EVALUATION OF PERFORMANCE-BASED CONTRACTS FOR ROAD MAINTENANCE: A CASE STUDY FROM ROADS IN CENTRAL AND SOUTHERN-EAST OF ALBANIA

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ABSTRACT

The implementation of performance-based road maintenance contracts (**PBCs**)**—**an essential element of road asset management—promotes effective and efficient maintenance of road networks. The contractor's payment is based on specified performance, as defined by management and operations performance measures. While questions about the measures exhibiting the real performance of the contractor for payment and deductions arise, defining the "right" performance standards or measurements becomes of crucial importance. A case study on performance measurements, specifically payments and deductions in performance-based contracts for road maintenance is in the present paper reported. The effectiveness of payment and deduction mechanisms in incentivizing contractors to meet performance targets, focusing on responsibilities, payments, and deductions for non-compliance is evaluated, in addition to the identified challenges in the implementation of performance-based contracts, such as the complexity of performance measurement and fairness in payment calculations. The need for robust monitoring and verification mechanisms for accurate and reliable performance measurements is emphasized along with the importance of contract flexibility to accommodate changing circumstances.
Keywords: Performance-based contracts, road maintenance, payments, deductions

1. INTRODUCTION

Road maintenance is a critical component of transportation infrastructure management, ensuring the safe and efficient movement of people and goods. Traditional road maintenance approaches, such as input-based contracts, have frequently been associated with issues such as lack of accountability, poor performance, and cost overruns (Sultana *et. al*., 2012; Sandborn *et. al*., 2017). Performance-based contracts (PBCs) arose as a response to the limitations of traditional maintenance contracts, which frequently focused only on input-based specifications with insufficient emphasis on performance outcomes.

Several developed countries began using PBMCs in the 1990s to increase the efficiency and effectiveness of their maintenance operations. The success of these programs sparked increased interest in using PBMCs in underdeveloped countries, where low resources and infrastructure constraints created unique maintenance requirements. Payments and deductions are frequently used in performance-based contracts to motivate contractors to meet or exceed performance expectations (Sultana *et al*., 2013; Selviaridis and Wynstra 2015). A case study of performance measurements, specifically payments, and deductions in a performance-based road maintenance contract is in the present paper reported.

Performance indicators or key performance indicators (KPIs) that reflect the desired outcomes of the road maintenance project, such as road condition, service availability, response time, and customer satisfaction, are typically included in performance-based contracts for road maintenance. Contractors receive predetermined payments based on agreed-upon rates when performance targets are met or exceeded. Deductions, on the other hand, are imposed when performance falls below certain thresholds and are deducted from the contractor's payment. These payment and deduction mechanisms are intended to incentivize contractors to achieve and maintain high levels of performance while penalizing poor performance.

Given the potential benefits, the use of performance-based contracts would be of great importance for the road maintenance industry because: i) they align the contractor's interests with the desired outcomes of the road maintenance project by incentivizing contractors to meet or exceed performance targets for a higher payment and, ii) promote accountability by imposing financial penalties on contractors who fail to meet performance expectations, encouraging them to improve their performance.

Despite the potential benefits of performance-based contracts, their implementation is challenging. First, a key feature of PBC is the risk transfer to the supplier, i.e., PBC transfers (financial) risks to contractors (Selviaridis and Norrman 2014). Risks should ideally be carried by those who are best positioned to do so because they have the best resources, information, or expertise. In reality, most participants try to shift risks to others, which leads to disagreements (Mehany and Guggemos 2015). Second, accurately measuring performance can be difficult due to the numerous factors involved, including data collection, performance thresholds, and performance attribution. Ensuring fairness in payment calculations is a critical challenge. As a result, conducting case studies to assess the effectiveness of performance measurements, including payments and deductions, in performance-based contracts for road maintenance is critical.

Performance-based contract faces many challenges for implementation and performance measuring, especially in developing countries, therefore risk

distribution, responsibilities, level of services, performance standards, performance levels, and penalties for non-achievement of monthly performance needs to be reviewed, evaluated, improved, and updated (EBRD 2016).

Based on the new concept of performance-based maintenance contracts, roads authorities, and financial firms created new performance measures and developed them throughout the years. The main categories of performance measures are Management Performance Measures (MPM) and Operations Performance Measures (OPM).

Measures supporting the real performance of the contractor for payment and deductions along with the adequacy, practicality, efficiency and efficacity of service level would be appropriate concern.

The present paper assesses the main performance measures implemented in a case study, to assess contractors' performance based on the responsibilities, payments, and deductions based on the data, and reports of Performance-based Road Maintenance and Safety Project, Lot 3 Contract C - Central/Southeast Albania - Fier, Elbasan and Korçë regions in the Republic of Albania. This is a case study that provides insights into the effectiveness of payments and deductions as performance measurement mechanisms, in addition to the existing literature on performance-based contracts for road maintenance.

2 Case Study

2.1 General information about the project

Due to a variety of issues, including limited financial resources, historical underinvestment, and challenging topography, Albania has experienced major hurdles in maintaining its road system. Over time, the country has taken various methods to road maintenance, shifting from traditional contracts to performance-based models.

