5} + \omega_{36}V_{i6} + \omega_{37}V_{i7} + \omega_{38}V_{i8} + \omega_{39}V_{i9} + \omega_{310}V_{i10} + \omega_{311}V_{i11} + \omega_{312}V_{i12} \]

Whereby we define
Timeless of a site possession $V_{31}$
Quality of a project program $V_{32}$
Adherence to the project program $V_{33}$
Quality of contractor’s site organization and staff $V_{34}$
Quality of supervising engineers’ site staff $V_{35}$
Quality of quality assurance program $V_{36}$
Adherence to quality assurance program $V_{37}$
Quality of environmental management plan $V_{38}$
Management of contractual documents including surety and insurance bonds $V_{39}$
Quality and management of project documentation $V_{310}$
Assessment including validity of variation $V_{311}$
Assessment including validity of claims and related cost overruns $V_{312}$
Assessment including validity of project delays and extension of time $V_{313}$
whereby the weights for this variable are defined and restricted as follows:

$$0 \leq \omega_{ij} \leq 1 \quad \text{whereby} \quad \sum_{i=1}^{n} \omega_{ij} = 1$$

### 3.2.4. Project Completion and Closure

Closure of a project stage, $V_4$ includes completion of all operational activities and financial accounts of the project. Road projects activities are planned to be implemented over a specific period of time. Therefore, each project requires a formal closure up on completion of project activities. A project may also require formal closure if a decision has been made to terminate the project. This is the fourth stage of the Tanzania maintenance road projects.

$$5 \quad V_4 = \omega_{41}V_{41} + \omega_{42}V_{42} + \omega_{43}V_{43} + \omega_{44}V_{44} + \omega_{45}V_{45} + \omega_{46}V_{46} + \omega_{47}V_{47} + \omega_{48}V_{48}$$

Whereby;

- Quality and completeness of as built-drawings $V_{41}$
- Compilation and management of snag list $V_{42}$
- Timely issuance of completion certificates, settlement of final account $V_{43}$
- Management of the defect liability period $V_{44}$
- Quality and adequacy of final project report $V_{45}$
Compliance of final quantities paid \( V_{46} \)
Compliance of project cost as per final account with accepted tender price \( V_{47} \)
Compliance of actual project completion time with the contract period \( V_{48} \)

Whereby the specific weights for this variable are defined and restricted as follows:

\[
0 \leq \omega_{ij} \leq 1 \quad \text{whereby} \quad \sum_{i=1}^{n} \omega_{ij} = 1
\]

### 3.2.5. Executed Work \( V_5 \)

Executed Works \( V_5 \) is the fifth and the last stage covering all details of the completed projects from the contractors soon after the completion. This stage comprises of seven parameters.

\[
V_5 = \omega_5 V_{51} + \omega_2 V_{52} + \omega_3 V_{53} + \omega_4 V_{54} + \omega_5 V_{55} + \omega_6 V_{56} + \omega_7 V_{57}
\]

Whereby:
Based on visual assessment on quality of workmanship, materials used, riding surface, and absence of defect \( V_{51} \)
Comply with drawings and technical specification \( V_{52} \)
Dimension of curvet and bridge comply with technical drawings and specification \( V_{53} \)
Quality of materials used in pavement structure comply with technical specification \( V_{54} \)
Quality of materials used in concrete and masonry works comply with technical specification \( V_{55} \)
Compliance of site cleanup and restoration of disturbed and/or damaged areas with EM \( V_{56} \)
Compliance of ongoing construction activities with safety and EMP requirement \( V_{57} \)

Whereby the specific weights for this variable are defined and restricted as follows:

\[
0 \leq \omega_{ij} \leq 1 \quad \text{whereby} \quad \sum_{i=1}^{n} \omega_{ij} = 1
\]
3.3. RFB-VfM Model Determination
The RFB-VfM model is determined according to mathematical modelling rules since we have six relations; 1 - 6, to determine the values of six endogenous policy evaluation target variables, \((V_1)\), \((V_2)\), \((V_3)\), \((V_4)\), \((V_5)\) and \(V\). In turn these determine cost, efficiency, effectiveness and equity. The final use of the RFB-VfM framework is to form a clear judgment on whether value for money has been secured during road maintenances in the area under examination. It will determine the criteria against which performance will be assessed by agreeing what optimal arrangements for the system under scrutiny would look like (Road Fund Board, 2008). ‘Optimal’ is hereby defined as the most desirable possible given expressed, restrictions or constraints during sample time.

