



PERFORMANCE-BASED ROAD MAINTENANCE CONTRACTS IN THE CAREC REGION

DECEMBER 2023

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6 ADB Avenue, Mandaluyong City, 1550 Metro Manila, Philippines
Tel +63 2 8632 4444; Fax +63 2 8636 2444
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ABBREVIATIONS

AAYDA	Azərbaycan Avtomobil Yolları Dövlət Agentliyinin (State Agency of Azerbaijan for Automobile Roads)
ADB	Asian Development Bank
cm	centimeter
CAREC	Central Asia Regional Economic Cooperation
DNP	defect notification period
IRI	International Roughness Index
km	kilometer
m	meter
m ²	square meter
mm	millimeter
MOT	Ministry of Transport
MPM	management performance measure
NPS	network performance score
OPRC	output- and performance-based road contract
PBMC	performance-based maintenance contract
PBRM	performance-based road maintenance
PRC	People's Republic of China
RDPM	road durability performance measures
RMPM	routine maintenance performance measures
RUS&CPM	road user service and comfort performance measures
SLA	service level agreement
SMART	specific, measurable, acceptable, relevant, and time
UAD	Управления Автомобильных Дорог (УАД) (Road Administration)
VAT	value-added tax

PERFORMANCE-BASED ROAD MAINTENANCE

Performance-based road maintenance (PBRM) contracts refer to maintenance contracts where part of the maintenance and repair work is paid on a performance basis. This means that the payment is not according to the completed volume of work (output-based or volume-based), nor is it according to the time spent and materials used (input-based), but instead the payment is according to the resulting condition of the road (outcome-based or performance-based). PBRM contracts make use of performance standards that consist of a performance indicator describing a specific defect and how to measure it, and an allowable threshold defining the acceptable values of the defect. Examples of performance indicators are the maximum number of potholes per kilometer of road, the maximum size of any pothole, and the maximum height of vegetation along the road. Allowable thresholds are then added to define the performance standards, for instance determining that there may not be more than 5 (small) potholes per kilometer of road, that no pothole may be more than 20 centimeters (cm) in diameter, and that vegetation may not be more than 20 cm high.

Such performance standards are prepared for different defects affecting different elements of the road such as the pavement, shoulder, drainage system, structures, and right-of-way. If these performance standards are complied with and any existing defects do not exceed the allowable thresholds, a fixed monthly payment is made. If one or more performance standards are not complied with anywhere in the contracted road section, a deduction is applied to the monthly payment. This deduction will depend on the type of performance standard and the degree of noncompliance. In some cases, the contractor is provided with a response time in which the noncompliance may be corrected. If the noncompliance is corrected within the response time, the deduction is not applied or the applied deduction is repaid in the next monthly payment.

PBRM contracts have the advantage that they provide an incentive to the contractor to provide timely maintenance in a cost-efficient manner, regardless of whether this involves private contractors or state-owned contractors. In PBRM contracts, the contractor receives a fixed payment to which a deduction is applied if the performance standards are not complied with, providing an incentive for ensuring that the defects do not exceed the allowable threshold, thus maximizing the payment. At the same time, timely maintenance can reduce the volume of work required, and thus reduce the costs for the contractor. The contractor is free to decide the timing and method of carrying out the maintenance, providing flexibility to carry out the work more efficiently, to invest in more efficient equipment, and to purchase materials in bulk. These characteristics of PBRM contracts and the incentives they provide have led to improved road conditions and reduced costs compared to traditional volume-based road maintenance contracts. It must be noted, however, that costs tend to increase when PBRM contracts are first introduced, mainly as a result of the lack of experience with such contracts. It must also be noted that the PBRM contracts only provide proper incentives if the contract properly covers the costs of the required maintenance and if the deductions applied in case of poor performance exceed the costs of the required treatments. If the contract amounts are consistently too low to cover the costs or if the deduction amounts are lower than the cost of complying with the contract, then there is no proper incentive for the contractor and the contract is likely to fail.

Under traditional volume-based road maintenance contracts, the contractor is paid according to the volume of work completed. Under such contracts there is an incentive for the contractor to delay the maintenance and allow the road to deteriorate further, thus increasing the volume of work to be carried out and thus the size of the payment to be received. In the case of road maintenance implemented through force account, a different approach is sometimes used where financing is provided according to the inputs used (salaries, fuel, materials). Although under such modalities there may be an incentive to do as much work as possible with the available financing, the balance between the different inputs is often not appropriate, with funding for salaries guaranteed but funding often lacking for the fuel and materials required to actually carry out maintenance. In both cases, there is no guarantee that the funding will result in a target service level or road condition as payment is against outputs or inputs, and not against outcomes or performance. Although performance-based contracts are considered more appropriate for road maintenance, the main challenge is that there is insufficient experience with this modality, compared to the input- and output-based contracts which have been used extensively.

Over the past decade, several development partner projects have piloted PBRM contracts in the different Central Asia Regional Economic Cooperation (CAREC) countries. This publication reviews a total of 24 completed, ongoing and canceled PBRM contracts in 6 of the 11 CAREC member countries (Azerbaijan, the People's Republic of China [PRC], Georgia, the Kyrgyz Republic, Mongolia, and Tajikistan) from the past 10 years. The contracts cover a total road length of nearly 2,900 kilometers (km) and were implemented under 13 different projects funded by the Asian Development Bank (ADB) and the World Bank.

Table 1: PBRM Experiences in the CAREC Region

Country	Project	Type	Length (km)	#	Duration (months)	Period	Initial Repairs	Performance-Based Activities	Provisional Sum
AZE	World Bank Third Highway Project	SLA	774 km	3	24	2019–2021 (completed)	-	RM+WM	EM
PRC	ADB Yunnan Sustainable Road Maintenance Project	OPRC	57 km	1	60	2015–2020 (completed)	Full RH+PM	RM	EM
PRC	ADB Yunnan Sustainable Road Maintenance Project	SLA	107 km	1	36	2016–2019 (completed)	Partial RH+PM	RM	EM
PRC	World Bank Anhui Road Maintenance Innovation and Demonstration Project	OPRC	488 km	6	60	2020–2025 (ongoing)	Partial RH+PM	RM	WM+EM

continued on next page

Table 1 *continued*

Country	Project	Type	Length (km)	#	Duration (months)	Period	Initial Repairs	Performance-Based Activities	Provisional Sum
GEO	World Bank Second Secondary and Local Roads Project	OPRC	117 km	1	60	2016–2021 (completed)	Partial RH	PM+RM+WM	EM
GEO	World Bank Secondary Road Asset Management Project	OPRC	240 km	1	60	Cancelled	Partial RH+PM	RM+WM	EM
GEO	ADB Batumi Bypass Road Project	OPRC	142 km	1	60	Cancelled	Partial RH	RM+WM	EM
KGZ	World Bank Central Asia Road Links Program	SLA	407 km	1	12	2014–2015 (completed)	-	RM+WM	EM
KGZ	ADB CAREC Corridor 3 Bishkek–Osh Road Improvement Project	OPRC	69 km	1	36	2018–2021 (completed)	Limited RH+PM	RM ^a	RM ^a +WM+EM
KGZ	ADB CAREC Corridors 1 and 3 Connector Road Project (additional financing)	OPRC	70 km	2	24+60	2020–2027 (ongoing)	Full RH	RM+WM+PM	EM
MON	ADB Regional Road Development and Maintenance Project	OPRC	58 km	1	24+36	2021–2026 (ongoing)	Full RH	RM+WM	
TAJ	ADB CAREC Regional Road Corridor Improvement Project	OPRC	149 km	2	36	2013–2016 (completed)	Limited PM	RM	WM+EM
TAJ	ADB CAREC Corridors 3 and 5 Enhancement Project	PBMC	219 km	3	36–48	2018–2023 (ongoing)	-	RM	WM+EM
Total			2,897 km	24					

ADB = Asian Development Bank, AZE = Azerbaijan, CAREC = Central Asia Regional Economic Cooperation, EM = emergency maintenance, GEO = Georgia, KGZ = Kyrgyz Republic, km = kilometer, MON = Mongolia, OPRC = output- and performance-based road contract, PBMC = performance-based maintenance contract, PBRM = performance-based road maintenance, PM = periodic maintenance, PRC = People's Republic of China, RH = rehabilitation, RM = routine maintenance, SLA = service level agreement, TAJ = Tajikistan, WM = winter maintenance.

^a Current repairs to the pavement were paid separately on a volume basis.

Source: Consultant's processing of data.

Each of the PBRM pilots is presented in terms of the aspects listed in Table 2 that are described in more detail in the following sections. The following six chapters describe these aspects for the PBRM experiences in each of the six countries. The final chapter of this publication provides the lessons from the PBRM pilots in the CAREC region and provides recommendations for future piloting and replication of PBRM contracts. These may serve to further improve the PBRM contracts in the countries concerned or can serve as the basis for developing new PBRM pilots in other countries in the CAREC region and the rest of the world.

Table 2: Main Aspects of PBRM Contracts

<ul style="list-style-type: none"> • Contract scope • Performance standards • Inspections • Response times • Payments and deductions • Procurement and contract costs

PBRM = performance-based road maintenance.

Source: Author.

Contract Scope

The scope of the PBRM contracts may include different maintenance and repair activities. These activities may be included under the performance-based portion of the contract, or alternatively may be included under a volume-based portion or provisional sum under the same contract with lump sums or unit costs. Contracts with both performance-based and volume-based payments are often referred to as hybrid contracts. Distinction is generally made between initial repairs, maintenance services, and a provisional sum. Initial repairs are carried out at the start of the contract to address any existing damages and backlog maintenance needed to bring the road up to the required condition. They tend to be paid on a volume basis since the volume of work is easily measured against unit rates defined in the bill of quantities. Not all PBRM contracts include initial repairs. Maintenance services start after the initial repairs and run for the full duration of the contract with the aim of sustaining the required road condition. Generally, they include routine maintenance and current repairs as well as certain winter maintenance activities. They tend to be paid on a performance basis since overall volumes are predictable, but not exactly measurable at the start of the contract or fixed in time. All PBRM contracts include maintenance services. A provisional sum is included for works that may be carried out at any time during the contract if required, and serve to address damages caused by unforeseen events or that are not easily predicted otherwise. The volumes of these works cannot be measured or predicted beforehand. Including these activities under the performance-based payments may introduce a large risk for the contractor and lead to high costs. Therefore, such activities tend to be paid on a volume basis under a provisional sum, thus reducing the risk for the contractor and the costs involved. Apart from emergency maintenance, the provisional sum may also include other maintenance and repair activities such as winter maintenance and pavement renewals (periodic maintenance). Provisional sums are most often included under PBRM contracts to address unforeseen events (emergency maintenance).

Table 3: Possible Components of a PBRM Contract

Initial repairs	<ul style="list-style-type: none"> • Repairs at the start of the contract to bring the road to the desired condition or standard • Measurable volumes • Volume-based payments (unit rates or lump-sum)
Maintenance services	<ul style="list-style-type: none"> • Maintenance and small repairs for full contract duration to keep the road at the desired condition • Volumes not measurable at the start of the contract, but easy to predict • Performance-based payments
Provisional sum	<ul style="list-style-type: none"> • Repairs to unforeseen damages or other larger repairs • Volumes not measurable at the start of the contract, and difficult to predict • Volume-based payments under a provisional sum

PBRM = performance-based road maintenance.

Source: Author.

The most common road maintenance activities included under PBRM contracts are as follows:

- **Routine maintenance and current repairs.** Current repair includes minor repairs to the pavement (e.g., pothole patching, crack sealing) and structures that are carried out on an annual basis, whereas routine maintenance refers to other annual activities such as cleaning drains and cutting vegetation. These form the basis for PBRM contracts and are generally part of the performance-based portion of the contract.
- **Winter maintenance.** Where applicable, winter maintenance is often included as part of the performance-based component of the PBRM contracts. However, where snow and ice volumes vary significantly from one year to the next, or where little historical data is available regarding snowfall, the winter maintenance may be instead included as a provisional sum with volume-based payments against work orders to reduce the risks for the contractor and avoid increased contract costs.
- **Emergency maintenance.** Because of the unpredictable nature of emergency maintenance, this is almost always included as a provisional sum with volume-based payments against work orders. Generally, the contract will include thresholds defining the minimum volume of damages caused by unforeseen events above which emergency maintenance will be funded from the provisional sum. All damages below this threshold are considered part of the performance-based routine maintenance and current repairs. This is again done to limit the responsibility and risk for the contractor and to avoid high contract costs.
- **Periodic maintenance and rehabilitation.** Periodic maintenance (midterm repairs) or rehabilitation (capital repairs) tend to be carried out at the start of the contract to address damages and any existing maintenance backlog in the contracted road. The objective is to bring the road to the required standard before the performance-based maintenance services are started. Since the volume of work can be determined at the start of the contract, these works tend to be paid on a volume basis under a separate payment under the same contract. The payments may be made on a lump-sum basis per kilometer of road or according to unit rates defined in a bill of quantities. The initial repairs may not cover all repair needs, and any remaining repairs needed to bring the road up to the required standard will need to be carried out under the subsequent maintenance services. Although it is more common to include such repairs at the start of the contract, it is also possible to plan for them in the course of the contract

(for instance, the implementation of periodic maintenance in a specific year). If it is certain that such repairs will be carried out in the course of the contract (e.g., programmed periodic maintenance), it may be included in the performance-based payments. If it is uncertain or if the volume of works to be carried out is uncertain, such repairs are best included in a provisional sum and paid on a volume basis to reduce the risk for the contractor and avoid high bid prices.

- **Management.** PBRM contracts may also require the contractor to prepare monthly statements and reports, annual maintenance plans, traffic management plans, quality assurance plans, health and safety plans, emergency procedures, etc.; and to regularly update these plans and comply with them. The PBRM contracts may further require the contractor to carry out certain road inventory and road condition surveys or traffic counts at certain intervals. These activities are generally included in the performance-based portion of the contract, with related performance standards.

Table 4: Maintenance Activities in PBRM Contracts

Activity	Initial Repairs (volume-based)	Maintenance Services (performance-based)	Provisional Sum (volume-based)
Rehabilitation (capital repairs)	At start		
Periodic maintenance (midterm repairs)	At start	(Full contract duration) ^a	Full contract duration
Management activities		Full contract duration	
Routine maintenance		Full contract duration	
Current repairs		Full contract duration	(Full contract duration) ^a
Winter maintenance		Up to threshold ^b	Above threshold ^b
Emergency maintenance		Up to threshold ^b	Above threshold ^b

PBRM = performance-based road maintenance.

^a This is not common but is applied in some contracts.

^b The contract defines thresholds regarding the volume of snow or damages, above which additional payments are awarded.

Source: Author.

Where a PBRM contract only includes routine maintenance complemented by emergency maintenance and possibly winter maintenance and management activities, this is referred to in this report as a **performance-based maintenance contract (PBMC)**. Such PBMCs are largely limited to performance-based payments, with a provisional sum for emergency maintenance and possibly winter maintenance to cover work volumes that cannot be easily predicted. These PBMCs are generally tendered out competitively to private sector contractors.

In many countries in the CAREC region, routine and winter maintenance tend to be carried out by state-owned maintenance entities. These may be set up as units that form part of the road agency, or they may be set up as state-owned enterprises or companies under the road agency or under a different government entity. To respond to this situation, some countries have introduced so-called **service level agreements (SLAs)**. These are similar in nature to the PBMCs, but are signed directly with the

state-owned maintenance entities. This introduces a more commercial relationship between the road agency and the maintenance entities, and often forms a step in their gradual commercialization, and possibly even their future privatization. Such SLAs tend not to be tendered competitively. SLAs normally include routine maintenance and current repairs as well as winter maintenance, but may also include some initial repairs if this is within the capacity of the state-owned maintenance entities to carry out.

Where a road requires significant repairs to bring it up to the required standard, such repairs are generally carried out under a volume-based payment at the start of the contract. Such contracts include two parts: (i) the initial repairs that are paid on a volume basis (output-based), and (ii) the subsequent maintenance services that include routine maintenance and current repairs that are paid on a performance basis. The benefit of combining these volume-based initial repairs with the subsequent performance-based maintenance services is that the contractor is motivated to do an extra good job for the initial repairs to reduce its costs for the subsequent maintenance services. Such contracts are generally referred to as **output- and performance-based road contracts (OPRCs)**. These contracts may include winter maintenance under the performance-based maintenance services or as a provisional sum, and also tend to include a provisional sum for emergency repairs. OPRCs are generally tendered out competitively, as state-owned maintenance entities often lack the capacity for larger initial repairs that tend to form part of these contracts.

Table 5: Maintenance Activities Included in PBMCs, SLAs, and OPRCs

Activity	PBMC	SLA	OPRC
Rehabilitation (capital repairs)	-	-	√
Periodic maintenance (midterm repairs)	-	-	√
Management activities	√√√	√√√	√√√
Routine maintenance	√√√	√√√	√√√
Current repairs	√√√	√√√	√√√
Winter maintenance	√	√	√
Emergency maintenance	√	√	√√√

- = not included, √ = often included, √√√ = always included, OPRC = output- and performance-based road contract, PBMC = performance-based maintenance contract, SLA = service level agreement.

Source: Author.