Albania has exhibited a trend in recent years in embracing PBCs for road maintenance. These contracts place a premium on performance indicators such as road smoothness, ride quality, repair response time, and other quantitative characteristics. PBCs promote contractors to emphasize preventative maintenance, fast repairs, and timely interventions to ensure optimal road conditions by implementing performance-based incentives and punishments.

However, it is important to emphasize that PBMC implementation in Albania is still in its early stages. The road maintenance industry continues to face issues such as insufficient institutional capacity, contractual disputes, and the need for performance measures to be refined further. Albania, as a developing country, is actively investigating measures to increase the efficacy and efficiency of its road maintenance practices using PBMCs, relying on the experiences and best practices of other countries.

The case study involves a performance-based road maintenance contract: Contract C - Central / South-East Albania. The road works were carried out in Fieri, Elbasani, and Korca regions as defined by the contract. These roads connect the cities of Tirana, Elbasani, Gramshi, Librazhdi, Pogradeci, Korça, Rrogozhina, Lushnja, Fieri, and Berati, and the bordering localities such as Qafe Thana (bordering the Republic of North Macedonia) and Kapshtica (bordering Greece). They include relatively new flat roads in the right condition and old hilly roads in poor conditions (SH72, especially section Berat-Corovode). The most trafficked road is SH4_Rrogozhine-Fier (part of the North-South corridor) (Table 1).

All roads are considered reasonably close to Elbasani, without access problems or any other circumstances capable of making their maintenance difficult. There are areas needing particular attention in the winter period such as Qafe Thane - Pogradec - Qafe Plloce because heavy winter maintenance is needed (Table 1).

Table 1 PBC Case Study Data

Road Map	Road Name	Road Length (km)
	3_Elbasan – Kapshticë	156,01
	A3_Tirane - Elbasan (new Motorway)	36,84
	4_Durrës - Fier (NEW)	44,00
	7_Elbasan – Rrogozhinë	44,49
	9_Qafë Thanë – Doganë	3,00
	64_Pogradec – Tushemisht	5,90
	59/70/71_Elbasan - Cerrik – Gramsh	41,20
	72_Lushnje - Berat – Çorovodë	87,98
Contract Length (km)		419,42

Standard Bidding Documents are prepared based on the procedures and guidelines of the World Bank by Albanian authorities earlier in 2014. Prequalification of contractors and tenders opened on 16th September, 2016, and the contract start date was March 13, 2017.

The contract scope of works is divided into four main categories, with the respective budget: network performance services (55%), rehabilitation works (25%), improvement works (8%), and emergency works (12%).

2.2 Technical aspects

A lump-sum monthly remuneration, which is paid to the contractor, will cover all physical and non-physical services provided by the contractor, except for emergency works which are rewarded separately. To be entitled to payments, the contractor must ensure that the roads under the contract comply with the service levels, which have been specified in the bidding document. It is possible that in some months it will be carried out a rather large amount of physical work to comply with the required service levels and very little work during other months. However, the monthly payment remains the same for as long as the target service levels are compiled (World Bank 2006).

The performance criteria should ideally cover all aspects of the roads included in the contract and consider the fact that different roads within the contract area might require different service levels. GTZ (2004) World Bank (2020) stated that criteria can be defined at three levels (although more straightforward contracts will not use all the criteria identified below): i) road user service and comfort measures, which can be expressed in terms of road roughness, road and lane width, rutting, skid resistance, vegetation control, visibility of road signs and markings, availability of each lane-km for use by traffic, attendance at road accidents, drainage off the pavement (standing water is dangerous for road users), ii) road durability measures, which can be expressed in terms of longitudinal profile, pavement strength, and degree of sedimentation in drainage facilities, and iii) management performance measures, which define the information for the employer who requires both to monitor the asset during the term of the contract and to facilitate the preparation of future contracts. Requirements should include delivery of regular progress reports to the road authorities, inventory updates and other data-sharing requirements, and maintenance history (so bidders can price the work).

The contractor is responsible for: i) network performance service for periodic and routine maintenance where the activities are designed to avoid road degradation (such as grading, drainage work, resurfacing, asphalt concrete overlays, and so forth) and maintain functionality, ii) rehabilitation works are needed to bring the road to the pre-defined standards, iii)

improvement works to enhance road characteristics in response to changes in traffic volumes or to improve traffic safety, and iv) emergency works to remedy unexpected damage occurring because of extraordinary natural phenomena which affect the regular use of the road or the safety and security of the users.

2.2.1 Network Performance Services (Routine Maintenance Works)

Network performance services include routine maintenance works which consist of all interventions on the roads that need to be carried out on a regular basis by the contractor to attain and maintain the defined Service Levels (LoS) for the roads included under the contract, and all other activities related to the management and monitoring of the road network under contract, throughout the entire contract duration.

Routine maintenance works include (but are not limited to) the following activities: i) repairing road defects cracking, edge break, potholes, rutting, raveling in the pavement, ii) maintenance of shoulder, verge, intersections, junctions with other roads, roundabouts, overpasses, and other road surface areas, iii) repair works in embankment and cut slopes, iv) drainage system cleaning, maintenance, and repairs, v) maintenance of bridges and other structures, vi) responding in emergencies because of natural disasters and traffic accidents, v) maintaining traffic during works carried out on the roads included under the contract, vi) maintenance of road markings and road signs, vii) winter maintenance services, and viii) vegetation control.