4.0. Indicative Application and Results of the RFB-VfM Model
Section 4.0 indicates data collection methods, approaches and policy analysis of the RFB-VfM model. Apart from meeting above modelling quality demands, the purpose is to accomplish a tool that has been integrated into RFB management systems in general, for VfM in particular. The implementation has complied with existing VfM standards as to computer operating systems and programming languages (Andersson, 2007). The model system can be modularized and flexible as to model types, e.g. admit both discrete and continuous state descriptions, and data input, and can be formulated in dialogue with VfM. The intended use is in all VfM stages before concrete project information is available. The model application can be capable of handling national, regional and district road networks. On the network level will think of RFB financial scenario studies, as well as budget allocation. Moreover, an intended use is on the road level, for the identification of candidate projects and central government supervision.

Value for money studies typically follow a structure of diagnosis – what is the issue, e.g. under performance or scope for doing things better to arrive at a hypothesis; the second stage is analyzing the underlying data – both quantitative and qualitative to test the hypothesis; the final stage is synthesis, where the data derived from the analysis is triangulated to arrive at well founded conclusions to derive practical recommendations for improvement. As with any major activity it is important that a value for money examination follows principles of good project management. RFB has used above model to undertake projects performance evaluation with expectation of gaining valuable results to be used as lessons for the coming projects. From July 2011 after consultations with stakeholders’ new weighting percent and parameters for assessing VfM were introduces in Tanzania.

The current VfM - 2017 weighting covers 20 percent for planning, designing and tender documentation; 10 percent for procurement stage; 20 percent for construction stage; 10 percent for project completion and closure stage and 40 percent for executed works. In VfM-2017 also there are several parameters as shown in Table 1 (Road Fund Board, 2008).
### Table 1: Features of the VfM Instrument - 2016

<table>
<thead>
<tr>
<th>S/No</th>
<th>Stage</th>
<th>Weighting (%)</th>
<th>Number of Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Planning, Designing and Tender Documentation</td>
<td>20</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>Procurement Stage</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>Construction Stage</td>
<td>20</td>
<td>13</td>
</tr>
<tr>
<td>4</td>
<td>Project Completion and Closure Stage</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>Executed Works</td>
<td>40</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>41</strong></td>
</tr>
</tbody>
</table>

Source: Roads Fund Board, 2016

### 3.4. Data Methods, Approaches and Analysis

#### 3.4.1. Data and Information Collection

The current data analysis of RFB technical audit reports has been based on the above Value for Money model which is independent evidence-based investigations to examine and report on whether economy, effectiveness and efficiency has been achieved in the use of road funds (Road Fund Board, 2008). The Quantity VfM Model has been used as an instrument used to collect audit data.

Based on the above model, data and information were collected by RFB from 23 technical audit reports in year 2012/13 with 571 total number of projects; 22 technical audit reports in year 2013/14 with 547 total number of projects; 21 technical audit reports in year 2014/15 with 628 total numbers of projects and 18 technical audit report in year 2015/16 with 542 total number of projects. Road engineers and consultants used various methods to collect data including meetings; desk study and field survey for verification, measurement and testing.

The RFB field research survey method involved visiting identified construction sites with the purpose of verifying the quality of executed works. This comprised of [1] visual assessment to check quality of riding surface shoulders; cross falls and super elevation and existence of cracks, potholes, ruts and the existence of corruption; [2] field measurements to assess dimensional accuracy of but not limited to carriageway; shoulders and drainage structures and [3] field/laboratory tests, during site inspection, the auditors must conduct some confirmatory tests to assess the compliance of road pavement layers with design specifications. In this method the following parameters must be covers: field density and thickness for base courses; TFV (dry and wet) for base and surface dressing wearing courses; thickness of pavement layers; grading of aggregates; binder content as well as rebound hammer for structural element.
3.4.2. Data Analysis
RFB in association with a consultant from the University of Dar es Salaam came up to evaluate the performance of Implementing Agency carrying out road projects with aim of examining VfM from those projects. The collected data was analyzed using computer software including Statistical Package for Social Science (SPSS) and MS Excel.