Performance Standards

Performance standards consist of a performance indicator that describes a specific defect and how it is measured (e.g., the diameter of a pothole, maximum height of vegetation within a specific distance of the pavement edge), complemented by a threshold that defines the maximum allowable value of that indicator (e.g., maximum diameter of any pothole is 20 cm, maximum height of vegetation within 3 meters [m] of the pavement edge is 30 cm). The performance standards cover different defects and different road elements. They form the basis for the performance-based portion of any PBRM contract.

Although generally they define the maximum allowable dimensions, volume, quantity, or severity of defects, in some cases they define also the maximum reaction time within which a defect has to be corrected from the moment of identification. This is specifically for defects that happen suddenly and that cannot be predicted, such as landslides, traffic accidents, and snowfall. Reaction times are used also for defects that have zero tolerance (this often involves safety-related defects) and where there is no time to correct the defect before the threshold is exceeded (e.g., damaged guardrail or parapet). In such cases the contractor cannot be held accountable for the threshold being exceeded, but is made responsible for correcting the defect within an acceptable time. In these cases, the reaction time forms the actual performance standard. The complete set of performance standards is often referred to as the service level, as it describes the level of service to be provided for the road as a whole.

This document discusses the performance standards applied in the different PBRM pilots. Where available, the performance standards used in the different contracts are included in the appendixes. These may serve as a basis for comparing performance standards used in different countries and identifying suitable performance standards to be included in new PBRM contracts. In the text in each country chapter, comments are made regarding the appropriateness of different performance standards and the related indicators and thresholds.

In selecting performance standards and defining allowable indicators and thresholds, it is important to take a number of aspects into account. The performance standards have to be specific, measurable, acceptable, relevant, and time-bound (SMART). Only if the performance standards are tested against these five aspects, will they result in a performance-based contract that is achievable and enforceable. There are many examples where improper performance standards have been difficult to enforce, have not resulted in the desired road conditions, or have resulted in very high bid prices. Examples are given under the country chapters.

- **Specific.** Performance standards must be specific about what the contractor is required to do to ensure compliance. For example, some performance standards use vague wording such as “good condition” or “no unsightly material,” without defining what that means exactly. It can then be very difficult for the contractor to ensure compliance and for the inspectors to monitor compliance, often resulting in disputes during inspections. A good example of a specific performance standard for culverts is the requirement that “no more than 25% of the cross section may be blocked in any part of the culvert.”
- **Measurable.** Performance standards must also be objectively measurable to avoid disputes about compliance. The measurement must be simple, allowing both the contractor and the employer to easily check whether the performance standard is complied with or not. For example, some performance standards are related to roughness or skid resistance, which require specific equipment to verify compliance and are difficult to check on a monthly basis. Other performance standards may be defined in such a way that objective measurement is not possible. A good example of a measurable performance standard for potholes is that “the maximum dimension of any pothole may not exceed 20 cm.” This can be easily verified with a ruler or tape measure.
- **Achievable.** Performance standards must have thresholds that are set at such a level that compliance is achievable at acceptable costs. Zero-tolerance standards or very low thresholds can result in high contract costs. For example, a performance standard stating that no potholes are allowed (zero tolerance) will require constant inspection of the road and a constant

readiness of the contractor to patch potholes. Similarly, a performance standard that states that all loose snow has to be removed from the carriageway within 2 hours requires a significant snow-clearing capacity on the part of the contractor. At the same time, very high thresholds that are easily achievable, may result in unacceptable road conditions. For instance, although a maximum allowable pothole size of 0.5 square meters (m²) may seem acceptable, it is actually equivalent to a pothole diameter of 80 cm that is clearly unacceptable. Such performance standards can have a significant impact on the required capacity of the contractor, and thus on the costs involved. Examples of more achievable performance standards are an increase of the allowable time frame for removing the snow to 4 hours or relaxing the standard to allow some depth of snow to remain on the road for longer, thus increasing the time frame for the contractor to respond while still ensuring an acceptable service level. This can lead to a significant reduction in costs as the required capacity on the part of the contractor is much smaller.

- **Relevant.** Performance standards must be specifically stated to ensure that compliance with the standard is actually relevant to the road condition. For example, a performance standard that defines the allowable length of drains that may be blocked is not relevant as even a short blockage can have significant impact on the functioning of the drain and on the potential for damages to the road. An example of a more relevant performance standard would be the allowable degree of blockage of the cross-section of the drain in any location.
- **Time-bound.** Performance standards must be clear about when the thresholds need to be complied with. Generally, this is at the moment of the monthly inspection. However, for certain defects that can occur suddenly, a reaction time should be included in the performance standard. For instance, some PBRM contracts set a reaction time of 4 hours to remove all loose snow from the carriageway after the snowfall has ended.

Inspections

The performance-based components of PBRM contracts generally involve small contract amounts of several thousands of dollars per kilometer per year. Inspection and supervision costs can easily make up a significant portion of the total cost, and the aim should be to reduce the effort and time involved in inspections. The performance standards play an important role in this, since most of them may be inspected through a general drive-over survey, stopping only to measure any perceived instances of noncompliance. The time spent in inspections tends to be significantly lower than in volume-based contracts where volumes have to be measured once before the work order is given, and again after the work has been completed.

Inspections in PBRM contracts are carried out by the road agency or by a third party on behalf of the road agency. Inspections are carried out on a regular basis, often monthly. These inspections verify the level of compliance of the road conditions with the performance standards. Such monthly inspections may be complemented by annual inspections to verify certain performance standards that require specific surveys or measurements and are not easily carried out on a monthly basis (e.g., roughness). Distinction is often made between formal inspections and informal inspections.

Formal inspections are carried out on a regular basis together with representatives of the contractor. The formal inspections are often preceded by the submission of a monthly statement by the contractor, in which the level of compliance with the performance standards is described. The formal inspections serve to check the reported level of compliance and the accuracy of the monthly statement, forming the basis for calculating any deductions to the monthly payment. Formal inspections involve driving over the contracted road section, stopping whenever a noncompliance is perceived, and verifying this through measurements. Inspections under performance-based contracts require less time and fewer inputs compared to volume-based contracts, as only noncompliances are measured instead of all completed works. The contractor is required to continuously monitor the full road length under contract, as this forms the basis for the planning of maintenance activities, and the results of this monitoring should be reflected in the monthly statement. Formal inspections may cover the entire road length under contract, or only a random sample. Sampling can further reduce the time and effort required for the surveys, but a proper sampling system needs to be in place to ensure that the entire road section is inspected each year, and that sampling is indeed random and the road sections to be inspected are unknown beforehand. After completion of the formal inspection, the inspection form is filled in, identifying all noncompliances, and signed by both the inspector and the contractor representative.

Informal inspections refer to unplanned visits to the contracted road sections, generally without the contractor representative. Noncompliances identified during such informal inspections do not automatically lead to deductions, but are instead reported to the contractor to be addressed in a timely manner. Correction of identified noncompliances may be checked during the next formal inspection. Where the noncompliances identified during an informal inspection include a reaction time, the reaction time is measured from the moment the contractor is informed about the noncompliance. If the defect is not corrected within the reaction time, this can lead to a deduction without the need for a formal inspection. In this case, the reporting of the noncompliance may also be by road users, by means of a specific hotline or website. Such reports then need to be properly logged, including the time of the report and information on the location and type of defect.

The compliance with the performance standards is generally inspected per **1 km road segment**. This allows segments with poor performance to be identified. For instance, a 20 km road with 30 potholes may be compliant with a performance standard of maximum five potholes per kilometer, but if those 30 potholes are all within a single 1 km segment, that 1 km segment is not considered compliant. The application of 1 km segments also means that the same performance standards can be applied to different contracts, regardless of the contracted road length.

Response Times and Reaction Times

Response times refer to the time that is given to contractors to correct any noncompliances with the performance standards identified during the formal inspection. In earlier versions of PBRM contracts, including the standard OPRC template of the World Bank, each performance standard was given a response time. If the noncompliances with the performance standards identified during the formal inspection are corrected within the response time, any applied deductions are repaid to the contractor. Only if the defects are not corrected in time do the deductions become permanent.

In practice, this has led to contractors not doing anything until after the formal inspection, and then only responding to the identified noncompliances, making use of the response times available to them. This minimizes their costs, avoiding that works are carried out for noncompliances that are not identified during the inspection. However, this approach undermines the objective of PBRM contracts where the contractor is expected to respond to defects before these exceed the performance standard thresholds. This also requires the entire road length to be surveyed in detail, as sampling will only result in some of the noncompliances being identified and subsequently corrected by the contractor. Although the contractor will ultimately need to correct all noncompliances as these are identified in subsequent formal inspections, this can lead to a lower level of service for the road than envisaged.

A second problem with the response times is that these require follow-up inspections to verify that, indeed, they have been corrected in time. The response times vary by performance standard from a few hours to a few days or even weeks, depending on the importance of the defect. This results in the need for several follow-up inspections, greatly increasing the time and effort involved and undermining one of the important benefits of the PBRM approach of having a much lower inspection burden than traditional volume-based contracts.

Therefore, this report recommends not using response times at all. Most defects occur gradually, and it can be predicted when the defect will exceed the threshold defined in the performance standard. The contractor is more than able to correct the defect before it exceeds the threshold, and a response time is not required. For instance, in the case of potholes, the threshold is generally defined in the maximum size of any pothole and/or the maximum number of potholes per length of road. If the maximum pothole diameter is 20 cm or a maximum of 5 potholes per kilometer are allowed, the contractor can start patching potholes when these are still 15 cm in diameter or when there are only 3 potholes or 4 potholes per kilometer, thus avoiding that the threshold is exceeded. Similarly, if the threshold for vegetation defines a maximum height of 30 cm, the contractor can mow the right-of-way when the height is 20 cm or 25 cm. Most of the performance standards can be treated in this way, and response times are not required, and deductions should be applied immediately if noncompliance is identified during a formal inspection.

The exception are the defects that cannot be predicted and where the defined thresholds can be exceeded suddenly, with the contractor unable to prevent this. Examples are landslides, traffic accidents, and snowfall. But also defects with a zero tolerance that are often applied to defects with a serious safety hazard, such as missing guardrails or parapets, can result in the threshold being suddenly exceeded. In these cases, the contractor cannot prevent the thresholds from being exceeded and will require some time to correct the defect. For these cases, this document argues that the time required to correct the defect should be defined as part of the performance standard.

This document uses the term **reaction time**, to distinguish from the response time that is defined as the time provided to correct any noncompliances identified during the formal inspection to avoid deductions becoming permanent and irreversible. Reaction times are only included in those performance standards where the threshold can be exceeded suddenly, and this cannot be predicted. The reaction time is measured from the time the noncompliance is first identified and reported, either by the contractor, by the employer (based on either a formal or informal inspection), or by a road user (using a hotline or website to report a defect). For road users to be able to report any noncompliances, there needs to be a proper hotline system in place (phone number, website) as well as a system for logging such reports. As soon as the contractor is made aware of the noncompliance, the defect needs to be corrected within

the given reaction time to avoid any deduction to the monthly payment. Compliance with the performance standard is only assessed at the end of the defined reaction time, and in case of noncompliance immediately results in a deduction that is permanent and irreversible. This deduction may be repeated if the noncompliance continues to go uncorrected. This generally involves only important defects that have a serious impact on trafficability or safety, with relatively short reaction times of a few hours or days. Inspection of these performance standards will be separate from the formal inspections and may happen at any time during the month.

Payments and Deductions

The payments for the initial repairs tend to be made on a traditional volume basis according to the unit costs included in the contractor's bill of quantities, although sometimes the payments are made on a lump-sum basis according to the length of road completed to standard. Emergency (and winter) maintenance under provisional sums tend to be paid on a volume basis according to unit rates in the bill of quantities, subject to a work order being issued in the same way as is traditionally done for dayworks. The payments for the performance-based portion of PBRM contracts generally involve fixed monthly lump-sum payments. These monthly lump sums are based on the contractor's annual bid price for the performance-based maintenance activities, divided into equal monthly payments. These bid prices are generally based on previous experience or previous contracts in the roads concerned, and involve an estimation of the volumes of work likely to be required during the contract period, and the costing of those volumes of work. Historic data on the volumes of maintenance carried out in previous years can help contractors to better estimate the volumes of work required, and improve both their bids and the cost estimates prepared by the road agency. In some contracts, different bid prices are included for different years to take account of the ageing of the road and increasing maintenance needs as well as expected price increases because of inflation. Price adjustments based on price indexes may also be included for longer contracts. The fixed monthly payments are defined in the PBRM contract document and define the payment that will be made in case of full compliance with all performance standards.

In case of noncompliance with one or more performance standards, a deduction may be applied to the agreed monthly payment. This deduction is expressed generally as a percentage of the monthly payment. The **deduction percentage** will depend on the type of performance standard that is not complied with and, in some cases, also the degree of noncompliance. Performance standards will have higher deduction percentages if they are related to defects that have a greater impact on road trafficability, road safety or road sustainability, or that involve greater costs to repair. For instance, the deduction percentage for a large pothole will be higher than for high grass, as large potholes can be a serious safety hazard. Blocked drainage will have a higher deduction percentage as this can lead to serious damage to the road. Potholes in a paved road surface will have a higher deduction percentage than potholes in gravel shoulders that are less expensive to repair. The deduction percentage should reflect the importance of the defect as well as the cost of correcting it. The deduction percentage should be high enough to provide a proper incentive to the contractor to comply with the performance standards. If deduction percentages are too low, the deduction will be less than the cost of correcting the defect and the contractor will be less inclined to correct the defect. The deduction percentage should not be too high also, as this will increase the risk for the contractor, leading to higher bid prices. Ideally, the deduction should be slightly higher than the cost of the treatment. However, in some cases, the deduction may be set even higher if the defect has severe implications for road safety (e.g., pothole) or for damages to the rest of the road (e.g., blocked drains).

As the inspections are applied to 1 km segments, the deductions are applied to monthly payment for the same 1 km segments. This is done by dividing the total monthly payment by the contracted road length to determine the monthly payment per kilometer, which is then multiplied by the deduction percentage. Where a contract includes different roads with different contract prices, this may result in different monthly payments per kilometer for the different roads. Where a 1 km segment is found to be noncompliant, the deduction percentage is applied to that 1 km segment. Where several 1 km segments are found to be noncompliant for the same performance standards, the deduction is applied to each of those 1 km segments. Where a particular 1 km segment is found to be noncompliant for more than one performance standard, the deductions percentages are added together and applied to the 1 km segment. Many PBRM contracts do not allow the total deduction from different performance standards for any single 1 km segment to exceed 100%, while others do not have this limitation.

A common approach to calculating the total deduction in a particular month, is to multiply the deduction percentage by the length of the noncompliant segment (generally 1 km, but this may be shorter for the end segments if the contracted road length does not involve a whole number of kilometers) to calculate the **deduction length** for that segment. The deduction lengths for the different 1 km segments that make up the entire contracted road length are added together to determine the total deduction length for the contract concerned. The contracted road length minus the total deduction length is considered to be the **compliant length**. The approved payment for a specific month is calculated by dividing the compliant length by the contracted length and multiplying this by the fixed monthly payment. The applied deduction is then equal to the total deduction length divided by the contracted length and multiplied by the fixed monthly payment. An example calculation of the deduction length, compliant length, and the resulting approved payment and deduction amount is in Table 6.

The example in Table 6 is the most basic form of calculating deductions. It is applied in many PBRM contracts and has proven to be suitable, as long as the deduction percentages are set properly. It has the advantage of being easy to apply and understand, making it easy for contractors to assess the risks and consequences of noncompliance.

It does have some issues, however. An important issue is the use of the term “compliant length.” This is the total contracted length minus the length of the noncompliant segments multiplied by their deduction percentages and, as such, is not equal to the actual length of road that is compliant. In the example in Table 6, only 2 segments with a combined length of 2.0 km were found to be fully compliant, while the remaining 3 road segments with a combined length of 3.8 km have different degrees of noncompliance. The actual length of road that is compliant is 2.0 km, whereas in the calculation the compliant length was determined to be 3.38 km (since the noncompliant lengths are multiplied by deduction percentages that are smaller than 100%). Although this does not affect the calculation of the deduction negatively, it makes it seem like the performance of the contractor is better than it actually is. When reporting the compliant length, it is important to calculate the actual length of road that is fully compliant. It would be preferable to avoid the term “compliant length” in the calculation of the deduction, and instead use a different term like “payment length.”

The effect mentioned above also leads to poor understanding of the deduction mechanism. In actuality, the deduction process involves the multiplication of the deduction percentage by the monthly payment per kilometer (the total monthly payment divided by the contracted road length). This is done for each noncompliant performance standard and for each 1 km segment. This calculation gives the same result as the approach described in Table 6, but in terms of understanding it is much clearer.