2.2.2 Improvement works

Improvement works are a means to address road safety. In 2014, an initial Independent Road Safety Audit (IRSA) was carried out within the national network of Albania, which (Mott Macdonald 2018) helped identify numerous areas needing interventions for the mitigation of the adverse effect of substandard safety conditions.

The report identified the following road safety issues in the road network: i) absence of international road design standards, ii) road signs and markings were not satisfactory, even along some recently constructed roads, iii) damages to the existing road signs and guard rails, iv) improper or unauthorized access to secondary or private roads intersecting the main ones, iv) insufficient distances between the road and buildings, v) presence of illegal activities along the roadside and on the road shoulders, vi) vertical signs covered by billboards or trees, v) missing adequate design and traffic calming devices in urban areas, absence of footways, pedestrian crossings, vi) lack of bus stops for interurban transport, vii) absence of service roads along main roads, viii) absence of road lighting and traffic lights at intersections, and ix)

absence of dedicated lanes for agricultural vehicles, mopeds, bicycles, etc., which are obliged to make use of the main lanes.

The improvement works in this specific contract include three types of interventions: i) urban zone addressing a typical design for an approx. length of 100m, this type of intervention focuses mainly on upgrading parts of the urban zone in terms of pedestrian safety and includes the following works: construction of refuge islands, walkways, pedestrian crossing marking, traffic signs class 2, informative signs class 2, pavement resurfacing and the necessary manholes, and gutters (which may require to be connected to the drainage system), ii) simple intersection. The detailed design of improvement works at any specific location shall be carried out by the contractor and must meet the minimum acceptable requirements. This type of intervention focuses mainly on the upgrade of an existing intersection in terms of signage and includes, without being limited to traffic signs class 2, informative signs class 2, horizontal road marking, arrow signs, guardrails, and noise strips, and iii) big intersection which might require the complete reconstruction of the whole intersection, including earthworks, pavement construction works, construction of dedicated lanes, lay-byes, islands, horizontal and vertical signs (traffic signs class 2, Informative signs class 2, road marking, arrow signs class 2), guardrails, noise strips.

2.2.3 Rehabilitation works

Rehabilitation works include pavement rehabilitation works and other-than-pavement ("non-pavement") rehabilitation works. They are meant to bring the road to the required level of service.

The contractor at the commencement of the contract must carry out a detailed initial road condition survey (including pavement surveys, inspections, and testing) of the road sections under this contract, to define the road condition and collect the necessary data for the elaboration of his detailed designs and the scheduling of the works required. The detailed survey shall include visual condition, as well as IRI (according to WB guidelines) and pavement strength (FWD) or other agreed methods of measurement.

Pavement rehabilitation works consist of any needed works on any of the layers of the road structure which are necessary to create a pavement of sufficient strength and compliant with the LoS.

Non-pavement rehabilitation works include the items following processes: i) construction, reconstruction, or repair of the drainage system including culverts and ditches (i.e., new drainage ditch-earth/ ditch-concrete lined, repair/reshape of earth ditches/ concrete-lined ditches and new concrete pipe culvert/ box culverts, repairs in pipe/box culverts), ii) repair of erosions and landslides (i.e., reshape cut slope in soil/rock), iii) earthworks related reconstruct/construct embankments, shoulders' repair, iv) repair of bridges

(i.e., expansion joints replacement, new placement/replacement of bridge safety barriers guardrails), v) construction or reconstruction or repair of retaining walls [i.e., construction of new concrete gravity wall/ reinforced concrete wall, repairs in existing retaining walls (masonry, concrete, and reinforced concrete)], vi) construction or reconstruction or repair of geotechnical works (i.e., slope stabilization using gabions), vii) installation/ repair of guardrails and other road safety features (i.e., new/replacement steel guardrail, road marking, guardrails, delineators, vertical traffic signs), and vii) installation/ repair of electromechanical features (lighting and traffic lights, etc.).

2.2.4 Emergency works

Emergency works are a means to address the roads' reinstatement when damaged due to natural phenomena with imponderable consequences (i.e., extreme weather conditions) or from other events which in the view of the client justify works to prevent further damages to the road, road users or others.

2.2.5 Managerial, monitoring, and controlling activities

Managerial, monitoring, and controlling activities aim to ensure: i) proactive compliance with the contract's requirements, and ii) contractor 's self-monitoring and reporting of his compliance and performance. Monitoring responsibilities will not only be necessary to fulfill the contract requirements but also to gather the information needed by the contractor to know the degree of his compliance with service level requirements, and to define/plan, promptly, all physical interventions required to ensure that service quality indicators do not fall below the indicated thresholds.

Under the PBC model, the contractor will not receive instructions from the employer concerning the type and volume of road maintenance works to be carried out. Instead, all initiative rests within the contractor who must do whatever is efficiently necessary to meet the required quality (World Bank 2020).

Performance-based road contracts transfer a significant burden of risk onto the contractor. Therefore, it is essential that the contractor has the technical and managerial capacity necessary to deal with such risk (Zietlow 2004). Responsible management, the timeliness of interventions, and the adequacy of technical solutions are critical. If the service levels are not achieved, a payment reduction will be applied based on a schedule given in the contract.