Data analysis involved statistical investigation of performances or behaviour of endogenous or policy target variables \( (V_1, V_2, V_3, V_4, V_5) \) during the sample period or over time (Chiang, 1984). It involved taking time derivatives of all these policy target variables. The time derivative is a derivative of all functions with respect to time, usually interpreted as the rate of change of the value of the function. The derivatives of functions or real variables measure the sensitivity to changes of the functions (outputs) values with respect to changes in their arguments (input values) (Chiang, 1984). For example, the derivative of the position of a moving object with respect to time is the object’s velocity. This measures how quickly the position of the object changes when time advances (Robinson, 1982).

The quantitative VfM Model considers both stock and flow variables as measuring indicators of performances. That is, the time derivative of a flow variable is used to measure performances of endogenous variables determined in this model. The growth rate of \( (V) \) is the time derivative of the flow of output divided by output itself. We will distinguish between quantities that are stocks and those that are flows. These differ in their units of measurement (Glenn, 1987). A stock variable is measured at one specific time, and represents a quantity existing at that point in time, which may have accumulated in the past. A flow variable is measured over an interval of time. Therefore, a flow would be measured per unit of time (say a year). Flow is roughly analogous to rate or speed in this sense (Robinson, 1982 and Glenn, 1987). The analyzed data can be presented in tables, graphs and charts followed with report writing. Report writing can be based on the data presented in the tables, graphs and charts in order to provide verbal descriptions for the observed findings on the VfM model.

4. Conclusion
This paper formalized the theoretical Value for Money model used by RFB by defining major variables, assumptions, scope and uses of value for model as integral part of the Performance-Based Road Maintenance system. It developed an instrument that provides transportation agencies with comprehensive and reliable guidelines to assess the overall benefits by all stakeholders as a result of implementing performance-based specifications in the roadway maintenance system.

Also, the paper articulated its corresponding non-parametric Quantitative RFB-VfM model and showed its model determination, use and results of the RFB-VfM
model. The Quantitative RFB-VfM model framework developed in this study is consistent with existing approaches commonly used by public and private organizations to monitor and evaluate performance-based work. The quantitative model procedures adopted in the framework to evaluate each component are based on mathematically valid techniques. These procedures are associated to the four evaluation research phases or activities: Input, Data Collection, Data Analysis, and Reporting. The proper implementation of these procedures and techniques provides reliable assessments of the road maintenance contractor’s performances. The procedures and techniques adopted are associated to the complete ex-post evaluation monitoring processes, through all stages or phases; from the planning stage through the reporting of results from the data and policy analysis.

Robust non-parametric techniques are developed to address the specific needs in the PBRM system. The implementation of Quantitative VfM has been the most important adopted technique that makes the proposed VfM to be very practical and reliable. The proposed framework presents several contributions to the body of knowledge. These contributions can be classified in two categories.

The first major contribution of this case study has been the clarification and formalization of those main components or elements that define the VfM framework. The VfM framework responds to the need of RFB to perform comprehensive and reliable assessments of the economy, efficiency and effectiveness of performance-based specification roadway maintenance system. The implementation of performance-based specifications in road maintenance in Tanzania is relatively new and current guidelines to monitor this type of initiative are considered are part of second-generation reforms in the road sector in Tanzania. For this reason, this case study can be categorized as unique and a major asset to the performance-based road maintenance arena in developing economies.

The second major contribution corresponds to the link between on one hand economy, efficiency and effectiveness theories and other hand the non-parametric VfM model. This case study provides the RFB in Tanzania not only with non-parametric valid procedures to estimate economy, efficiency, and effectiveness accrued as a result of the implementation of performance-based specifications, but also proved methodologies to evaluate the ex-post impact. Since there are no known previous studies in Tanzania addressing these issues; the methodologies presented can be categorized as the most comprehensive attempt until now to evaluate the social economic efficiency of PBRM initiatives in the road maintenances in Tanzania.

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