Table 6: Example Calculation of Deduction Based on Inspection Results

A formal inspection of a contracted road of 4.8 kilometers (km) finds the following noncompliances for the different 1 km segments:

- Segment 1: fully compliant
- Segment 2: pothole that is too large
- Segment 3: vegetation that is too high
- Segment 4: fully compliant
- Segment 5: too many small potholes and a blocked culvert

As per the signed contract, the deduction percentages are

- Size of large potholes: 50%
- Number of small potholes: 30%
- Blocked culverts: 60%
- Vegetation height: 20%

The deduction lengths for each 1 km segment are

- Segment 1: $0\% \times 1.0 \text{ km} = 0.0 \text{ km}$
- Segment 2: $50\% \times 1.0 \text{ km} = 0.5 \text{ km}$
- Segment 3: $20\% \times 1.0 \text{ km} = 0.2 \text{ km}$
- Segment 4: $0\% \times 1.0 \text{ km} = 0.0 \text{ km}$
- Segment 5: $30\% \times 0.8 \text{ km} + 60\% \times 0.8 \text{ km} = 0.72 \text{ km}$

The total deduction length is $0.5 + 0.2 + 0.72 = 1.42 \text{ km}$. The compliant length is $4.8 - 1.42 = 3.38 \text{ km}$. If the fixed monthly payment were 1,000, the approved payment for that month would be $3.38/4.8 \times 1,000 = 704$, and the applied deduction amount would be $1.42/4.8 \times 1,000 = 296$. The applied deduction is 29.6% of the monthly payment.

Source: Author.

A number of countries have introduced variations to the basic deduction calculation described above. One common variation is to **limit the deductions** in the first months of the contract, providing the contractor time to become accustomed to the PBRM contract and to correct any defects because of a previous maintenance backlog. This can take different forms, from fully pardoning all deductions during the first months, to defining a minimum level of compliance above which deductions are not applied. An example of the latter is where the minimum level of compliance is set at 60%, meaning that a contractor with a compliance level of 70.4%, as in the example in Table 6, would not be subject to any deductions and would receive the full payment. This minimum level of compliance may be increased to 100% over the course of several months. Some countries keep a minimum level of compliance of 95% or so for the entire duration of the contract to avoid immediately penalizing contractors for small noncompliances. Limiting the deductions during the first few months is a well-accepted approach. Even if deductions are not applied or are limited, inspections should still be carried out, identifying all noncompliances and calculating the applicable deductions. This allows the contractor to understand where the issues are and what the repercussions will be if the full deductions were to be applied in later months.

Some PBRM contracts have introduced **more complicated formulas** for calculating the deductions. These generally do not apply a linear deduction as is the case in the example above, but instead apply a deduction that increases exponentially as the number and degree of noncompliances increases. Although the reasoning for such an approach is understandable, it makes it very difficult for a contractor to predict the impact of different defects on the monthly payments, and tends to lead to higher bid prices to cover the increased risks. Although changes to the calculation of the deductions should not

necessarily be avoided altogether, it is important that the resulting calculation is easy to understand and that implications on the size and probability of deductions are clear to contractors. The main objective of the deductions is not to penalize and reduce the payment to the contractor in case of poor performance, but to provide an incentive to the contractor to comply with the performance standards and motivate good performance.

To ensure that noncompliances are corrected, most PBRM contracts apply **ever increasing deductions** if the noncompliances are not corrected by the next formal inspection. In some cases, this simply involves a doubling of the deduction percentage if the noncompliance is not corrected by the next formal inspection (after application of the first deduction). A number of contracts treat this as liquidated damages, applying a penalty that generally doubles each month that the noncompliance is not corrected. Such an exponential increase can result in very high deduction amounts within a relatively short period. In addition to such deduction increases and liquidated damages, several PBRM contracts include provisions that allow the contract to be terminated in case of continued failure to correct noncompliances. Such contract termination is often complemented by liquidated damages to correct the noncompliances at the contractor's expense.

Procurement and Contract Costs

PBRM contracts are procured in different ways. OPRCs with large initial repairs involve larger contract amounts (generally in the order of \$150,000–\$250,000 per kilometer for two-lane roads). This is primarily because of the inclusion of initial repairs that make up most of the contract cost. These contracts are generally attractive to international contractors, although the performance-based routine and winter maintenance may be less attractive because of the lower payments and the fact that these are spread over a longer period. As a result, joint ventures between international contractors for the rehabilitation works and domestic contractors for the maintenance services are common in OPRCs, although larger domestic contractors may also successfully bid for such contracts because of their knowledge of the roads and their maintenance needs.

PBMCs that consist almost entirely of routine and winter maintenance, involve smaller contract amounts (generally in the order of \$3,000–\$8,000 per kilometer for a two-lane road) and require less capacity. As a result, they are more attractive to domestic contractors, and involvement of international contractors tends to be limited.

In the case of SLAs, there is no competitive tendering, and the contracts are directly awarded to the state-owned maintenance entities responsible for the roads concerned. Here, it is important to negotiate appropriate contract amounts, based on the expected costs and taking into account any other payments made to the maintenance entities (for instance, the payment of salaries of government staff or the provision of maintenance equipment financed from the government budget). Costs tend to be similar as for PBMCs, but may be higher if periodic maintenance or rehabilitation are included.

Different bidding and contract documents are used. The World Bank has prepared standard bidding documents for OPRCs, but these have issues that are highlighted in this report. Standard ADB and World Bank bidding documents for (small) works have been used successfully for OPRCs and PBMCs. The employer's requirements form the most important part of such bidding and contract documents,

and need to properly describe the approach to be used in the performance-based component of the contract, as well as the other components. This needs to define the performance standards, the inspections, the response times or reaction times, the payments and the calculation of deductions, as well as all other aspects of the contract. The specific performance-based clauses included in the employer's requirements should be complemented by further amendments to the bidding documents. These amendments include specific clauses in the bid data sheet, bidding forms, and the evaluation and qualification criteria, as the contractors need to have experience in carrying out maintenance (and repair) works, but also in planning for maintenance. As such, the requirements will be set slightly higher than for traditional maintenance contracts. There will also be a need to have special forms for submitting bid prices for the different components of the PBRM contracts, depending on the type of contract. Changes are also required to the contract conditions. An important aspect here relates to the performance security, especially in OPRCs with costly initial repairs. Keeping a performance security for the entire contract duration and the full contract amount can be costly, and it is preferable to have separate performance securities for the initial repairs and for the subsequent maintenance services. Similarly, the use of liquidated damages needs to be well defined, especially regarding how these will be applied for the performance-based maintenance services. Some examples are provided in this report.

Another important aspect with OPRCs is regarding the duration and starting date of the performance-based maintenance services. In OPRCs, initial repairs are carried out at the start of the contract, either limited to certain road segments or applied to the entire contracted road length. Where such initial repairs are ongoing, it will not be possible to carry out the performance-based maintenance services, or at least not in their entirety. Some OPRCs apply an approach where the first few months or years are reserved for the initial repairs, with the maintenance services only starting after a specific date or once the initial repairs are completed. In such OPRCs the maintenance services generally start during the defect notification period (DNP) applied to any initial repairs, although this is less relevant as repairs of any defects are also included under the maintenance services. Other OPRCs, especially those where the initial repairs are limited, have the maintenance services start immediately. In this case, deductions are applied for each month that the segments under initial repairs are not completed up to standard. This provides an incentive to the contractor to quickly complete the works to the required quality to avoid further deductions to the payment for the maintenance services, but it also means that a large portion of the payments for maintenance services in the initial months will be deducted and left unused under the contract. A preferred approach is a combination of these two approaches, whereby the maintenance services start a short period before the initial repairs are due to be completed, thus providing the incentive to contractors to ensure timely completion, but avoiding large deductions because of ongoing repair works. For those road segments that are not subject to initial repairs, the maintenance services should start immediately to prevent further deterioration.

This report will also look at the contract costs. This of course depends on the scope of works of the different contracts, especially the initial repairs included under the contract. In OPRCs, the initial repairs easily make up about 80%–90% of the total contract costs, and even more if full rehabilitation of the entire road length is involved and if the duration of the subsequent maintenance services is short. Even for the maintenance services, the costs will depend on the scope of works included under the performance-based payment, and whether this includes current repairs to the pavement and winter maintenance, for instance. The provisional sums for emergency (and winter) maintenance are generally recorded separately, on top of the awarded contract price. To the extent that the information has been made available, this report will present the costs per kilometer and per year of the different components of the PBRM contracts to show the cost ranges.

AZERBAIJAN

Azerbaijan carried out an SLA pilot involving three SLAs with recently established state-owned motorway maintenance companies that are responsible for routine, winter, and emergency maintenance as well as current repairs. The agreements were introduced under the World Bank-funded Third Highway Project between 2019 and 2021. These are direct agreements with the State Agency of Azerbaijan for Automobile Roads (AAYDA), which is responsible for the management of the public road network, including the motorway network. Additional SLAs with the four other motorway maintenance companies are being considered.

Contract Scope

The SLAs were carried out on two motorways: two SLAs are for the M2 that runs from Baku toward Tbilisi in Georgia, and the other SLA is for the M4 that runs from Baku and connects to the M2 in Yevlach. The three SLAs together covered 774 km of motorways. Most of the contracted length has four lanes, although there are also some sections with six lanes. The SLAs do not include initial repairs (rehabilitation or periodic maintenance) because these are considered capital works and are tendered competitively. The SLAs were limited to performance-based routine maintenance (including current repairs) and winter maintenance. Emergency maintenance was included as a provisional sum that had to be approved through a work order and was paid on a lump-sum basis, with payment amounts based on measurement of the required volumes multiplied by the unit rates (completed works are not measured).

Table 7: PBRM Contracts in Azerbaijan

Pilot section	Length	Years	Months	Type	RH	PM	RM	WM	EM	Status
M2 Baku–Yevlach	264 km	2019–2021	24	SLA	-	-	PB	PB	VB ^a	Completed
M2 Yevlach–Georgia	229 km	2019–2021	24	SLA	-	-	PB	PB	VB ^a	Completed
M4 Baku–Yevlach	253 km	2019–2021	24	SLA	-	-	PB	PB	VB ^a	Completed

Initial repairs
 Maintenance services
 Provisional sum

EM = emergency maintenance, km = kilometer, PB = performance-based payments, PBRM = performance-based road maintenance, PM = periodic maintenance, RH = rehabilitation, RM = routine maintenance, SLA = service level agreement, VB = volume-based payments, WM = winter maintenance.

^a Paid from provisional sum, against work order.

Source: Consultant’s processing of pilot data.

The SLAs were introduced for three of the seven recently established motorway maintenance companies. Although the pilot under the project has been completed, the SLAs appear to still be ongoing and expansion to the other motorway maintenance companies is expected. These corridor-based companies are responsible for different sections of the six motorways in Azerbaijan.¹ Up until the establishment of the dedicated motorway maintenance companies, the motorways were maintained by various area-based road maintenance units, resulting in a fragmented approach to motorway maintenance. The SLAs fit within the government objective of commercializing the relationship between AAYDA and the maintenance companies and units, clearly distinguishing between employer and contractor roles and responsibilities. In this line, the maintenance companies are set up as state-owned limited liability companies and have been placed under the newly established Azerbaijan Investment Holding rather than under AAYDA. The SLAs provide a contractual relationship between AAYDA and the motorway maintenance companies, covering all costs related to salaries, equipment, materials, etc. As such, it provides the basis for possible further commercialization and even privatization in the future. Additional SLAs are reportedly being prepared for the other four motorway maintenance companies.

Performance Standards

The SLAs in Azerbaijan have an extensive set of 64 performance standards that are presented in Appendix 1. The performance standards deal with a variety of activities that are organized into 12 groups as listed in Table 8. This large number of performance standards allows more precise monitoring of performance, but can make it difficult to keep an overview and to carry out inspections.

Table 8: Performance Standard Categories in Azerbaijan

- Roadway and other paved areas
- Vegetation control
- Road surface cleanliness and safety
- Signing and safety devices
- Electrical and mechanical systems
- Winter maintenance
- Drainage
- Earthworks and roadside
- Structures
- Traffic incident response measures
- Buildings and miscellaneous facilities
- Management performance

Sources: Draft contract documents.

The performance standards list the defect types and the corresponding thresholds allowed for each defect type. However, the allowable thresholds are not always defined in a SMART format that allows compliance to be properly assessed and measured. For instance, regarding obstructions on the road, one of the service levels is defined as “Immobilized vehicles or large obstructions.” Although it may be

¹ This does not include the two motorways in the Nakhichevan Autonomous Republic.

assumed that these are not allowed on the roadway, this is not properly defined. This is the case with several performance standards, where the indicator and threshold are not clearly defined. The poor definition of measurable thresholds makes it difficult to properly assess compliance and can lead to disputes regarding the level of compliance.

Some performance standards are presented in the common PBRM format, where the maximum volume of a specific defect is defined in relation to any 1 km segment. For instance, the maximum allowable length of linear cracks wider than 3 millimeters (mm) in any 1 km segment is 20 m. If the length of cracks exceeds 20 m in a 1 km segment, that 1 km segment is defined as noncompliant. The inspection may identify multiple 1 km segments as noncompliant for the same performance standard. However, most performance standards in the SLA are not defined in this way, and instead are defined for any individual defect anywhere in the contracted road section. For instance, no potholes are allowed that are larger than 20 cm in any dimension. It is not clear how the compliance is assessed for these performance standards. It would appear that each pothole is considered as a separate noncompliance, and that multiple potholes will result in a lower level of compliance, even where these occur in the same 1 km segment. This is different from the approach commonly applied in PBRM contracts and makes the deductions more dependent on the contracted road length (longer roads will generally have more potholes).

The performance standard for potholes defines a maximum dimension of any pothole of 20 cm. This makes the performance standard easy to apply, and results in an acceptable pothole size. However, the performance standards do not define how many potholes smaller than this allowable maximum dimension are allowed. Such a secondary performance standard is included in most PBRM contracts, setting both the maximum size and the maximum number of potholes per (lane-) kilometer or per area of pavement. While the maximum pothole dimension for the roadway is 20 cm, for paved shoulders and other paved areas this is 10 cm, and for unpaved shoulders it is 15 cm. It is not clear why different maximum dimensions are used and why larger potholes are allowed in the traffic lanes, where they cause the most risk and damage to road users.

A performance standard on skid resistance is also included. This is not common, as it requires specific equipment for measuring compliance. Correction of poor skid resistance also requires a new wearing course with higher skid resistance. Especially where large areas are concerned, this can be a costly undertaking compared to other common routine maintenance and current repair activities. Poor skid resistance can also be difficult to predict, making this a risky activity to cost for, likely leading to higher bid prices to cover the perceived risks. This may be avoided by including such activities in a provisional sum, rather than as part of the performance-based fixed payment.

Several performance standards are included regarding bridges. These cover aspects of step height at bridge joints, sealing of joints, bearings, corrosion of steel parts, erosion of foundations, etc. Together these different performance standards cover a wide range of routine bridge maintenance and repair activities that are often missing from PBRM contracts.

Apart from the road itself, there are also performance standards related to the buildings of the motorway maintenance companies. This is uncommon, as the contractor is generally responsible for its own buildings and other assets. The performance standards are very basic, relating to the proper functioning of heating, lighting, and plumbing; and the regular emptying of garbage cans and septic tanks. Response times related to these performance standards are very short, generally 24 hours, implying a significant

importance. In comparison, the response time for erosion of bridge foundations is 14 days. Deduction percentages are similar to those for much more serious defects. The inclusion of these performance standards and the high importance given to them is not considered appropriate, and the proper management of the buildings used by the motorway maintenance companies is better addressed in a different manner (for instance, in the agreement allowing the company to use the buildings). Since these are limited liability companies, they should be responsible for the management of their own assets.

The SLAs do not have a high requirement in terms of preparing plans for quality assurance, health and safety, traffic management, emergency procedures, data collection, etc. The only requirement is for an operational plan to be prepared and updated each year, for monthly reports to be submitted together with the monthly invoices, and for other documents to be prepared and submitted as required. Although the requirements are limited, they are all linked to performance standards, providing an incentive to submit the documents as required. However, the performance standards are only linked to the submission of these documents, and do not strictly require the contractor to comply with the contents.

Inspections

In Azerbaijan, there does not appear to be a system of formal monthly inspections. Instead, inspections may be carried out at any time. Where a noncompliance is identified, the contractor is immediately required to correct the defect within the defined response time. This system requires continuous inspections, both by the employer and by the contractor. The use of response times for all performance standards requires additional follow-up inspections to verify whether identified defects have been corrected in time, further increasing the inspection burden.

Although a higher frequency of inspections can contribute to avoiding defects or avoiding that these remain unaddressed for longer periods of time, it puts a significant burden on the employer and contractor in carrying out these inspections, recording when defects are identified and when they are resolved. The contractor is required to carry out daily patrols of the entire road section. The employer will also need to carry out frequent surveys of the road, and with a contract covering 200 km–300 km of road, this will likely require a full-time inspector to survey the road and visit defects identified and reported by the contractor. The need for continuous inspections is likely to result in more superficial inspections, as opposed to the system of formal monthly inspections that allow greater focus. Azerbaijan should consider introducing a system of formal monthly inspections, complemented by informal inspections for specific performance standards that require a rapid response.

The SLA documents do not require the contractor to establish a hotline or website that road users can call to report any defects. Identification of defects relies solely on the contractor and the AAYDA inspectors. Introduction of a hotline or website could allow performance to be improved and defects to be better recorded, possibly reducing the burden on the inspectors.