3 Performance measurement and payments

Performance-Based Maintenance Contracts (PBMCs) have grown in popularity in road infrastructure management, with the goal of aligning

contractor incentives with desired maintenance outcomes. Adoption of PBMCs presents a potential to improve the quality and longevity of road networks in Albania, where road conditions have been an issue by rewarding contractors for meeting or exceeding specific performance indicators. These incentives are closely related to road condition measures such as smoothness, ride quality, repair response time, and maintenance schedule adherence. Contractors are compensated or given bonuses based on their performance, which encourages them to prioritize high-quality maintenance methods.

Deduction procedures are often included in PBMCs to hold contractors accountable for poor performance. Failure to fulfill performance targets, delays in completing maintenance activities, or inadequate reaction times may result in penalties. Deductions from the contractor's payment are made based on the severity of the non-performance, with the goal of discouraging poor maintenance practices and ensuring contractor accountability.

Defining the "right" performance standards or measurement indicators is challenging since the minimal costs and the comfort and safety criteria for the end users are addressed and met. In addition, in case of ambiguity, performance indicators must be clearly defined and objectively measurable (Zietlow 2004).

The contract defines the two types of performance measures, the Management Performance Measures (MPMs) and the Operational Performance Measures (OPMs).

3.1 Management Performance Measures (MPMs)

MPMs are a set of performance criteria that reflect the contractor's ability to manage the road assets successfully and include the supply of timely information to the Albania Road Authority (ARA) project manager as input to ARA's pavement management system (Table 2). MPMs are measured either monthly or as otherwise defined in the contract. Results are expressed as either being in ―conformance or ―non-conformance. In the case of non-conformance, this will continue to be recorded until a rectification action has been undertaken by the contractor to the satisfaction of the ARA project manager.

Table 2 Management Performance Measures (MPM's)

Ref. Code	Item	Service Level	Tolerance Permitted
MPM-1:	Contractor's Quality Assurance with its Supplements HSMP, ESMP, EPP and TMP	It is the tool to deliver and monitor the contract effectively. Must ensure compliance with the contract's requirements. to include all details and supplements as required by the contract	Must be submitted by the due date. In case of comments, the revised document must be resubmitted within fourteen (*14) days* after the receipt of the official letter informing of comments
MPM-2	Winter Service Plan	It shall include all these elements to ensure that the winter maintenance	Must be submitted by the due date. In case of comments, the revised

		shall be carried out satisfactorily and meet set standards according to the contract. It must be submitted annually by the end of October.	document must be resubmitted within fourteen (*14) days* after the receipt of the official letter informing of comments
MPM-3:	Program of Performance	Initial Program of Performance with updates by Sub-Section	Must be submitted by the due date. In case of comments, the revised document must be resubmitted within fourteen (*14) days* after the receipt of the official letter informing of comments
MPM-4.1:	Initial Contract Area Condition Report	Initial Contract Area Condition Report shall be submitted within 1 (one) month of the start date of the contract.	Initial submission by the due date. The modification must be completed within *twenty-one (21) days* after the official letter informing of comments.
MPM-4.2	Asset Inventory Report and its updates	Asset Inventories Report (AIR) shall be provided annually in December, showing the current information.	Initial Submission by the due date. The modification must be completed within *twenty-one (21) days* after the official letter informing of comments.
MPM-5	Submission of Designs	Submission of designs on the dates anticipated for each specific design for the proposed rehabilitation works for each section of road in the approved contractor's program.	Initial submission by the due date. The modification must be completed within *seven (7) days* after the official letter informing of comments
MPM-6	Monthly Progress Report	For Section on Maintenance Services, submission on the 1st working day of the following month. For Sections on Rehabilitation, Improvement and Emergency works, submission by the 10th calendar day of the following month. Must include summaries of activities carried out, progress, difficulties, an updated work plan, etc.	Initial submission by the due date. Revision and resubmission must be completed within *seven (7) days* after the official letter informing of comments.
MPM-7	Road asset Damage and Emergency Incident report	A brief Incident Report must be submitted within 24 hours and a detailed one within one week. (Sub-Section)	Submission by the due date. No tolerance.
MPM-8	End of Contract Handover Report	A complete description of maintenance activities, construction details (as-built drawings), ongoing problems and requirements, current pavement condition, strength, and roughness with trends. Overall network condition. Projections of future maintenance requirements. Submission at the 1st day of the 6th month before the end of the contract.	Initial Submission by the due date. Revision and resubmission must be completed within *seven (7) days* after the official letter informing of comments

MPM-9	Road Roughness Profiles	IRI measurements for roads included in the contract.	To be submitted when due according to specifications.
MPM-10	Road Strength Profiles		To be submitted when due according to specifications.

3.2 Operational Performance Measures (OPMs)

OPMs are a set of performance criteria listed below that reflect the contractor ‘s ability to complete network performance activities (Table 3). To address the daily routine maintenance, it needs all year round (including winter) maintenance activities and to fulfill the needs of road users. OPMs will be monitored continuously and measured monthly by the contractor, as defined in the contract. Results will be expressed as either being in ―conformance or ― non-conformance. In the case of non-conformance, this will continue to be recorded until the contractor remedies the non-conformance to the satisfaction of the employer.