Response Times and Reaction Times

In many PBRM contracts, the contractor is given a response time within which any defects identified during the formal inspection must be corrected. If the defects are corrected within the response time, any applied deductions will be repaid. If the defects are not corrected within the defined response time, the deductions become permanent. The contractor is still required to correct the defects, but will not be repaid the deducted amount. If the defects are still not corrected by the next inspection, a new deduction may be applied. The SLAs in Azerbaijan also define response times (Appendix 1), but these work in a different way. If a defect is identified at any time by either the contractor or AAYDA, the contractor must correct it within the defined response time. Only if the defect is not corrected within the defined response time will a deduction be applied, and that deduction is immediately permanent and irreversible (it will not be paid or repaid). Thus, the response times defined in the SLAs are not response times as traditionally applied in PBRMs, but rather function as reaction times and form part of the performance standard. Deductions are applied if both the allowable threshold is exceeded, and this is not corrected within the allowable reaction time. Although they work in a similar way, the manner in which response times and reaction times are calculated and used is very different.

The SLA agreement defines reaction times for all performance standards. This also includes performance standards for which the defect can be predicted and treated before it exceeds the allowable threshold. For example, potholes can be patched before they exceed 20 cm in size and vegetation can be cut before it exceeds 20 cm in height, thus ensuring continued compliance with the performance standards. For such performance standards, a reaction time or response time is not required since corrective action can be undertaken before the threshold is exceeded. For defects that occur suddenly such as snowfall or landslides, or for zero-tolerance thresholds where there is not a gradual growth in the severity of the defect before it reaches the threshold, it is not possible to address the defect before it exceeds the threshold, and a reaction time is justified. This reaction time then functions as it does in the SLAs in Azerbaijan, from the moment of identification of the defect, whether this is by the contractor or during an (in)formal inspection by the employer (or reported through a hotline). However, for most of the performance standards included in the SLAs, reaction times are not required since they involve defects that can be predicted and addressed before they exceed the threshold. As a result, the use of reaction times can be greatly reduced, avoiding the need for follow-up inspections. For such predictable defects, deductions should be applied whenever the threshold is exceeded and a noncompliance with the performance standards is identified.

Reaction times will still be needed for some performance standards. This especially involves obstacles on the road surface and snow or ice on the road that form a traffic safety hazard and can interrupt traffic. Here the aim is to restore traffic passability and safety within a short time period. The reaction times defined in the SLAs are very short, with 1 hour for obstacles, 2 hours for removing snow and ice from at least one lane, and 48 hours for removing all snow and ice when temperatures rise above freezing. Although road users will appreciate such short reaction times, this comes at a considerable cost since the contractor will require several teams standing by to immediately react to such defects. The capacity requirements are already reduced by requiring only one lane to be free of snow and ice, and to require all snow and ice to be removed only once temperatures rise above freezing. However, removing snow for 200 km–300 km of road, one lane in each direction, within 2 hours and keeping it clear during snowfall (maximum 5 cm of snow and 5% of ice) requires significant capacity in terms of equipment, staff, and materials. The 48 hours allocated for removing all snow and ice from the road, shoulders, and drainage

system once temperatures rise above freezing also seems very short, putting a high demand on available capacities. Reaction times often have more effect on costs than the allowable thresholds (e.g., 5 cm or 10 cm of snow), and a proper balance needs to be sought between acceptable reaction times and reasonable costs.

The reaction times defined in the SLAs appear to be rather arbitrary. Usually, the length of the reaction time depends on the urgency of the defect and the impact it can have on road damages and traffic safety (more urgent defects require shorter reaction times), and on the time required to carry out the necessary repairs (more comprehensive repairs require longer reaction times). This approach does not appear to have been applied in Azerbaijan. The reaction time for removing garbage from the road shoulder is only 48 hours, while deformed signs and blocked culverts can remain uncorrected for up to 7 days. The reaction times should be reviewed with respect to the importance of the defect for future damages and traffic safety.

In general, the reaction times are very short. This is justified since the contracts involve motorways with high traffic volumes and high speeds. However, for some defects, the reaction times can be increased without a major impact on traffic safety and road protection. An example is the earlier mentioned garbage on the shoulder. Where this does not form a safety hazard, the reaction time can be increased to 7 days or 14 days, allowing the contractor to have a team collect garbage every 2 weeks instead of every 2 days. This lowers costs without significantly affecting performance. Better still, the reaction time can be removed altogether, and the performance standard amended to define the maximum number of garbage items allowed per 1 km segment of road. This will have a similar result of requiring all garbage to be collected regularly, but reduces the need for frequent inspections to verify how long garbage has been present along the road.

Payments and Deductions

The motorway maintenance companies are paid fixed monthly lump sums based on the costs per kilometer per month for the different road sections included in the bill of quantities. In case of noncompliance with one or more performance standards, deductions are applied to these monthly payments. For each performance standard, 1 deduction point is applied in case of noncompliance (Appendix 1), whereby a deduction point is equivalent to 0.1% of the monthly lump-sum payment for the entire contracted road section. One deduction point is applied for each day (or part thereof) that the performance standard is not complied with (when the threshold and the reaction time are both exceeded). There are seven performance standards where one deduction point is applied every hour that the performance standard is not complied with, instead of every day. This includes serious safety hazards related to obstacles on the road surface, hazardous material on the road surface, snow and ice on the road surface, safety hazards related to the condition of structures, traffic accident response, and poor structural integrity of buildings. The SLA allows a list of defects to be included for which deductions will not be applied during the first 6 months of a new contract, allowing the contractor to become familiar with the performance-based approach and address any backlog maintenance that may exist.

In most PBRM contracts, the deduction percentages vary by performance standard. Performance standards related to defects that have a significant impact on traffic safety or road damages tend to have higher deduction percentages to motivate the contractor to prioritize these. Performance standards related to defects that are more costly to correct are also given higher deduction percentages to ensure that the applied deductions are in line with the repair costs of the defects concerned, avoiding a situation where it is less expensive for the contractor to receive a deduction than to comply with the performance standard. For less-important performance standards that are easier to comply with, the deductions are lower, reducing the risks for the contractor and avoiding high bid prices. In the Azerbaijan SLAs, the deduction percentages are all the same: 0.1% of the monthly lump-sum in case of noncompliance, and 0.1% for each additional day/hour that the performance standard is not complied with. In terms of payment deductions, it does not matter to the contractor whether the noncompliance is related to a pothole or to garbage on the road shoulder—the deduction amount is the same. For some performance standards, the deduction may be much higher than the cost of correcting the defect; for other performance standards, the deduction may be lower than the cost of correcting the defect. This provides an incentive to focus on those performance standards where the costs involved are lowest, which tend to be less important performance standards (like removing garbage from the road shoulder). Increasing the deduction points for the more important performance standards and lowering them for less important ones may lead to better prioritization of maintenance activities, and can potentially lead to better road conditions as well as lower contract costs.

The deductions are applied to the full monthly lump-sum payment for the entire contracted road section. This is different from PBRM contracts in other countries, where deductions tend to be applied to the monthly lump-sum payment per kilometer, for those 1 km segments that are noncompliant for a specific performance standard. Applying deductions to 1 km segments ensures that the applied deduction amount is similar for all contracts, regardless of the length of the road included under the contract, assuming a similar contract price per kilometer of road in the different contracts. That is not the case in Azerbaijan, since the deduction is applied to the full monthly lump-sum payment for the entire contracted road section. Assuming the same contract price per kilometer, a longer contracted road section would mean a higher monthly lump-sum payment and thus a higher deduction amount for the same defect. In addition, the longer road has a higher chance of defects appearing and thus a higher risk of deductions. The approach applied in Azerbaijan makes it preferable to have a shorter road section, or even to have two separate contracts for a single road section, as this reduces the risk and the amount of the deduction. This is why most PBRM contracts apply a system of deductions per 1 km segment to avoid an influence of the contracted road length on deduction amounts.

The application of an approach based on 1 km segments means that, if a performance standard is found to be noncompliant in a specific 1 km segment, the 1 km segment is then defined as being noncompliant for that performance standard. It does not matter if there is one pothole too many in that 1 km segment, or five potholes too many. However, if the five potholes are spread over different 1 km segments, this will result in higher deductions as several 1 km segments will be defined as noncompliant. In both cases, all five potholes will need to be repaired to avoid the deduction being repeated in future months. In the Azerbaijan SLAs, the deductions are applied per instance of noncompliance. That means that in case of five potholes, five deductions will be applied, regardless of whether these are all located in one single 1 km segment of road or spread over the full length of road. Although this may appear fair, it can result

in very high deductions in problematic road segments where damages are frequent, even though the performance in the rest of the road is in very good. This is another reason why most PBRM contracts apply a system of deductions per 1 km segment, to reduce the impact of problem segments and to limit the risks for the contractor.

Although the deduction points are the same for all performance standards, they are applied every day (and in some cases every hour) that the noncompliance is not corrected. In most PBRM contracts, formal inspections are carried out on a monthly basis with deductions applied for any identified noncompliances. Where identified noncompliances have not been corrected before the next formal monthly inspection, the deduction will be repeated. Often, contracts increase the deduction percentage if the noncompliance has not been corrected after the first month. Short reaction times are defined only in the case of performance standards for defects that occur suddenly and that have significant traffic safety or road damage risks, and in these cases the deduction may be repeated more frequently. Generally, the period between deductions is the same as the reaction time. The high frequency of repeating deductions in Azerbaijan introduces a high risk for the contractor. Although the deduction percentage of an individual noncompliance is low at 0.1% of the monthly lump-sum, this can rapidly increase if the contractor requires more time to correct the defect. If there are potholes on the paved shoulder, the contractor has 7 days to correct this. If the contractor does not manage to do so, the result is a deduction point. If for some reason the contractor requires 14 days to correct these potholes, twice the allowed time, the deduction is multiplied by seven. For defects with hourly deductions like snowfall, the deduction can already amount to 2.4% after 1 day delay. This means the contractor needs to have an over capacity available to avoid any delays because of equipment or staff dropping out. This, of course, comes at a cost. This risk and the related costs can be reduced by applying varying frequencies of repeating deductions, depending on the seriousness of the defect. Taking the example of garbage on the shoulder again, this is not serious enough to justify applying a deduction point for each day of delay.

The approach used to calculate deductions in Azerbaijan introduces high risks for contractors. With deductions applied for each instance of noncompliance, rapid repetitions of deductions, and 64 different performance standards, 7 of which have deductions repeated every hour, there is a significant risk of high deductions to monthly payments. Where risks of deductions are high, contractors tend to increase their bid price to cover these risks and avoid making a loss. High risks thus tend to lead to unnecessarily high costs that are not related to the actual implementation costs, but to the perceived risks.

This approach to calculating deductions also requires a very comprehensive system for recording defects, including the moment of identification and the moment of resolution of the defect. This needs to be done for each individual defect, each pothole, each piece of garbage on the shoulder, and each patch of grass that is too long. This information then needs to be used to determine for each defect, whether it was resolved within the defined response time (no deduction), or whether it was resolved beyond the response time, in which case a deduction should be applied. This also needs to reflect how many hours or days after the elapsing of the response time the defect was resolved to see if the deduction needs to be repeated and, if so, how many times. All these deductions and repeated deductions for each individual defect need to be added up each month to calculate the total deduction to be applied to the lump-sum payment. This is clearly a very complicated system for assessing compliance and calculating deductions. Although it may be justified for some serious defects, for most defects a simpler system is recommended.

Procurement and Contract Costs

The three SLAs were financed from government funds and were contracted under government procurement modalities. The SLAs are contracted directly to the motorway maintenance companies for a period of 2 years, with the option of extension. Open tendering is not applied, and the contract amounts are instead negotiated with the companies. This includes the lump-sum payment for maintenance services defined as a cost per kilometer per month, often distinguishing different prices for different segments of the contracted road section. It also includes the unit costs for emergency works, defined for different activities and volumes of work, which are paid from a provisional sum against issuance of a work order by AAYDA.

The contract documents have been prepared specifically for the purpose of the SLAs, and do not appear to be based on standard bidding documents. As a result, they lack certain features and are not fully clear on certain aspects. Although the SLAs mention that payments will be adjusted for advance payments and for retention, the same contract states that the monthly lump-sum payment for maintenance services is not subject to retention. This implies that only the emergency works are subject to retention, although the contract does not mention the retention percentage or how repayment will be made. No information is provided on the modality or percentage of advance payments. A performance security does not appear to be required under the agreements.

Actual contract costs for the three SLAs are not published as they are considered commercially sensitive. Table 9 presents the cost estimates for one of the SLAs based on an initial draft of the contract agreements. These costs may not be fully in line with the actual amounts as agreed between AAYDA and the motorway maintenance companies.

The estimated costs for the maintenance services for 264 km of motorways amounts to just under \$4 million per year, equivalent to \$15,000/km/year. This is the cost for a motorway with four lanes and in some sections six lanes, and is in line with costs of maintenance services in other countries. The bill of quantities stipulates the costs per kilometer per month. The bill of quantities includes different costs per kilometer for different road segments within the contracted road length. This clearly shows higher costs for segments with more lanes (and more traffic), more bridges, and poorer road conditions. The contract duration is only for 2 years (with possibility of extension), and price adjustment is not included. This is only the cost for maintenance services, and the cost for emergency works needs to be added to this. However, the draft contract document only defines the estimated unit costs, not the expected volumes of work, and the contract amount for emergency works could not be determined.

Table 9: Estimated Costs for Maintenance Services
(AZN)

Section	Chainage	Length	Lanes	Condition	Bridges	AZN/km/ Month	AZN/km/ Year	AZN/Year
Garadakh	14–69	55 km	4/6	Fair/poor	14	3,517	42,204	2,321,220
	69–79	10 km				2,559	30,708	307,080
Hadjigabul	79–114	35 km	4	Good/ poor	8	2,294	27,528	963,480
	114–164	50 km				1,599	19,188	959,400
Kurdamir	164–209	45 km	4	Good	4	1,578	18,936	852,120
Udjar	209–256	47 km	4	Good	2	1,561	18,732	880,404
Agdash	256–278	22 km	4	Good	2	1,678	20,136	442,992
Total (AZN)		264 km				2,123	25,480	6,726,696
Total (\$)						\$1,249	\$14,988	\$3,956,880

km = kilometer.

Sources: Draft contract documents.

PEOPLE'S REPUBLIC OF CHINA

Under the ADB-funded Yunnan Sustainable Road Maintenance project, two types of PBRM contracts were piloted in Yunnan Province in the south of the People's Republic of China (PRC). The first was a 5-year OPRC for 57 km of national highway, including initial rehabilitation and periodic maintenance of the full road length and subsequent performance-based routine maintenance. The contract was tendered out to the private sector using national competitive bidding and ran from 2015 to 2020. The second pilot involved a 3-year SLA for 107 km of national and provincial roads that was signed between the Yunnan Highway Administration Bureau and its underlying county-level road maintenance unit that is traditionally responsible for the maintenance of these roads. The contract was directly negotiated and ran from 2016 to 2020.

Under the World Bank-funded Anhui Road Maintenance Innovation and Demonstration Project, a total of 8 performance-based contracts with a total length of 756 km were planned to be carried out in Anhui Province in the east of the PRC, including 6 OPRCs and 2 PBMCs. However, during implementation, the road selection and contract scope was changed, with only 6 OPRCs being awarded with contract lengths varying from 63 km to 125 km. The contracts include national and provincial roads, with different roads included under a single contract. The contracts were tendered out to the private sector under national competitive bidding.

Contract Scope

The OPRC in Yunnan Province was awarded in 2015 and ran for 5 years until 2020. It included initial repairs consisting of 40 km of rehabilitation and 17 km of periodic maintenance (overlays), covering the full 57 km road length under contract. These initial repairs were paid on a volume basis and were completed in the first year of the contract. Routine maintenance and repairs were paid on a performance basis for a period of 4 years following the initial repairs. Winter maintenance was not required because of the subtropical climate in Wenshan prefecture where the pilot was carried out. Emergency maintenance was paid on a volume basis from a provisional sum against work orders. To be eligible for payments for emergency maintenance, the damages had to exceed the thresholds listed in Table 10. Damages below these thresholds were to be repaired under the performance-based maintenance services.

Table 10: Thresholds for Use of the Provisional Sum for Emergency Maintenance

Damage to Road	Minimum Value
Slides of material onto the road	200 m ³
Partly or fully damaged pipe culvert	1 fully damaged culvert
Partly or fully damaged wing walls	1 fully damaged wing wall
Partly or fully damaged railing including rail post	10 m
Damaged asphalt concrete (per 500 m road section)	500 m ²
Damaged base course (per 500 m road section)	50 m ³
Damaged cement concrete (per 500 m road section)	5 m ³
Damaged Embankment (per 500 m road section)	100 m ³

m = meter, m² = square meter, m³ = cubic meter.

Sources: Draft bidding documents.

The SLA in Yunnan Province covered 107 km of road, including 50 km of national roads and 57 km of provincial roads running through Ruili county in Dehong prefecture. The SLA was originally proposed to include only limited initial repairs consisting of 45 km of double bituminous surface treatments and 10.8 km of overlays (slightly more than 50% of the contracted road length). However, it was later decided to carry out more extensive initial repairs, including 18.7 km of seals, 16.1 km of double bituminous surface treatments and 23.5 km of overlays. The initial repairs were carried out under a separate agreement and started in 2014, while the actual SLA was signed in 2016 and continued for a period of 3 years up to 2019, covering only routine maintenance and repair. Winter maintenance was not required because of the subtropical climate in Dehong prefecture. Emergency maintenance was paid on a volume basis from a provisional sum against a work order, using the same thresholds as for the OPRC.

The PBRM contracts in Anhui Province were planned to cover a total length of 756 km, divided over 8 contracts varying in length from 49 km to 157 km. The shorter contracts involved more comprehensive initial repairs. These were intended to include six OPRCs with initial repairs and subsequent performance-based maintenance services, and two PBMCs with only performance-based maintenance services. However, because of adjustments to the road selection and an increase in the volume of initial repair works, the scope of the contracts has been reduced to 6 OPRCs with a total contracted length of 488 km. All 6 contracts have been awarded and have a duration of 5 years, including the initial repairs. Winter maintenance is included under a provisional sum and paid on a volume basis since snowfall is relatively common in Anhui Province. The contracts also include a provisional sum for emergency maintenance that is similarly paid on a volume basis against work orders.

Table 11: PBRM Contracts in the People's Republic of China

Pilot section	Length	Years	Months	Type	RH	PM	RM	WM	EM	Status
Yunnan G320, S324	107 km	2016-2020	12+36	SLA	-	-	PB	-	VB ^a	Completed
Yunnan G323	57 km	2015-2020	12+48	OPRC	VB	VB	PB	-	VB ^a	Completed
Anhui G205	89 km	2020-2025	60	OPRC	VB	-	PB	VB ^a	VB ^a	Ongoing
Anhui S215, G233	65 km	2021-2026	60	OPRC	VB	-	PB	VB ^a	VB ^a	Ongoing
Anhui S303, S229	81 km	2021-2026	60	OPRC	VB	-	PB	VB ^a	VB ^a	Ongoing
Anhui G206, S233, S246	63 km	2021-2026	60	OPRC	VB	-	PB	VB ^a	VB ^a	Ongoing
Anhui G312, S210, S213	65 km	2021-2026	60	OPRC	VB	-	PB	VB ^a	VB ^a	Ongoing
Anhui S601	125 km	2021-2026	60	OPRC	VB	-	PB	VB ^a	VB ^a	Ongoing

Initial repairs
 Maintenance services
 Provisional sum

EM = emergency maintenance, km = kilometer, OPRC = output- and performance-based road contract, PB = performance-based payments, PBRM = performance-based road maintenance, PM = periodic maintenance, RH = rehabilitation, RM = routine maintenance, SLA = service level agreement, VB = volume-based payments, WM = winter maintenance.

^a Paid from provisional sum, against work order.

Source: Consultant's processing of pilot data.

Performance Standards

For the Yunnan OPRCs and SLAs, the performance standards are presented in Appendix 2. The same set of performance standards was used for the performance-based routine maintenance and repair in both the OPRC and the SLA pilots. A limited number of performance standards are included, divided into six types of requirements.

The first of these is regarding road usability, where the road has to remain passable at all times. This performance standard is different from the others in the sense that the indicator is the time required to correct any noncompliance (to open up the road after blockage). As such, the reaction time forms the actual performance standard. This performance standard can also be checked through informal inspections, with deductions applied immediately if the reaction time is exceeded.

The second type of requirement is regarding the submission of monthly reports and updates (monthly statement, progress report, work plan, and cash flow), as well as the compliance with existing plans (quality assurance plan, health and safety management plan, emergency procedures and contingency plan, traffic management plan, and environmental management plan). The inclusion of these requirements in the performance standards makes it easier to enforce compliance.

The other four types of requirements are related to defects to different road elements. This includes (i) the right-of-way and roadbed (including side drains and retaining walls); (ii) the carriageway and shoulders; (iii) bridges, tunnels, and culverts; and (iv) traffic engineering (including signs, guardrails, lighting, and kilometer posts). The performance standards focus on routine maintenance, and do not include repairs except for pavement patching and crack sealing.

The performance standards use easily measurable thresholds, such as the maximum diameter or depth of potholes, and the maximum area of surface distress per 1 km segment of road. For the drainage system, the threshold is linked to the percentage of the cross-section that may be blocked. Some of the performance standards are more subjective or are not fully clear. Examples are the reference to “clean” and “legible” signs and road markings, without stipulating how this is to be measured or assessed. Another example is the reference to a maximum of 5% of lights not operational, without clarifying whether this is for a 1 km segment or for the road as a whole.

A copy of the performance standards of the Anhui OPRC and the underlying performance standards could not be obtained, and these are not included in the appendixes, nor are they commented upon in this report.

Inspections

In the Yunnan OPRCs and SLAs, formal inspections are carried out by the project supervisor together with the self-control unit of the contractor. The formal inspections are carried out within 5 days after submission of the contractor’s monthly statement to verify the performance as recorded in that statement. The project supervisor is required to inform the contractor at least 48 hours in advance of the date and time for the formal inspection. The results of the formal inspection are recorded in the inspection form and provide the basis for calculating the monthly payment and any deductions to be applied.

Informal inspections can be carried out by the project supervisor at any time. Any noncompliances identified during informal inspections should be reported to the contractor in writing within 24 hours so they can be corrected. Such noncompliances identified during the informal inspections do not have any influence on the monthly payment and deductions, unless they continue to exist during the formal inspection. The only exception is regarding road usability, where the road is blocked and no longer passable. Here, a deduction can be applied if the contractor does not correct the situation and open up the road to traffic within the stipulated reaction time, which starts from the moment of first identification and reporting of the noncompliance to the contractor.

Response Times and Reaction Times

The Yunnan OPRC and SLA pilots do not include any response times. The contractor is required to comply with all performance standards at the time of the formal inspection. Any noncompliance identified during the formal inspection immediately results in a deduction. The responsibility of the contractor is limited by stating that any noncompliances that occur because of extreme weather events

just before the formal inspection will not lead to immediate deductions. As a result, the situation is avoided where the contractor does not have sufficient time between the defect occurring and the formal inspection. However, this is only for defects that occur suddenly as a result of the extreme weather event.

This is very different from most other experiences assessed in this document, which all tend to apply response times in which the contractor can correct any noncompliance identified during the formal inspection. This means that the contractor needs to be more proactive and needs to correct any defects before these exceed the thresholds defined in the performance standards. In the case of the road usability performance standard, a reaction time is included. However, this involves a defect that can occur suddenly, and the performance standard actually consists of the reaction time to correct the defect. This is also applied differently, in the sense that it is not dependent on formal inspections.

The Anhui OPRCs make use of the standard OPRC bidding document of the World Bank, which includes response times. However, it has not been possible to confirm how these are applied.

Payments and Deductions

The Yunnan OPRCs and SLAs apply the same approach to payments and deductions. During the formal inspection, the compliance with the performance standards is checked for each 1 km segment of road. Where one or more noncompliances are identified in a specific 1 km segment, these are indicated in the inspection form. For the noncompliant 1 km segments, a deduction percentage is applied to the payment for that 1 km segment, depending on the performance standard concerned (the deduction percentages are listed in Appendix 2). The deduction percentage is multiplied by the length of the 1 km segment to determine the deduction length.² This is deducted from the contracted length to determine the compliant length, which is multiplied by the monthly payment per kilometer (equivalent to the monthly payment divided by the contracted road length) to determine the monthly payment that the contractor is eligible for.

The deduction percentages vary by performance standard. For small defects such as vegetation that is too long, the deduction for each noncompliant performance standard is 10% of the monthly payment for each noncompliant kilometer, equivalent to about \$50. For important defects or defects that are costly to correct such as pavement defects and missing signs, the deduction percentage for each noncompliant performance standard is 50%, equivalent to about \$260. The deduction percentages are higher than in many other contracts reviewed in this report, providing a strong incentive to comply with the performance standards. However, they are not so high as to present a serious risk to the contractor, which may result in high bid prices. In case of noncompliance with different performance standards for the same 1 km segment, the deduction percentages are added together. However, the total deduction may not exceed 100% for any single 1 km segment.

Most deductions are applied by 1 km segment, with the deduction percentage multiplied by the monthly payment per kilometer. The road usability performance standard forms an exception, where the deduction percentage is multiplied by the full monthly payment to determine the deduction amount. With a deduction percentage of 20%, noncompliance amounts to a deduction of about \$6,000,

² Generally, this will be equal to 1 km, but it can be less for end segments.

reflecting the importance of the performance standard. This deduction may be repeated every 24 hours that the defect is not corrected. Any deduction because of noncompliance with the road usability standard is added on top of the deductions applied to noncompliant 1 km segments, even where these have already reached 100%.

The deduction for monthly reporting and compliance with plans is also applied to the full monthly payment. Although the percentage seems low at 5%, this is equivalent to a deduction of about \$1,500. This is considered to be on the high side for such a noncompliance, especially in comparison to the other deduction amounts.

To ensure that identified noncompliances are corrected before the next formal inspection, the deductions are doubled in case they have not been corrected. In the case of the road usability standard, the deduction is applied for each 24 hours that the road remains impassable. If the contractor continuously fails to address the noncompliances, the contract can be terminated.

The start of the performance-based maintenance services and the requirement to comply with the performance standards is defined in the contract specifications and may vary by road section depending on the initial works to be carried out. Once the start date has passed, deductions will be applied in case of noncompliance, even if the initial repair works have not yet been completed. This provides an incentive to the contractor to complete the initial repair works within the allocated time to ensure compliance with the performance standards and avoid deductions.

A copy of the Anhui OPRCs could not be obtained and its approach to payments and deductions is not reviewed here.

Procurement and Contract Costs

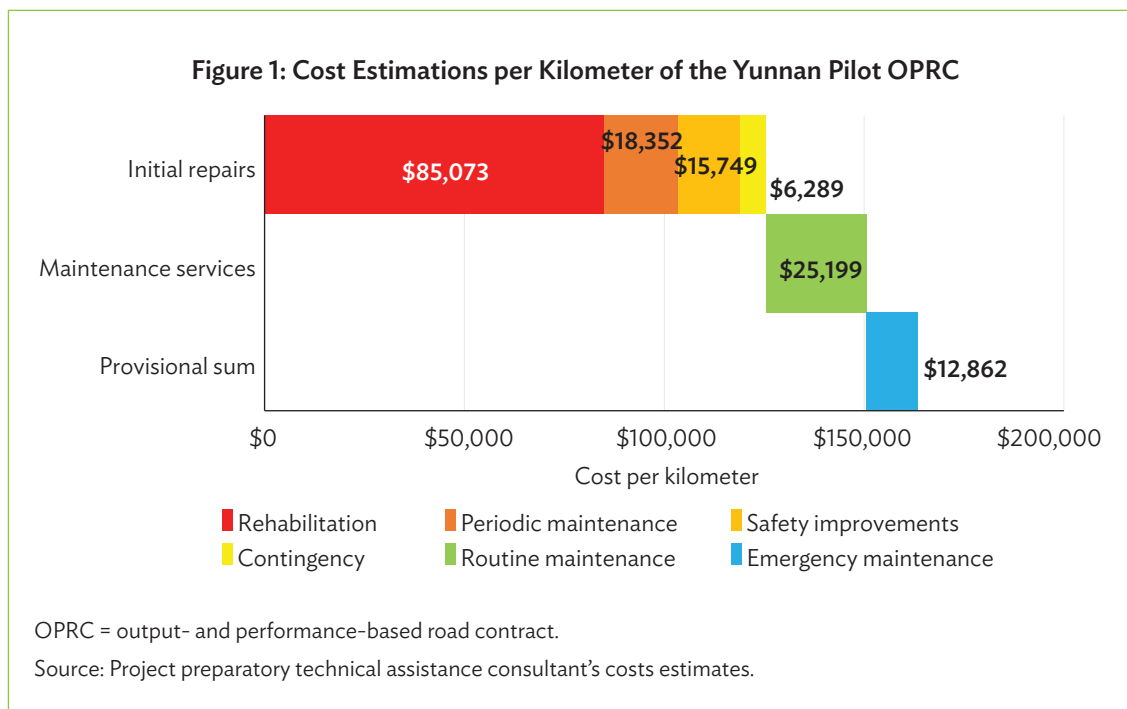
The Yunnan OPRC was largely financed with ADB funding and was tendered using national competitive bidding. The standard bidding document for procurement of goods under national competitive bidding of the Ministry of Finance, which is largely in line with the standard bidding documents for works used by ADB and the World Bank. The employer's requirements included a detailed description of the performance-base component of the contract, including the performance standards and the calculation of deductions. The contract was awarded to a local contractor from the province concerned for an amount of \$9.7 million, including all initial repairs. The exact division of costs as per the contract is not known, but the estimated costs are presented in Table 12. Based on these cost estimates, initial repairs together with safety improvements made up 73% of the contract costs, with the 4 years of performance-based maintenance making up 15%, the provisional sum for emergency maintenance 8%, and contingencies 4%. The average cost for the performance-based routine maintenance amounted to \$6,300/km/year.

Table 12: Cost Estimations of Yunnan OPRC Pilot

Cost Item	Amount	Amount/km	Percentage	Amount/km/Year
Rehabilitation	\$4,849,172	\$85,073	52%	Initial repairs
Periodic maintenance (overlays)	\$1,046,067	\$18,352	11%	Initial repairs
Safety improvements	\$897,708	\$15,749	10%	Initial repairs
Routine maintenance	\$1,436,334	\$25,199	15%	\$6,300
Emergency maintenance (10%)	\$733,157	\$12,862	8%	\$3,216
Contingency	\$358,498	\$6,289	4%	
Total	\$9,320,936	\$163,525	100%	

km = kilometer, OPRC = output- and performance-based road contract.

Source: Project preparatory technical assistance consultant's costs estimates.



The ADB SLA pilot contract was fully financed by the government and was negotiated with the county-level road maintenance unit under the Yunnan Highway Administration Bureau. The initial cost estimate including initial repairs and performance-based maintenance amounted to \$5.0 million, but it was later decided to carry out more comprehensive initial repairs and the contract amount increased to \$8.0 million. This mostly involved initial repairs and safety improvements that were carried out under a separate contract. The exact amount of the subsequent SLA is unknown, but based on the initial cost estimates the amount was slightly more than \$1.0 million, equivalent to \$3,150/km/year. It must be noted that this did not include staff costs, which were covered under separate government budget lines.

The contracts for the World Bank pilots in Anhui Province were largely financed by the World Bank and were all tendered competitively using national competitive bidding. The contracts were awarded to domestic contractors. The total contract costs including initial repairs are indicated in Table 13, averaging \$186,000 per kilometer, only slightly higher than the Yunnan OPRC. Unfortunately, the division of the costs by cost item could not be obtained.

Table 13: Anhui OPRC Amounts

Contracted Road	Length (km)	Amount	Amount/km
Anhui G205	88.5	\$12,774,916	\$144,349
Anhui S215, G233	65.1	\$13,930,000	\$213,847
Anhui S303, S229	81.0	\$17,540,000	\$216,543
Anhui G206, S233, S246	63.0	\$8,800,000	\$139,683
Anhui G312, S210, S213	65.2	\$14,007,786	\$214,810
Anhui S601	125.3	\$23,729,084	\$189,318

km = kilometer, OPRC = output- and performance-based road contract.

Source: Anhui Road Maintenance Innovation and Demonstration Project procurement plan.

GEORGIA

A first OPRC was piloted in Kakheti region from 2016 to 2021 under the World Bank-funded Second Secondary and Local Roads Project. The contract covered 117 km of secondary roads and included 38 km of rehabilitation, as well as 5 years of performance-based routine and winter maintenance of the full road length.

A second OPRC pilot was tendered in Guria region under the World Bank-funded Secondary Road Asset Management Project. The contract covered 240 km of secondary roads and was planned for the period 2020–2026. It included 68 km of rehabilitation and 107 km of periodic maintenance, as well as 5 years of performance-based routine and winter maintenance of the full road length. Because of the high bid prices received and in light of the coronavirus disease (COVID-19) pandemic, it was decided to cancel the tender and instead carry out the rehabilitation works through a traditional volume-based contract.

A third OPRC pilot was planned in Mtskheta–Mtianeti region under the ADB-funded Batumi Bypass Road Project. The contract would be area-based and cover 142 km of international and secondary roads. Most of these roads were recently rehabilitated, but there was also a 20 km section that was in poor condition and would be rehabilitated under the contract. The entire contracted road length would be subject to 5 years of routine and winter maintenance. However, following the difficulties in the tendering of the second OPRC pilot and the impact of the COVID-19 pandemic, it was decided to cancel the OPRC pilot and use the funding for traditional volume-based rehabilitation works.

Contract Scope

The Kakheti OPRC covered 117 km of secondary roads in flat terrain with limited snowfall, making it an easier road to pilot the OPRC approach. The contract included 38 km of rehabilitation spread over 4 segments of road, which was paid on a lump-sum basis against the completed length of road complying with the minimum standards set for rehabilitation (e.g., roughness < 2.5 m/km, pavement strength in line with a 20-year design life). The contractor was responsible for the design of the rehabilitation works, which had to be approved by the government. The rehabilitation was complemented by 5 years of routine and winter maintenance of the entire road length, which was paid on a performance basis. This also included any periodic maintenance required during the contract period (for the road segments not receiving initial rehabilitation). For the road sections that did not require rehabilitation, the performance-based maintenance services started immediately at the beginning of the contract and continued for 5 years. For the sections requiring rehabilitation, the maintenance services started only after rehabilitation had been completed, and thus lasted for a shorter period. There was a provisional sum to pay for any required emergency maintenance, which was paid against unit rates according to an approved work order in a similar way as dayworks.