Table 3 Operational Performance Measures (OPM’s)

Ref. Code	Item	Service Level
1.	OPM-1:	Usability (Availability of each lane-km for use by traffic)
2.	OPM-2:	Pavement defects (potholes, rutting, raveling, cracking in the pavement, edge break, average speed, etc.)
3.	OPM-3:	Shoulder and verge maintenance
4.	OPM-4:	Drainage
5.	OPM-5:	Routine maintenance of bridges and other structures
6.	OPM-6:	Embankment and cut slopes
7.	OPM-7:	Incident Response and Emergency Works (Attendance at road accidents, including traffic control)
8.	OPM-8:	Functionality, of road signs and line markings and other road furniture (including retro-reflectivity)
9.	OPM-9:	Vegetation control
10.	OPM-10:	Winter service requirements
11	OPM-11	Assessment of the performance of the contractor’s self-control unit (SCU) as observed by MC during monthly formal inspections.

4 Performance payments and deductions

4.1 Payment and deductions for network performance services

The payment schedule is the basis of payment for network performance services. The monthly payment for maintenance works and services will be made to the contractor if he has complied, during the calendar month.

In his monthly statement, the contractor will report the result of his evaluation of compliance with the required performance measures (MPM, OPM). The Monitoring Consultant (MC) carries out formal inspections to verify the statement and make any corrections when needed. If the Performance Measures do not meet, payments are reduced based on the provisions of these specifications. Payment reductions are to be applied based on the corrected monthly statement for network performance services.

Payments due to the contractor for network performance services (maintenance operations) are subject to deductions in case of failures to meet the Operational Performance Measures defined in the specifications.

Most payment reductions increase in line with the duration of the non-compliance. Once a payment reduction is applied, it cannot be recovered. If the contractor fails to remedy a non-compliance for which a payment reduction has already been applied the corresponding payment reduction will continue to be applied in the same way to the following monthly statement(s) for that particular cause of non-compliance, until the non-compliance has been remedied, without a time limit applied. The provisions for grace periods are granted to apply. The calculation of the amounts of payment reductions and the formula for their adjustment over time are to be based on the following rules (Zietlow 2004): i) payment reductions for non-compliance with the Management Performance Measures (MPM) are calculated by multiplying the time of delay (in days), as determined by the project manager, by the unit rate defined. This amount is to be deducted by the project manager from the monthly lump-sum payments due to the contractor and, ii) payment reductions for non-compliance with Operational Performance Measures (OPM) are to be applied on a per-km basis, which means that any 1km section in which a non-compliance with an OPM is detected is to be considered as non-compliant for that OPM and the payment reduction applied accordingly. The project manager shall reduce the monthly payment due to the Contractor, by deducting the sum of any payment reductions due to non–compliance with any of the Operational Performance Measures. It is important to stress that for OPM-1: Usability and OPM-10: Winter Maintenance, the length suffering from defects (the affected length) is not only the particular part of the road having the defect which makes the road non-useable (i.e., closed due to snow) but the whole road section that is closed for users.

A “first day” unit rate of payment deduction is defined in the relevant table for OPMs of the Specifications. The unit rate is a percentage of the monthly payment, which would generally be due. This unit rate is to be applied in full as a payment reduction for the length of road (in km) which is non-compliant on the first day of detection of any non-compliance, during a monthly formal inspection.

The project manager shall only suspend the application of the “first day” payment reduction for a particular road length if: i) at the formal inspection time, the contractor is already actively working on remedying the non-compliance which has been detected. This action has to be demonstrated by the Contractor through the clearly ongoing specific and appropriate activity of the contractor´s personnel and equipment on the exact site of the non-compliance and, ii) the contractor can credibly demonstrate that the non-compliance is so recent that the contractor could not yet have reasonably reacted to it in order to remedy the non-compliance, the MC shall apply his judgment to the “credibility” of the contractor´s statement and to the “reasonable” period and the contractor cannot appeal the MC´s determination.

Payment deductions for non-compliance are cumulative, means that if any one-km section of road is non-compliant with various OPM´s, all the corresponding payment reductions are to be applied. The maximum amount of “first day” payment reductions during one month for any one-km road section shall however not exceed the total payment typically due to that one-km section for that month.

4.2 Payment and deductions for improvement works

Payments for improvement works shall be made based on the total completion of a defined output. The maximum amount payable for improvement works is as defined in the letter of bid. The due amount must not be exceeded unless the volume and scope of Improvement works are modified through the change orders. The employer and the contractor may agree on the execution of improvement works that differ from those initially foreseen in the Contract. Such improvement works will be executed based on the change orders. If improvement works are substantially different from those initially foreseen in the bidding documents (agreed through the change orders), then the option of using the ad-measurement payment method based on traditional priced bills of quantities may also be stipulated in the change order.

The total price for improvement works shall include all costs of whatsoever nature implied in the contract. The prices also include the cost of all measures needed to prevent or mitigate adverse environmental impacts, and safety measures, and are fully in compliance with the laws and regulations of ARA.

The contractor invoice improvement works in his monthly statements for improvement works when such works have been completed satisfactorily (as

verified by the MC). The payable amount shall be adjusted for repayment of the advance payment and retention monies (if any) and shall be certified by the MC.