The Guria OPRC covered 240 km of secondary roads in mountainous terrain with higher snowfall, making it more challenging than the Kakheti contract. The contract included 68 km of rehabilitation. Based on lessons from the Kakheti OPRC, the rehabilitation works were paid on a volume basis against unit costs, rather than on a lump-sum basis according to the length of road completed, giving greater control over the type and quality of works carried out. The design was also carried out under a separate consultancy contract instead of by the contractor. The rehabilitation works were to be completed within 3 years, with a third of the length to be completed each year and liquidated damages to be applied if progress was not in line with the contract. Based on lessons from the Kakheti OPRC, it was decided to remove the periodic maintenance from the performance-based component of the contract and to pay this on a lump-sum basis. As a result, the contract included 107 km of periodic maintenance that was to be paid through lump sums for each kilometer of road completed in compliance with the defined standards (e.g., at least 40 mm overlay, International Roughness Index [IRI] < 2.7 m/km, design life of at least 5 years). This covered the remaining contracted road length except for some limited sections that had a cement concrete surface or that were unpaved. In the case of periodic maintenance, the contractor remained responsible for the design and for submitting this for government approval. The periodic maintenance was also to be completed within 3 years, with a third of the length to be completed each year and liquidated damages to be applied if progress was not in line with the contract. Routine and winter maintenance were to be carried out under the contract over a period of 5 years and were to be paid on a performance basis. However, since most of the contracted road length was subject to rehabilitation or periodic maintenance to be carried out in the first 3 years of the contract, the actual duration of the performance-based maintenance was more limited. A provisional sum was included to pay for any emergency maintenance, with payments made against a work order and according to unit rates.

For the Mtskheta–Mtianeti OPRC, less information is available since this was never tendered. The contract was to cover 142 km of roads, most of which had been recently rehabilitated. However, a 20 km section of road in poor condition was also included, which was subject to rehabilitation under the contract, with payment on a volume basis according to unit rates. The contract was to include 5 years of routine and winter maintenance to be paid on a performance basis with fixed monthly lump-sum payments. A provisional sum was to be included to finance any emergency maintenance on a volume basis, against unit rates and after issuing a work order.

The Roads Department was pleased with the results of the Kakheti OPRC and promoted additional piloting of OPRCs, although these have not been successfully tendered. The Roads Department also changed its traditional area-based maintenance contracts from annual routine maintenance contracts to 3-year contracts covering routine maintenance as well as some limited periodic maintenance. The Roads Department is considering converting these volume-based contracts to performance-based contracts to improve the predictability of costs and avoid cost overruns, but government procurement and financing legislation, currently, do not allow performance-based contracting under normal government funding.

Table 14: PBRM Contracts in Georgia

Pilot Section	Length	Years	Months	Type	RH	PM	RM	WM	EM	Status
Kakheti	117 km	2016-2021	60	OPRC	VB ^a	(PB)	PB	PB	VB ^b	Completed
Guria	240 km	2020-2026	60	OPRC	VB ^c	VB	PB	PB	VB ^b	Cancelled
Mtskheta-Mtianeti	142 km	2020-2026	60	OPRC	VB ^c	-	PB	PB	VB ^b	Cancelled

Initial repairs
 Maintenance services
 Provisional sum

EM = emergency maintenance, OPRC = output- and performance-based road contract, PB = performance-based payment, PBMC = performance-based maintenance contract, PBRM = performance-based road maintenance, PM = periodic maintenance, RH = rehabilitation, RM = routine maintenance, SLA = service level agreement, VB = volume-based payment, WM = winter maintenance.

^a Paid on a lump-sum basis.

^b Paid from provisional sum, against work order.

^c Paid on a unit rate basis.

Source: Consultant's processing of pilot data.

Performance Standards

The performance standards in the Kakheti OPRC are presented in Appendix 3. In addition to the performance standards listed in Appendix 3, the Kakheti OPRC also includes a performance standard for road usability, which requires that the road is kept open and remains passable at all times. Several adjustments were made to the performance standards through contract amendments during the first years of the contract, removing performance standards that were found not to be relevant, and amending those that were difficult to measure. The same set of performance standards was used in the 2020 OPRC pilot in the Kyrgyz Republic, with only minor amendments.

The performance standards are well structured and presented in an easily readable format. However, in some cases, the performance standards and related thresholds are not very well defined, making it unclear what the contractor is required to do. For example, there are five performance standards relating to the maximum size of potholes, the maximum number of potholes, the maximum height of pavement drop-offs, missing traffic safety signs, and missing guardrails or parapets that result in immediate deduction of the full monthly payment for the 1 km segment concerned in case of noncompliance. However, the same performance standards are repeated further on in the list of performance standards, but then with longer response times and lower deduction percentages. For the repeated performance standards, the threshold is not treated as a lower limit above which the deduction is applied, but it is treated as an upper limit below which the deduction is applied. For instance, if the threshold defines a maximum number of five potholes per 1 km segment and there are more than five potholes, this results in an immediate deduction of the full monthly payment for that 1 km segment according to the first set of performance standards. However, if there are fewer than five potholes, the immediate deduction is not applied, but according to the second set of performance standards the contractor is still required to patch the potholes within 10 days to avoid a deduction of 10% of the monthly payment for that

1 km segment from being applied. This is not clear from the performance standard, which should state that there should be no potholes at all instead of stating that there should be fewer than five potholes. The requirement of not having any potholes (meaning that all potholes should be patched every month) is quite strict and can be costly to comply with. The fact that this is not immediately clear from reading the performance standards may cause contractors to submit bid prices that are too low, leading to disputes during implementation.

Other performance standards in the Kakheti OPRC are similarly strict. For instance, the road surface and shoulders must always be clean and free of soil, debris, trash, and other objects, while roadside ditches and lined drains must be clean with no standing water. Such strict performance standards can be difficult and costly to comply with. The use of response times means that the performance standard only needs to be complied with a number of days after the formal inspection, reducing the risk of noncompliance immediately resulting in deductions. However, it should be considered whether such zero-tolerance standards are suitable and enforceable, and whether it is not better to define low thresholds linked to immediate deductions when the threshold is exceeded, or to include reaction times in the performance standard as part of the threshold.

In the Kakheti OPRC, different sets of performance standards are applied in the summer season and winter season, as indicated in Appendix 3. In the summer season, the performance standards for winter maintenance are not applied. In the winter season, only some of the other performance standards are applied as indicated in the corresponding column of the performance standards. The winter maintenance performance standards in the Kakheti OPRC revolve around reaction times. Although some performance standards define maximum allowable snow or slush depths that may not be exceeded during snowfall events, most focus on the allowable reaction time to remove snow and ice and restore friction after the snowfall or freezing temperatures have ceased. The performance standards are not very well structured, making it difficult to understand the exact requirements and to determine the implications of noncompliance.

Apart from these performance standards related to the maintenance activities, the Kakheti OPRC included a separate set of management performance measures (MPMs) that are related to the timely submission of reports as well as the annual collection of inventory, condition, and traffic data (Appendix 4). The contractor was required to submit different reports, with clear time frames for doing so (including for the submission of revised versions after comments had been given). Where the contractor exceeded the indicated time frames, a penalty was applied ranging from GEL100 to GEL500 (\$45–\$215), which was repeated for each day of delay. The use of monetary values made it very clear what the implications were of any noncompliance and facilitated the application of the penalties.

The Guria OPRC included a completely different approach to the performance standards. The performance standards were grouped together into 10 so-called road user service and comfort performance measures (RUS&CPM). A specific performance standard could cover several defects and related indicators and thresholds. For instance, the performance standard for pavement maintenance (RUS&CPM-1) covered potholes, cracks, and various other pavement defects. These 10 RUS&CPM performance standards were complemented by a further 3 road durability performance measures (RDPMs) and 6 MPMs. The RDPM performance standards related to larger works, including programmed periodic maintenance and rehabilitation works (failure to comply with the timing leads to liquidated damages), as well as requirements to keep the average pavement roughness below a certain threshold and to address any erosion of cut and embankment slopes. The MPM performance standards

are related to submission of reports and compliance with plans, as well as the collection of inventory and traffic data. The resulting 19 performance standards are presented in Appendix 5. The details of the specific performance standards could not be obtained, and this report does not include any comments of the specific indicators and thresholds used in the Guria OPRC. However, based on the information that was available, it is clear that the system of performance standards applied in the Guria OPRC was much more complicated than in the Kakheti OPRC, which likely contributed to the failure of the tender process.

Inspections

Under the Kakheti OPRC, the contractor was required to establish a self-control unit to monitor the compliance with the different performance standards and prepare the monthly statement. During the summer season, formal inspections were carried out each month to verify the level of compliance as presented in the monthly statement of the contractor. In case of noncompliance, the contractor was given a response time to correct these, and additional formal inspections were planned to check whether the defects had been corrected within the allocated response times. During the winter season, formal inspections were triggered by each winter event, and usually took place within 1 day after the winter event to check that the snow and ice have indeed been removed.

Informal inspections could be carried out by the project manager at any time. Any noncompliance identified during these inspections had to be reported to the contractor in writing within 24 hours. The informal inspections did not lead to deductions, although the failure of the contractor to correct the identified defects within the defined response time could lead to a deduction, but this would require a formal inspection before the deduction could be applied. A number of performance standards were indicated as having safety implications, and for these performance standards the deductions could supposedly be applied based on informal inspections. It is not clear exactly how this worked, as the monthly payment and all applied deductions were only defined during the monthly formal inspection.

Response Times and Reaction Times

The Kakheti OPRC included response times for each performance standard, as presented in Appendix 3. These response times refer to the time given to the contractor to correct any noncompliance identified during the formal inspection (in some cases involving safety-related performance standards, the response times appear to have been initiated from the time of first identification, which may be during an informal inspection). In the case of the five important performance standards, the response time was set at zero days and the deduction was applied immediately if a noncompliance was identified. This is in line with the approach proposed in this report, but is only applied to a few performance standards. For most of the performance standards, response times of between 1 day and 90 days were defined. This required multiple follow-up inspections to verify that the noncompliances had indeed been corrected within the allocated response time and to determine whether the deduction was to become permanent or not, significantly increasing the burden of the inspections.

In several cases, the response times actually refer to reaction times, the time that the contractor is given to correct the noncompliance from the moment of first identification (not necessarily during a formal inspection). These performance standards are indicated as being safety measures, where the application of deductions is not dependent on formal inspections. An example is the response time for missing, damaged, or illegible traffic safety signs. The response time is 1 day, but this is actually the reaction time from first identification of the noncompliance, rather than the response time that is applied from the moment of the formal monthly inspection (since the formal inspection could take place several days or even weeks after the first occurrence of the missing sign). This mixed approach involving reaction times and response times causes some confusion. For example, in the case of objects on the road that form a safety hazard the response time is 12 days, while for objects on the road that are not a safety hazard the response time is 10 days. It is strange to have a longer response time for obstacles that are a safety hazard. In the case of a safety hazard, this is actually the reaction time and can start any time during the month when the object is first identified, while in the case of obstacles that are not safety hazards, the response time is from the moment of the formal inspection (in this case, the first identification may have happened well before the formal inspection). Where reaction times are concerned, it is preferable to include these as part of the performance standard (as has been done for winter maintenance), rather than as a response time. Where response times are involved, it is preferable to remove these altogether and to apply immediate deductions in case a noncompliance is identified during the formal inspection (as has been done for the five important performance standards).

The longer response times of 30, 60, or 90 days refer to structure repairs, road markings, and signs and pavement rutting and raveling. Correcting such defects requires more time, and thus longer response times are applied. However, these response times are very long and encompass several months and consecutive formal inspections. It is not clear why such long response times are applied and how they have functioned in practice.

For the Guria OPRC, it was decided to remove all response times. Any noncompliance identified during the formal inspection would immediately result in a deduction. This is in line with the approach proposed in this report. However, in the Guria OPRC all performance standards included reaction times. Contrary to the response times in the Kakheti OPRC, these reaction times were from the moment of first identification instead of from the moment of the formal inspection. In the case of potholes, these needed to be repaired within 7 days from first identification under the Guria OPRC (reaction time), instead of within 10 days from the formal inspection in the Kakheti OPRC (response time). The widespread use of reaction times increases the need for informal inspections to continuously survey the road and check the compliance with the reaction times, severely increasing the inspection burden. Since the contract was not awarded and implemented, it is unclear how well this widespread use of reaction times would have worked in practice.

Payments and Deductions

In the Kakheti OPRC, the payments for rehabilitation works were on a volume basis according to lump-sum payments per kilometer of road completed. For the performance-based maintenance services, a fixed monthly payment is made, with deductions applied in case of noncompliance. The deductions are applied to each 1 km segment that is found to be noncompliant with one or more performance standards. The deduction percentages are presented in Appendix 3 and are applied to the

monthly payment per kilometer (full monthly payment divided by the contracted road length) for each 1 km segment found to be noncompliant.

For the first five performance standards, the deduction percentage is equal to 100% of the monthly payment per kilometer. These are considered the most important performance standards that should be complied with at all times, and any noncompliance immediately results in a deduction of the full monthly payment for the 1 km segment concerned (equivalent to about \$400 per instance based on the awarded contract price). For all the other performance standards, the deduction percentages are much lower, ranging from 3% to 10% of the monthly payment for the 1 km segment concerned (equivalent to about \$10–\$40 per noncompliant 1 km segment). Multiple noncompliances for different performance standards in the same 1 km segment will result in multiple deductions to the monthly payment for that 1 km segment.

The total of all the deduction percentages (excluding the first five performance standards with 100% deduction and the winter maintenance performance standards) amounts to exactly 100%. This means that only in the case of noncompliance with all 16 performance standards and application of all 16 related deduction percentages in a 1 km segment would the full monthly payment for that 1 km segment be deducted. Noncompliance with all standards is unlikely, even if the contractor were to carry out no work at all, and such low deductions do not provide an appropriate incentive for the contractor to ensure compliance. Even if the contractor would carry out no maintenance at all for an extended period of time, the contractor would still be eligible for a partial amount of the monthly payment. The first five performance standards with 100% deduction in case of noncompliance, on the other hand, do provide a proper incentive for compliance, and such higher deduction percentages should be applied to the other performance standards as well. Not all deduction percentages should be 100%, but the deduction percentages should range from a minimum of 10% to about 50% for most performance standards, depending on the seriousness of the defect concerned and the cost of correcting it. Very important defects can have higher deduction percentages.

For the road usability performance standard, the deduction is calculated differently. If the road is blocked in any location and not opened up in time, a deduction is applied according to the formula in Figure 2 that multiplies the monthly payment per kilometer by the number of kilometers that are impassable, and divides this by 30. The formula appears to attempt to calculate the daily payment per kilometer and to multiply this with the number of blocked kilometers. However, most blockages will occur in specific locations, meaning that 1 km will be affected at most. The deduction is equal to about \$14, and is applied each hour that the road is impassable (except when works are ongoing to open up the road). On a daily basis (24 hours), this works out to about \$330. This deduction amount is quite low when compared to the impact of road closures on road users.

Figure 2: Formula for Calculating Deduction for Road Usability Performance Standard

$$PR = (A \times B) / 30$$

PR = payment reduction, A = monthly payment per kilometer, B = number of blocked kilometers.

Source: Roads Department.

In the case of winter maintenance, the deductions are applied per day of noncompliance. The deduction percentage of 5% is applied to the monthly payment for the 1 km segment(s) found to be noncompliant. Such a deduction percentage is equivalent to only \$20 for each noncompliant 1 km segment, and does not provide a very strong incentive for timely removal of snow and ice since the costs of providing sufficient capacity to remove snow and ice over the entire road length within 2–8 hours will be many times higher. The deduction is repeated every day that the snow or ice is not removed. The reaction times that form part of the winter maintenance performance standards range from 2 to 8 hours, and the application of deductions on a daily basis (24 hours) does not seem suitable. Once the deduction has been applied, there is little incentive to the contractor to quickly comply if the next deduction is only due 24 hours later. There is a big difference between a reaction time of 2 hours and one of 26 hours (2 hours + 1 day) in terms of the required implementation capacity of the contractor. It would be preferable to repeat the deductions in a time frame that is more in line with the reaction time, for instance every hour or every few hours.

The Kakheti OPRC also includes a possibility to apply liquidated damages if the contractor continues to fail in correcting a defect even after application of the corresponding deductions. During the first 30 days after identification and notification of any defects, the corresponding deduction percentages are applied. If the noncompliance has not been corrected within 30 days, liquidated damages are applied according to the formula in Figure 3. This basically means that the deductions are doubled 30 days after the start of the response time, and doubled again every consecutive 30 days that the noncompliance is not corrected. It is not clear how this applies to performance standards with a response time that is longer than 30 days. The liquidated damages applied to a noncompliant 1 km segment may exceed 100% of the monthly payment for that 1 km segment (thus affecting the monthly payment for other 1 km segments). The liquidated damages can add up to large amounts if the noncompliance is left uncorrected, forming a strong incentive for the contractor to correct any noncompliances, even if the starting deduction percentages are low. A deduction percentage of 5% for a noncompliance in a 1 km segment would amount to a deduction of only \$20. Assuming a response time of 30 days, the monthly deduction would increase to \$640 after 6 months (with a cumulative deduction over the 6-month period of \$1,260). It would continue to increase exponentially, reaching nearly \$40,960 in month 12 (with a cumulative deduction over the 12-month period of nearly \$82,000).

Figure 3: Formula for Calculating Liquidated Damages

$$PR = 2^n \times PR_u$$

where $n = (J-1)/30$

PR = actual payment reduction, PR_u = payment reduction unit rate, J = number of days since the start of the response time.

Source: Roads Department.

The Guria OPRC applies a very different approach to deductions. For each of the 19 performance standards, a weight and sub-weight are defined (Appendix 5). The number of noncompliances for a specific performance standard are counted for the entire contracted road length, and this number is multiplied by the weight and subsequently by the sub-weight to calculate the noncompliance score for that performance standard. This is repeated for all 19 performance standards to calculate the total noncompliance score. If the noncompliance score is less than 150, the full monthly payment is made. If the noncompliance score is more than 250, a full deduction is applied to 80% of the monthly payment and the contractor only receives 20% of the monthly payment that is not subject to deductions. For noncompliance scores between 150 and 250, a complicated formula is used to calculate the percentage of the monthly payment payable to the contractor (Figure 4). Applying this formula, a noncompliance score of 200 would result in $Y = -0.0091(200-150)^2 - 0.097(200-150) + 100 = 72.4\%$. This percentage is only applied to 80% of the monthly payment, with the remaining 20% not being subject to any deductions. As a result, the contractor would receive $72.4\% \times 80\% + 20\% = 77.92\%$ of the monthly payment (equivalent to a deduction of 22.08%).

Figure 4: Formula for Calculating the Deduction to the Monthly Payment (Guria)

$$Y = -0.0091X^2 - 0.097X + 100$$

Y = approved payment percentage applicable to 80% of the fixed monthly payment, X = the actual noncompliance score minus the threshold for full payment.

Source: Roads Department.

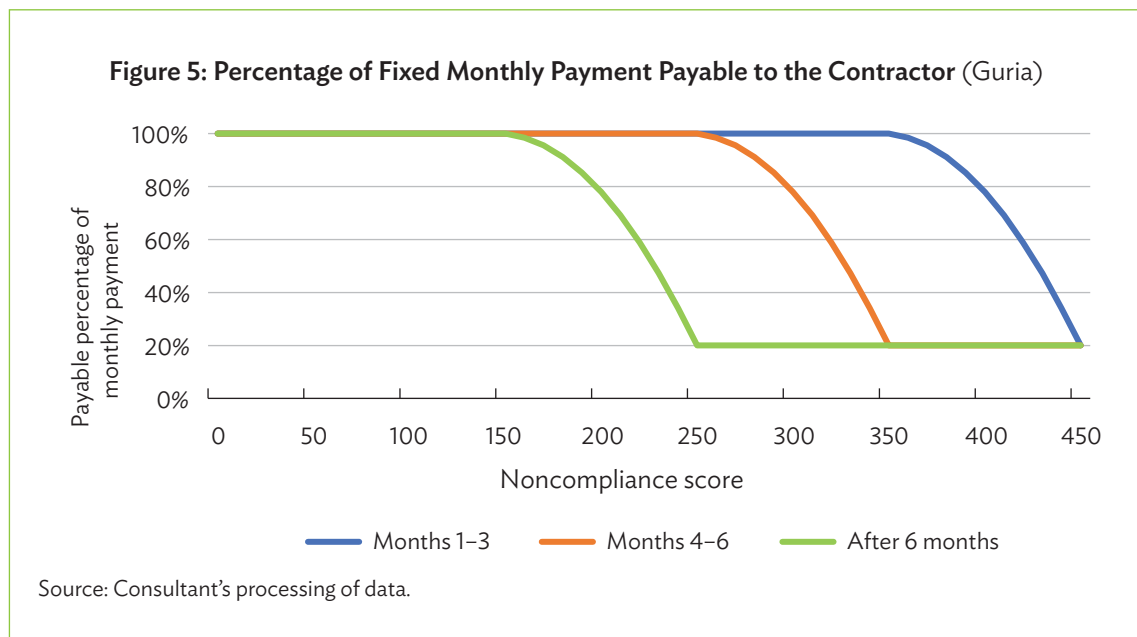
The upper and lower thresholds for the noncompliance score related to 100% payment and 100% deduction (of the 80% of the monthly payment subject to deductions) are set higher during the initial months of the contract. This means that the contractor can have a greater number of noncompliances during the initial months, without this directly resulting in deductions to the monthly payments. This allows the contractor to become accustomed with the OPRC and to address any maintenance backlog. After 3 months, the allowable thresholds are lowered and, after 6 months, they are lowered again to their long-term levels. The thresholds for the different periods are shown in Table 15.

Table 15: Thresholds for the Noncompliance Score (Guria)

Period	100% Payment	100% Deduction
Months 1-3	Score < 350	Score > 450
Months 4-6	Score < 250	Score > 350
After 6 months	Score < 150	Score > 250

Source: Roads Department.

The basis for the formula is not clear. It appears to be a random quadratic formula that results in ever greater deductions as the number of noncompliances exceeding the lower threshold increases, reaching 100% deduction (of the 80% of the monthly payment subject to deductions) once the number of noncompliances reaches the upper threshold. Figure 5 shows the percentage of the fixed monthly payment that is payable to the contractor depending on the noncompliance score. In the figure, the payment remains at 100% until the lower threshold is reached, and then quickly drops, reaching 20% when the upper threshold is reached. The remaining 20% of the monthly payment is not subject to deductions. The figure shows the process for each of the three sets of thresholds described in Table 15.



Under this system, the contractor is eligible for the full monthly payment, even if there are several noncompliances. The exact number of noncompliances will depend on the weight and sub-weight, but taking the example of pavement defects that have a weight of 2 and a sub-weight of 1, it would take a total of 75 noncompliances in the entire contracted road length to reach a noncompliance score of 150 that would start resulting in deductions to the monthly payment. Based on the contracted road length of 240 km, this is equivalent to about 1 noncompliance for every 3 kilometers of road. This means that a large pothole every 3 kilometers would not yet result in any deduction to the monthly payment. During the first 3 months, up to 175 noncompliances are allowed before deductions are applied, equivalent to more than two noncompliances for every 3 kilometers of road (e.g., two large potholes every 3 kilometers). Once the threshold is reached, the deductions very quickly increase. Taking the example of pavement defects again for the period after 6 months, the deductions would start when there are 75 noncompliances identified (e.g., 1 pothole every 3 kilometers), and if there would be 125 noncompliances in the contracted road length (e.g., 1 pothole every 2 kilometers), the remaining monthly payment would already reach its lowest point of 20% (this last 20% is not subject to deductions). Although the threshold where deductions start is set quite high, the very high rate of increase of the deductions once that threshold is exceeded, poses a severe risk for contractors.

The use of weights and sub-weights is unclear. For the road user service and comfort performance measures, both the weights and sub-weights are fixed and could have been combined into a single weight. For the RDPMs and the MPMs the weight is fixed, but the sub-weight depends on the number of months, weeks, or days delay in carrying out works, submitting a report or implementing plans. However, even here, this could have been combined into a single weight. At the same time, the weights for the road user service and comfort performance measures seem very low. The weights are either 1 or 2, while the sub-weights are all 1. This means that any noncompliance contributes 2 points at most to the noncompliance score. With a lower threshold of 150 points before the noncompliance score results in any payment deduction, this means that between 75 and 150 noncompliances can be registered before this affects the monthly payment (even more during the initial months). The weights for the road durability measures are set at 5, and the weights for the MPMs are all set at 2, rising to 4 in case of continued noncompliance from an earlier month. The sub-weights are at least 1 and increase with each month or week delay in implementing works, each week of delay in submitting a report or each day of not implementing the road safety and traffic management plan. This means that the late submission of a report by 2 weeks actually has a greater effect on the monthly payment than the presence of a large pothole.

The intention of the new approach to calculating deductions seems to be to move away from the need to determine noncompliance for each 1 km segment, as the noncompliances are determined for the entire road length under contract. However, this means that the weights, sub-weights, and thresholds for the noncompliance score need to be adjusted for each contract. If the contracted road length is longer, there will likely be more noncompliances and thus a higher noncompliance score. At the same time, the longer road length will likely be linked to a higher monthly payment, and thus the applied deduction percentage will result in a higher monetary value of the deduction. The effect becomes especially visible if the road section is divided into two contracts instead of one. Although the contract remains the same for the rest, with the same payment per kilometer, the effect of noncompliances on deductions changes drastically as the thresholds are less likely to be exceeded, and even when they are, the deduction percentage is applied to a smaller contract amount (for half the road length). Under this system, a longer contracted road length will need to have lower weights and sub-weights, and/or higher thresholds for the noncompliance score. This is very difficult to do in a fair manner that results in all contracts having similar deductions from their noncompliances. It also means that difficult road segments that have a lot of noncompliances can have an exaggerated effect on the deductions to the monthly payment, even if the performance in the rest of the road is exemplary. This is exactly why the common approach in performance-based contracts is to carry out the inspections and deductions per 1 km segment to avoid that the length of the road has any effect on the size of the deduction and to avoid that difficult road segments have too much impact on the overall performance.

In the Guria OPRC, the impact of a specific noncompliance on the monthly payment deductions is not very clear, as it is hidden behind a combination of weights, sub-weights, noncompliance scores, lower and upper thresholds, and a complicated quadratic formula. It is very difficult for contractors to predict the likelihood and level of deductions being applied, which means that the perceived risk will be quite high. This is likely an important reason why the resulting bid prices were much higher than the cost estimate, leading to the failed tender. Even if the procedure for calculating the deductions would have been more transparent and easier to understand, it would still need to be adjusted for each contract depending on the contracted road length, meaning that contractors would need to carry out a detailed analysis of each contract to estimate the risks involved. On the other hand, the Kakheti OPRC pilot applies a much simpler and more transparent approach to calculating the deductions. This approach can be applied unchanged to any road length, facilitating replication of a standardized approach to the whole network.

Procurement and Contract Costs

The Kakheti OPRC was first tendered through international competitive bidding using the World Bank standard bidding document for OPRCs in 2014, encompassing a total road length of 225 km, including paved and unpaved roads as well as several bridges. The lowest bid received was 3 times higher than the cost estimate and, as a result, the tender process was cancelled. Discussions with bidders revealed that they had increased their bids to cover various perceived risks. These included risks related to the required maintenance of unpaved roads and bridges, as well as risks related to the novelty of performance-based contracting.

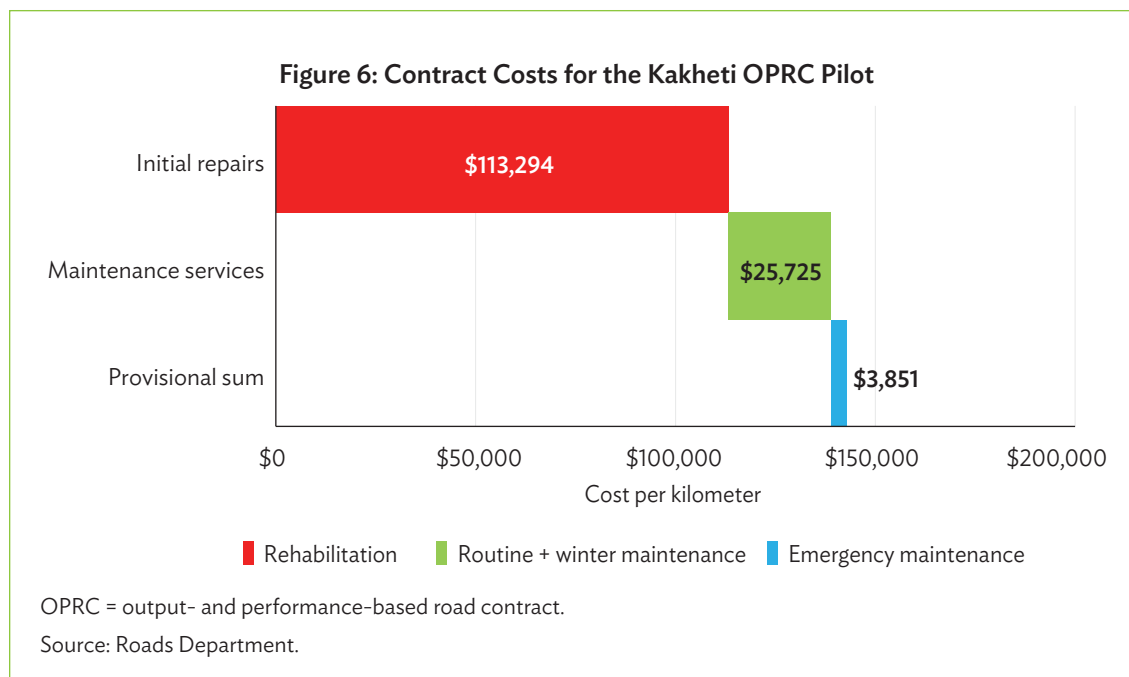
The scope of work of the contract was adjusted subsequently, removing the maintenance of unpaved roads and bridges from the contract and reducing the overall road length to 117 km to fit the available budget, while at the same time taking account of possible increases to bid prices because of the novelty of the performance-based contracts. A second tender was published in late 2015 through international competitive bidding. This resulted in three bids (bidders were from Georgia, the PRC, and Spain). The contract was awarded in early 2016 to a joint venture from Georgia for a contract price of GEL40,549,225 (\$16.7 million), which was two-thirds of the next lowest bid. The contract functioned well, although several contract variations were required in the first years to facilitate the implementation and compliance with the performance standards. Because of the delays in the contract award, the project needed to be extended from 5 years to 7 years to cover the full implementation of the OPRC, with the last 2 years of implementation of the OPRC fully financed by the government. The Roads Department was pleased with the approach and supported the inclusion of additional OPRCs under other projects.

In the Kakheti OPRC, the rehabilitation works formed 79% of the contract price, with 18% made up by the routine and winter maintenance services and 3% by emergency maintenance under a provisional sum. The rehabilitation costs under the Kakheti OPRC (\$0.31 million/km) were found to be comparable to those under traditional rehabilitation contracts (\$0.28 million/km), while the costs for maintenance under the Kakheti OPRC (GEL12,481/km/year, equivalent to about \$5,150/km/year) were found to be slightly higher than in other government road maintenance contracts (GEL11,100/km/year). However, in the OPRC, these maintenance costs included backlog maintenance not covered under the initial repairs and related design costs. The novelty of the OPRC approach was also considered to attribute to the higher maintenance costs, as the bid price was subject to deductions in case of poor performance.

Table 16: Contract Costs for the Kakheti OPRC Pilot

Item	Payment	Amount	%
Rehabilitation (+contingency)	Lump-sum	\$13,255,421	79%
Routine and winter maintenance	Performance-based	\$3,009,832	18%
Emergency maintenance (provisional sum)	Volume-based	\$450,563	3%
Total		\$16,715,815	

Source: Roads Department.



In the case of the Guria OPRC, the contract was not awarded, and the tender was cancelled. However, based on the cost estimates, 55% of the contract cost was expected to go to volume-based rehabilitation, 25% to lump-sum-based periodic maintenance, and 20% to the performance-based routine and winter maintenance. The provisional sum for emergency maintenance formed an additional 7% on top of the contract price.

Table 17: Estimated Contract Costs for the Guria OPRC Pilot

Item	Payment	Payment basis	%
Rehabilitation	Volume-based	Unit costs	55%
Periodic maintenance	Lump-sum	Lump-sum per km	25%
Routine and winter maintenance	Performance-based	Lump-sum/km/month	20%
Emergency maintenance (provisional sum)	Volume-based	Unit costs	7%

km = kilometer, OPRC = output- and performance-based road contract.

Source: Roads Department.

KYRGYZ REPUBLIC

A total of five OPRCs were planned to be piloted under the ADB-funded CAREC Regional Road Corridor Improvement Project (2008–2014), with the same number of pilots planned in neighboring Tajikistan under the same project (500 km in total). The pilots were planned to be fully financed from government funding and to have a duration of 4 years. However, legal obstacles and problems securing the multiannual government budget allocations caused significant delays and the Kyrgyz Republic pilots were not carried out.

Around the same time, the World Bank's Central Asia Links Program also aimed to pilot OPRC. Because of the problems encountered in the ADB project, it was decided to instead pilot an SLA between the Ministry of Transport and Communications and the Osh–Batken–Isfana **Управления Автомобильных Дорог (УАД)** [Road Administration (UAD)]. The objective was to move away from traditional force account works with payments based on consumed inputs, and to link payments to resulting road conditions. The pilot was financed under government funding, except for the procurement of maintenance equipment for the UAD that was financed by the World Bank. Because of underfunding and delays in providing the maintenance equipment, the SLA underperformed and was not renewed after the first year of operation from 2014 to 2015.

The ADB-funded CAREC Corridor 3 Bishkek–Osh Road Improvement Project piloted a single OPRC pilot on a 68.5 km section of the Bishkek–Osh road from Karabalta to Sussamyr (61–129 km). The pilot was funded from a combination of 50% government funding and 50% ADB grant funding, with a duration of 3 years from December 2017 to December 2020. In February 2020, two additional OPRCs were awarded under the additional financing of the CAREC Corridors 1 and 3 Connector Road Project. These contracts covered a 70 km section from Balykchy to Kochkor (0–43 km) and from Kochkor to Epkin (62–89 km).