4.3 Payment and deductions for rehabilitation works

Rehabilitation works are generally rewarded by lump sum amount, indicating however the "quantities" of measurable outputs are executed. Payments for rehabilitation works shall be made based on actual progress achieved in their execution, as follows: i) For those Rehabilitation works that are executed by the Contractor's bid, payments will be monthly, on a lump sum basis and paid pro rata for the road length completed and, ii)For those Rehabilitation Works that are executed based on a Change Order, the applicable prices and the appropriate payment mechanism are to be indicated in the relevant Change Order. Payments can be either: i) monthly, on a pro-rata basis for the length of road where the works have been completed during the previous month and certified by the MC/ARA, or ii) monthly, based on priced Bills of Quantities, for the quantities of works which have been executed in the previous month.

The maximum amount that is payable for Rehabilitation Works is defined in the Letter of Bid. The limited amount must not be exceeded unless the volume and scope of rehabilitation work are modified through the change orders. The total price for rehabilitation works shall include all costs of whatsoever nature, including but not limited to all necessary designs and engineering services, all plants, equipment, labor, supervision, materials, erection, maintenance, quality control, maintenance of traffic, insurance, guarantees, the establishment of work camps for the contractor and MC, profit, taxes and duties, together with all general risks, liabilities and obligations of whatsoever nature sets out, or implied, in the contract.

The prices shall also include the cost of all measures needed to prevent or mitigate adverse environmental impacts, implement safety measures, and comply with laws and regulations. In any case, payment for Rehabilitation Works shall be made monthly for the work outputs completed during the previous month satisfactorily, in conformity with the approved detailed designs and the specifications, as measured by the contractor and verified by the monitoring consultant and valued at the applicable unit prices.

The contractor shall request payment for rehabilitation works in his monthly statement for rehabilitation works. The payment due to the contractor is to be adjusted for repayment of advance payment and retention money (if any). The employer and the contractor may agree on the execution of rehabilitation works that differ from those initially foreseen in the contract. Such rehabilitation works will be executed based on the change orders.

4.4 Remuneration of Emergency Works

Emergency works are remunerated based on traditional bills of quantities payments based on contractual rates for the execution of work items and the provision of materials, labor, and equipment, by the bidding data. Payment for each emergency works occurrence shall be in the form of a lump sum established based on the quantities estimated by the contractor and confirmed by the MC/ ARA at the time of issuing the particular work order, and the unit prices stated in the bill of quantities. The payment amount for each emergency works may, however, be adjusted if for any reason where the actual volume of work needs to be executed, and the materials used, differ substantially from the original estimate made and is reflected in the work order.

5 Application of Payment deduction based on OPMs and MPMs

5.1 Payment Reductions of OPMs

After the monthly formal inspection is done jointly between the contractor and monitoring consultant, a payment deduction is calculated for non-compliance based on OPMs, succeeding a grace period given by MC. If the contractor remedies the non-compliance(s) within the grace period granted, no further payment reductions are to be applied for those same non-compliances. However, if a non-compliance is not remedied within the grace period granted, further payment reductions or liquidated damages are to be applied for the entire duration of the non-compliance, including the grace period granted, as shown below:

$$DRx = [1 + (1/29)\ x\ days]\ x\ Dru \qquad (1)$$

DRx is the daily Unit rate for the calculation of payment reduction any day from the 2nd day up to the day when the non-compliance is remedied.

Dru is the daily unit rate for the calculation of payment reduction for the 1st day of non-compliance.,

Days is the number of additional days after the "first day" during which the noncompliance has persisted, including the grace period granted.

Having calculated the applicable unit rate, the amount of the payment reduction for the respective measure (PRM) is calculated by:

PRM = the appropriate daily unit rate (DRx) x the number of days of non-compliance x the affected length in Km (L) x Percentage payment Reduction of OPMs

The above-described method can be applied to all operational measures, except OPM-1 and OPM-11.

The monthly payment reductions due to non-conformances are cumulative and equivalent to the sum of the calculated payment reductions per performance measure. When an overall measure (e.g., OPM - 2) includes a group of sub-measures (e.g., patching, cracking in pavement, potholes, etc.),

then if the road suffers from several of these defects, the overall payment reduction for this measure is equal to the sum of each payment reduction per type of defect.

For OPM-1 (road usability) the payment reduction is calculated as a simple percentage of the monthly lump sum for the entire road link that is not useable. This payment reduction unit Rate is applied for 2 hours of periods of non-compliance.

The general methodology to apply deductions is to divide the road sections for stations as each station is one Kilometer (Km), and then apply non-compliance for each OPM or sub OPMs percentage as shown in Table 4.

For instance, the road section length is 3.45 Km which will be divided into four sections, each of them is one Km, and one is 0.45 Km. The DRx (daily Unit rate for the calculation of payment reduction) will be calculated, a site inspection will be carried out to integrate with SCU (Self Control Unit) to verify and to calculate the duration of noncompliance per day, grace period allowed, and penalized days.

The noncompliance OPM has a reduction factor that varies from 1% up to 25% from the Unit price per Km for non-compliance (Table 4). Based on the above payment reduction, the respective measure (PRM) is calculated by the appropriate daily unit rate (DRx) x the number of days of non-compliance x the affected length in Km (L) x Percentage Payment Reduction of OPMs. A further calculation example is provided in Table 5.

The sample calculation above shows a road with a 20.75 km length. The unit price per km per month is 320 euros, total lump sum price is 6,640 euros. The calculation shows noncompliance with three sub-OPMs and two main OPMs. OPM-2.1 has five days of noncompliance duration for one Kilometer length with a 10% payment reduction factor: the total deduction amount is 36.41 Euro. OPM-2.3 has seven days noncompliance duration for a one-kilometer length with a 10% payment reduction factor09 is 38.62 Euro.

Same of the above calculation is done for OPM-2.6, OPM-4, and OPM-9, for various durations and lengths of non-compliances with a total deduction of 500.96 Euro, which is equal to 8% of the total lump sum value of 20.75Km length.

Table 4 Payment Reductions of OPM's

Operational Performance Measures (OPM)	Compliance Criteria	Non- Compliance	
		Unit rate for non-compliance	% Payment Reduction
OPM-1	Usability (availability of each lane-km for use by traffic	1% of monthly LS for entire road and all other effected roads included in the contract for each 2 hours of non-compliance	1%
OPM-2	Pavements Defects (potholes, rutting, raveling, racking in pavement, edge break, average speed, etc.)		
OPM-2.1	Potholes	10% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	10%
OPM-2.2	Patching	10% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	10%
OPM-2.3	Cracking in pavement	10% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	10%
OPM-2.4	Multiple cracks in the pavement	10% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	10%
OPM-2.5	Cleanliness of the pavement surface and shoulders	10% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	10%
OPM-2.6	Rutting	10% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	10%
OPM-2.7	Raveling	10% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	10%
OPM-2.8	Loose pavement edges	10% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	10%
OPM-3	Shoulder and verge maintenance	10% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	10%
OPM-3.1	Height of shoulders vs. comply, for the first day of non-height pavement	10% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	10%
OPM-3.2	Paved shoulders	10% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	10%
OPM-3.3	Unpaved shoulders	10% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	10%
OPM-4	Drainage	10% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	10%
OPM-5	Routine maintenance of bridges and other structures	25% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	25%
OPM-6	Embankment and Cust Slopes	25% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	25%

OPM-7	Incident response and emergency works	25% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	25%
OPM-8	Functionality of road signs and line markings and other road furniture	10% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	10%
OPM-9	Vegetation control	10% of the monthly LS rate for each one km which does not comply, for the first day of non-compliance	10%
OPM-10	Winter service requirements	1% of monthly LS for the entire affected length of the road (the total length of the road that is not available to traffic users), and all other affected roads included in the contract for each 24-hours or part thereof of non-compliance	1%
OPM-11	Assessment of the performance of the contractor's Self Control Unit (SCU)	10% of the monthly LS rate if during the monthly formal inspections jointly by the MC and the contractor's SCU, the difference between the data provided by the contractor to the MC in the measurement or in the quality results in more than 20%, it will be considered as a non-compliance and will trigger the action for the application of penalty	10%

Table 5 Sample Calculations for OPM's Non-Compliance Reductions

Payment Reduction for Network Performance Services										
Contract No/Title:	RRMSPC/CW/RPAD MAINTENANCE AND SAFETY PROJECT FOR CONTRACT C		**Current IRI (Rai):**							
Contract month:			**Maximum permitted IRI (Rpi):**							
Road:	**xx**		**Unit rate per km. per month:**			**320. Euro**				
Contract L (km):	**156.01**									
Road Section:	**xx-x**		**Total LS per month**			**6,640.00 Euro**				
Section Length (km):	**20.75**									
	Required		Actual compliance			Non-Compliance				
2. Operational Performance Mesures (OPM)	Existing (LoS)	Target (LoS)	Compliance Criteria	Compliant length (km)	Non-compliant length (km)	% Payment Reduction	(i)Days of non-compliance remaining	(ii)Days of non-compliance within the current month	All days of non-compliance (i)+(ii)	Current payment reduction (Euro)
OPM-1	G	G	Usability	20.75	-	1%	-	-	-	-
OPM-2	G	G	Pavements Defects					-	-	-
OPM-2.1	G	G	Potholes	20.75	1	10%	5	-	5	36.41
OPM-2.2	G	G	Patching	20.75	1	10%	7	-	7	38.62
OPM-2.3	G	G	Cracking in pavement	20.75	-	10%	-	-	-	-
OPM-2.4	G	G	Multiple cracks in the pavement	20.75	-	10%	-	-	-	-
OPM-2.5	G	G	Cleanliness	20.75	-	10%	-	-	-	-

			of the pavement surface and shoulders							
OPM-2.6	G	G	Rutting	20.75	2	10%	15	-	15	94.9
OPM-2.7	G	G	Raveling	20.75	-	10%	-	-	-	-
OPM-2.8	G	G	Loose pavement edges	20.75		10%	-	-	-	-
OPM-3	G	G	Shoulder and verge maintenance			10%	-	-	-	-
OPM-3.1	G	G	Height of shoulders vs. comply	20.75	-	10%	-	-	-	-
OPM-3.2	G	G	Paved shoulders	20.75	-	10%	-	-	-	-
OPM-3.3	G	G	Unpaved shoulders	20.75	-	10%	-	-	-	-
OPM-4	G	G	Drainage	20.75	3	10%	2	-	2	99.31
OPM-5	G	G	Routine maintenance of bridges and other structures	20.75	-	25%	-	-	-	-
OPM-6	G	G	Embankment and cust slopes	20.75	-	25%	-	-	-	-
OPM-7	G	G	Incident response and emergency works	20.75	-	25%	-	-	-	-
OPM-8	G	G	Functionality of road signs/markings/ other furniture	20.75	-	10%	-	-	-	-
OPM-9	G	G	Vegetation control	20.75	7	10%	2	-	2	231.72
OPM-10	G	G	Winter service requirements	20.75	-	1%	-	-	-	-
OPM-11	G	G	Assessment of the performance of the contractor's Self Control Unit (SCU)	20.75	-	10%	-	-	-	-
(3) Total payment reduction for OPM (Euro)										500.96

5.2 Payment reductions for MPMs

The methodology to apply deductions based on MPM noncompliance is a straightforward method: calculation for days of delays for each MPM is made then the Unit rate for non-compliance is used, as shown in Table 6.

Table 6 Payment Reductions of MPM's

Management Performance Measures (MPM)	Actual Compliance	Non-Compliance			Unit rate of Payment Reduction to be applied
	Compliance Criteria	Unit Rate for non-compliance	Days of delay	(EUR)	(EUR/day)
MPM-1	QAP with its supplements HSMP, ESMP, and EPP	75 EUR for each day of delay either in the initial of final submission	-	75.00	-
MPM-2	Winter Service Plan	75 EUR for each day of delay either in the initial of final submission	-	75.00	-
MPM-3	Program of performance	75 EUR for each day of delay either in the initial of final submission	-	75.00	-
MPM-4.1	i)Initial contact area condition report	75 EUR for each day of delay either in the initial of final submission	-	75.00	-
MPM-4.2	ii) Update of the asset inventories report (AIR)	75 EUR for each day of delay either in the initial of final submission	-	75.00	-
MPM-5	Submission of designs	75 EUR for each day of delay either in the initial of final submission	-	75.00	-
MPM-6	Monthly progress reports	1000 EUR per day, up to a maximum of EUR 6000 in each month, for each section of the Monthly Progress Report	-	1 000	-
MPM-7	Road assets damage and emergency incidents report	75 EUR for each day of delay either in the initial of final submission	-	75.00	-
MPM-8	End of contract handover report	75 EUR for each day of delay either in the initial of final submission	-	75.00	-
MPM-9	Road roughness profile	75 EUR for each day of delay either in the initial of final submission	-	75.00	-

MPM-10	Road strength profiles	75 EUR for each day of delay either in the initial of final submission	-	75.00	-
Total payment reduction of MPM (EUR)					0.00

6. CONCLUSIONS

This study offers important insights into the performance measurements of performance-based contracts for road maintenance in developing countries, with a particular emphasis on payments and deductions. The case study sheds light on the challenges and opportunities of implementing such contracts in developing country contexts, as well as the implications for improving road maintenance performance. There are gaps in fully addressing and describing the risk, responsibilities, scope of services, performance standards, and performance levels and penalties for non-achievement of monthly performance standards, so the contractors were inexperienced to do this type of road work using PBMC procedures.

First, in Albania, performance-based incentives in PBMCs have proven to be motivating to contractors as they impose high-quality maintenance results. Contractors are incentivized to focus on preventative maintenance, timely repairs, and overall road improvement by directly connecting payments to performance indicators. The financial incentives offered encourage contractors to spend effort and resources into attaining and exceeding performance targets.

Deduction methods in PBMCs have helped to ensure contractor responsibility. The fear of penalties and deductions serves as a disincentive to poor performance or insufficient maintenance practices. PBMCs hold contractors accountable for fulfilling agreed-upon maintenance standards and schedules by enforcing financial penalties for underperformance, resulting in enhanced contractor responsibility.

Second, the results emphasize the significance of contextualizing performance indicators in developing countries. When designing performance indicators, the unique challenges, and constraints of road maintenance in developing country contexts, such as limited resources, inadequate infrastructure, and capacity gaps, must be considered.

There is a big concern regarding the MPM's and OPM's deduction, reaching up to 80% for one OPM only. In case the contractor fails to meet any compliance for a full segment length, for 29 days, the deduction reaches up to 400% of the payment amount, regardless of the limitation of contract terms in which the maximum deduction is total due to payments for a road segment. In such cases, where the reductions for noncompliance performance are increasing up to 400% of the contract value for specifying the road section, the

contractor's risk will increase which strictly reflects in his lump sum cost and performance bond which is 10% of the tender value.

The case study findings suggest that performance indicators should be realistic, practical, and relevant to the local context in order to motivate contractors to achieve desired performance outcomes. For future implementations of Performance-Based Maintenance Contracts in developing countries, it is recommended to establish a Road Asset Management System to ensure all data records and road assets conditions are correct. Moreover, training of staff, contractors, and consultants who are interested in future contracts is compulsory to assure the success of this type of contract. It is recommended to encourage the Contractor to propose a "Bonus" clause as well. For example, if the contractor records successful response time for all non-compliance reports within the grace, some of the operation performance reduction can be retained by the contractors.

|However, several limitations are acknowledged. The case study was carried out in the context of a specific developing country and may not be fully generalizable to other developing countries with different contexts and challenges. The study relied on limited data and may not capture all of the nuances of performance-based road maintenance contracts in developing countries. Future research could investigate other factors, as well as the long-term effects of performance-based contracts on road maintenance performance in these settings.

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