Contract Scope

The SLA pilot included routine, winter, and emergency maintenance of the entire 407 km Osh–Batken–Isfana road corridor up to the border with Tajikistan. All activities were financed under a single performance-based payment, apart from the road maintenance equipment that was provided separately to the state-owned contractor.

The 2017 OPRC pilot included initial repairs involving 8 km of rehabilitation and 9 km of periodic maintenance (just under one-quarter of the total contracted length), which were paid on a volume basis according to unit rates. Current repair of the pavement involving pothole patching, crack sealing, and removal of large landslides was paid under a provisional sum on a volume basis according to unit

rates, while routine maintenance of the road and structures (temporary pothole patching with aggregate, maintenance of signs, clearing of culverts and drainage ditches, small concrete repairs, vegetation control, slope stabilization, and removal of obstacles) was paid on a performance basis. Winter maintenance was paid under a provisional sum on a volume basis, depending on the length of road cleared and the number of days this was required, except for certain basic activities, such as placing snow poles, cleaning signs, patrolling, and traffic management, which were paid on a performance basis. As such, the performance-based payments only formed a small portion of the contract activities.

The 2020 OPRC pilots included full rehabilitation of the roads over a period of 2 years, followed by 5 years of performance-based maintenance. The rehabilitation works were paid on a volume basis. All other activities, including current repairs to pavements and structures, routine maintenance, and winter maintenance, were paid on a performance basis. Even periodic maintenance, including chip seals and thin overlays to comply with the maximum roughness thresholds, was included under the performance-based component of the contract (although this required a work order). The scope of the performance-based activities under the 2020 pilots is much greater than under the 2017 pilot.

Table 18: PBRM Contracts in the Kyrgyz Republic

Pilot section	Length	Years	Months	Type	RH	PM	RM	WM	EM	Status	
Osh-Batken-Isfana	407 km	2014-2015	12	SLA	-	-	PB	PB	VB ^a	Completed	
Karabalta-Sussamyr	69 km	2018-2020	36	OPRC	VB	VB	PB	VB ^a	PB	VB ^a	Completed
Balykchy-Kochkor	43 km	2020-2027	24+60	OPRC	VB	PB	PB	PB	VB ^a	Ongoing	
Kochkor-Epkin	27 km	2020-2027	24+60	OPRC	VB	PB	PB	PB	VB ^a	Ongoing	

 Initial repairs  Maintenance services  Provisional sum

EM = emergency maintenance, km = kilometer, OPRC = output- and performance-based road contract, PB = performance-based payments, PBRM = performance-based road maintenance, PM = periodic maintenance, RH = rehabilitation, RM = routine maintenance, SLA = service level agreement, VB = volume-based payments, WM = winter maintenance.

^a Paid from provisional sum, against work order.

Source: Consultant's processing of pilot data.

The 2017 and 2020 pilots also included a provisional sum for emergency maintenance. In the 2020 pilots, this was indicated as dayworks for performance-based maintenance. Emergency maintenance could only be invoked by the contractor if the volume of damage exceeded the thresholds listed in Table 19. For damages below these thresholds, the contractor was required to carry out the repairs as part of the performance-based maintenance services.

Table 19: Thresholds for Emergency Maintenance

Defect	2017 Thresholds	2020 Thresholds
Landslide onto road	>300 m ³ in any one location	>1,000 m ³
Damaged culvert	>1 per 5 km of road	1 completely damaged culvert
Bridge railings or guardrails	-	>25 m due to accident
Washouts	-	>1,000 m ³ per 500 m of road
Flooding	-	>100 m submerged
Damaged asphalt concrete pavement	>20 m ³ in any one location	>4 m ³
Damaged base course	>50 m ³ in any one location	>20 m ³
Damaged concrete structure	>5 m ³ in any one location	>10 m ³
Damaged embankment	>300 m ³ in any one location	>200 m ³

km = kilometer, m = meter, m³ = cubic meter.

Sources: Contract documents.

Performance Standards

A copy of the performance standards applied in the SLA could not be obtained. However, the World Bank reports that the performance standards were not well defined, containing inconsistencies and lacking clearly defined duties and responsibilities of the UAD. To a large degree, this was caused by the need to sign the SLA early on in the project as a project effectiveness condition, before the international consultant was mobilized to support the pilot.

The performance standards applied in the 2017 pilot are presented in Appendix 6 and those applied in 2020 pilots are in Appendix 7. It must be noted that the 2020 performance standards appear to have been copied from the 2016 OPRC experience in Georgia (Kakheti region), with only very minor changes to the thresholds, response times, and deduction percentages. However, for the winter maintenance in the 2020 OPRC, the performance standards from Georgia have not been used and instead these have been copied from the 2017 OPRC pilot in the Kyrgyz Republic.

The 2017 pilots made use of two sets of thresholds, one for the road segments in good condition (52 km) and one for the road segments in poor condition (16 km). The thresholds for the road segments in poor condition were the same, set lower, or removed altogether. However, for most performance standards the main difference was that the response time was changed to 1 November (official start of the winter season) rather than a fixed number of days from the first identification. This means that the defects still needed to be corrected, but the contractor was provided more time to do so.

The 2017 pilot performance standards are not well structured, and sometimes contradicting. Sometimes the response times are mentioned in the performance standard (large potholes to be repaired within 7 days), and sometimes the performance standard is mentioned in the response time (potholes to be immediately filled with aggregates as temporary measure). The 2020 pilot introduces a more structured approach, but here too there is some confusion with different tables dealing with performance standards and the measurement methodology to be applied. The resulting confusion regarding the exact definition of the performance standards to comply with can cause problems during inspections.

In the 2020 performance standards, the thresholds are not always properly defined, making it unclear what the contractor is required to do. For example, the first five performance standards relating to the maximum size of potholes, the maximum number of potholes, the maximum height of pavement drop-offs, missing traffic safety signs, and missing guardrails or parapets result in immediate deduction of the full monthly payment for the 1 km segment concerned. These can be seen as the upper thresholds beyond which the contractor is not allowed to go, applying immediate deductions if the threshold is exceeded as recommended in this report. However, the same performance standards are repeated in a subsequent section in the list of performance standards, but then with a longer response time and lower deduction percentage. For the repeated performance standards, the threshold is not seen as the lower limit above which the deduction is applied, but it is seen as the upper limit below which the deduction is applied. For instance, the threshold defines a maximum number of 5 potholes per 1 km segment. If there are more than 5 potholes, this results in an immediate deduction of the full monthly payment for that 1 km segment. If there are fewer than 5 potholes, the immediate deduction is not applied, but the contractor is still required to patch the potholes within 10 days, after which a deduction of 10% of the monthly payment for that 1 km segment will be applied. Thus, the threshold is not properly defined, and should instead state that there should be no potholes at all, with 10 days to comply in case a pothole is identified. This is a very strict requirement that is costly to comply with, and which is not immediately clear from reading the performance standards. It should be considered whether a zero-tolerance standard for potholes is applicable and enforceable, and whether it is not better to simply have immediate deductions when the number or size of potholes exceeds a certain threshold.

In the 2017 pilot, some current repairs (pothole patching, isolated crack sealing, and slope repair) are paid on a volume basis under a provisional sum. Nevertheless, these activities are also reflected in the performance standards. It is not clear what role these performance standards play, especially since the contractor requires a work order before the activities can be carried out. Such volume-based activities should not be included in the performance standards that should only relate to the performance-based activities.

The definition of the performance standards is not always in the form of a measurable threshold, and often takes the form of activities to be undertaken by the contractor. The lack of such measurable thresholds can impact the objectivity of inspections and can lead to disputes. Where measurable thresholds have been defined, these are not always acceptable. For instance, the maximum allowable pothole size in the 2017 performance standards is set at 0.5 m², equivalent to a pothole with a diameter of 80 cm. If a square is used, this would still have sides of 70 cm. In the 2020 performance standards, the maximum pothole size is defined as a maximum diameter of 20 cm, which is much more appropriate and easier to apply.

The 2017 performance standards include a number of standards related to the submission of (monthly) reports, compliance with traffic management plans, and reporting of defects to the project manager. The contractor is also required to provide data for the road database every 12 months, including updates of road inventory and road condition data, as well as traffic counts. The inclusion of these activities in a performance standard is a good aspect of the contract that allows these requirements to be enforced. Although similar requirements exist in the 2020 pilots, these do not include any performance standards to facilitate enforcement. In the Georgia OPRC pilot that these performance standards were copied from, there were separate MPMs with monetary penalties to enforce timely submission of reports.

Winter maintenance in the 2017 pilots is paid on a volume basis, except for some preparatory activities that are paid on a performance basis. Nevertheless, the performance standards include thresholds and corresponding deduction percentages for all winter maintenance activities. It is not clear how these are applied to the volume-based payments. In the 2020 pilots, the exact same performance standards have been applied as in the 2017 pilot instead of copying these winter maintenance performance standards from the Georgia OPRC. Here, however, all winter maintenance activities are performance-based, and thus the performance standards make more sense. Formally, the winter performance standards apply only during the official winter season (1 November until 15 March or 1 April in mountainous areas), but in case of snow or ice outside this period, the contractor is still required to comply with the performance standards. In case of extreme weather events (defined as occurring no more than once every 2 years in the past 5 years), the contractor is not required to comply with the performance standards and separate payments are made on an hourly basis under the provisional sum for emergency maintenance. This reduces the risk for the contractor and likely leads to lower costs. The contractor is required to bring the road back up to standard within 48 hours after the extreme weather event has ended.

In the 2020 pilot, different sets of performance standards are applied in the summer season and winter season (1 November up to 15 March or 1 April in mountainous areas). In the summer season, the performance standards for winter maintenance are not applied, while in winter some of the other performance standards are not applied (this is indicated in Appendix 7).

The 2020 OPRC also includes a performance standard for roughness, requiring the roughness to remain under 2.4 m/km. Where the pavement roughness exceeds the allowable threshold, this can only be reduced through periodic maintenance (seals or overlays), and not through basic routine maintenance (pothole patching and crack sealing). This puts a much greater requirement on the contractor and can lead to high bid prices because of the risks involved. In the preparation of the 2016 OPRC pilot in Georgia, it was decided to drop the roughness performance standard that was normally included in the World Bank standard bidding document for OPRCs. In the case of the 2020 OPRC pilot in the Kyrgyz Republic, the contract included full rehabilitation of the entire road length during the first 2 years. As such, the risk of exceeding the roughness performance standard is limited and can be mitigated by ensuring high quality during the rehabilitation works. At the same time, the duration of the performance-based maintenance services after rehabilitation is completed is quite long at 5 years.

Inspections

In both OPRCs, the contractor is required to establish a self-control unit to monitor the compliance with the different performance standards and prepare the monthly statement. During the summer season, formal inspections are carried out each month to verify the level of compliance as presented in the monthly statement of the contractor. In case of noncompliance, the contractor is given a response time to correct these, and additional formal inspections are planned to check whether the defects have been corrected within the allocated response times. During the winter season, formal inspections are triggered by each winter event, and usually take place within 1 day after the winter event to check that the snow and ice have indeed been removed.

Informal inspections may be carried out by the project manager at any time. Any noncompliance identified during these inspections has to be reported to the contractor in writing within 24 hours. Although the informal inspections do not lead to immediate deductions, the failure of the contractor to correct the identified defects within the defined response time can lead to a deduction, although this would require a formal inspection before the deduction can be applied. In the 2020 pilot, several performance standards have been indicated as having safety implications and, for these performance standards, deductions supposedly can be applied based on informal inspections. It is not clear exactly how this would work because the monthly payment and all applied deductions are only defined during the monthly formal inspection.

Under the 2020 pilot, the contractor is required to install signs that indicate the telephone number of a hotline to report any defects. These signs are to be placed at a maximum distance of 20 km apart. The hotline is to be operational during normal office hours and during snowfall and emergency events. The contractor is required to keep a log that indicates the date and time of any reported defect, the type and location of the defect, and the date and time it was corrected. Although this is a useful exercise, it is not clear if and how this may affect the monthly payments and the application of deductions.

Response Times and Reaction Times

The 2017 performance standards (Appendix 6) and 2020 performance standards (Appendix 7) also include response times. If any noncompliances are identified during the formal (or informal) inspections, the contractor is given a period of time to correct the noncompliance. Only if the contractor fails to correct the noncompliance within the provided response time does the deduction to the monthly payment become permanent.

In the 2017 pilot, most response times are equal to 28 days, implying that correction of the noncompliance will be verified during the next monthly formal inspection. For some performance standards, the response times are double at 56 days. This is mainly for pavement repairs, pavement markings, structure repairs, and slope stabilization that require more time to correct. The advantage of such response times is that no additional formal inspections are required. The 2020 pilots have a wider range of response times. Although some response times are 30 days or 60 days and similarly require re-inspection during the next formal monthly inspection, there are also many performance standards with response times

of 2, 3, 5, 7, 10, 12, 14, and 15 days. This variety of response times means that several different follow-up formal inspections may be required, greatly increasing the management burden of such contracts. Where response times are applied, it is preferable to have a limited range of response times to limit the number of follow-up formal inspections. Even more preferable is to avoid the response times altogether.

In the 2017 pilots, there are a few performance standards with shorter response times. In reality, these are reaction times and should form part of the performance standard. These shorter reaction times are applied for road blockages, snow and ice, landslides, large potholes, and traffic safety hazards, ranging from 5 hours to 7 days. These all involve defects that occur suddenly and have serious effects on passability or traffic safety. They are applied from the moment of first identification of the noncompliance, and thus function as reaction times rather than response times. Similarly in the 2020 pilots, there are performance standards indicated as being safety measures, each with short response times that are actually reaction times. The 2017 and 2020 pilots tend to confuse response times (the time to correct any noncompliance from the time of formal inspection) with reaction times (the time to correct any noncompliance from the moment of first identification). It is recommended to remove all response times, and to integrate the reaction times as part of the performance standards concerned.

Payments and Deductions

A copy of the performance standards and the related methodology for applying deductions in the SLA could not be obtained. However, the World Bank reports in its project completion report that the SLA did not properly define deductions in case of noncompliance with the performance standards, and did not clearly explain how monthly lump-sum payments were to be calculated. Actual compliance with the performance standards was low as a result, reaching only 91.4% by the end of the 1-year contract. It is not clear if this refers to 91.4% of the contracted road length. More likely, this is the contracted road length minus the deduction length, where the length of noncompliant road sections has already been multiplied by the deduction percentages, in which case the actual length of road found to be noncompliant would be significantly longer. Assuming an average deduction percentage of 20%, it would mean only 57% of the road length was fully compliant.

For the 2017 and 2020 OPRC pilots, deduction percentages are set for each performance standard and are listed in Appendix 6 and Appendix 7. The contractor was not required to comply with the performance standards for the first 45 days of the contract. Reduced compliance was also required for the first 45 days of the summer season (starting on 15 March or 1 April in mountainous areas), with deductions only applied in this period if more than 50% of the 1 km segments were found to be noncompliant for one or more performance standards. For the road segments included under the initial repair works, compliance with the performance standards was not required until the works had been completed. In the 2020 pilot, compliance was only required after rehabilitation of the entire contracted length had been completed.

In the 2017 pilot, the deduction is only applied if the contractor does not correct the noncompliance within the allocated response time. For most performance standards, this means that the deduction for a noncompliance identified during a monthly inspection is only applied if that noncompliance is not corrected by the next monthly inspection (or for pavement and structure repairs, after 8 weeks). It is not clear from the contract document what happens to the monthly payment in the meantime, but it is assumed that the deduction amount is retained and repaid if the noncompliance is corrected

by the next inspection. For the 2020 pilot, the contract clearly states that in case of noncompliances, the deduction to the monthly payment is retained at the time of inspection, but is repaid if the noncompliance is corrected within the response time. This repayment takes place together with the next monthly payment. If the noncompliance is not corrected within the response time, the deduction becomes permanent.

In the 2017 pilot, the deduction percentages are applied in different ways. For most performance standards, the deduction percentage is applied to the monthly payment per 1 km segment (monthly payment divided by the contracted road length), for each 1 km segment found to be noncompliant, and for each performance standard separately. These deduction percentages vary from 5% to 10% of the monthly payment per kilometer. Based on the contract amount, this is equivalent to \$6–\$12. For some performance standards where the compliance is not linked to a specific 1 km segment (e.g., road blockages, reporting, and winter preparation), the deduction percentage is applied to the full monthly payment for the entire contracted road section, with deduction percentages ranging from 2% to 15% (equivalent to a \$161–\$1,200 deduction to a monthly payment of \$8,000). The deductions applied to the full monthly payment in the 2017 pilot appear to be quite high (5% of the full monthly payment in case of late submission of reports, equivalent to about \$400), whereas for the deductions applied by 1 km segment, the percentages seem to result in very low deductions (blocked culvert resulting in 7% deduction to that 1 km segment, equivalent to 0.1% of the full monthly payment or \$8). The 2017 pilot even includes deductions for activities that are paid on a volume basis. For the current pavement repairs, this simply means that the volume-based payment is not made. For the winter maintenance, however, deduction percentages are listed, and it is unclear how these are applied to the volume-based payments.

In the case of the 2020 pilot, all deduction percentages are applied to the monthly payment per 1 km segment (monthly payment divided by the contracted road length), even where this involves performance standards that are difficult to link to a specific 1 km segment (e.g., road usability, availability of salt and grit at start of the winter season). In the 2020 pilot, there are a few performance standards related to large potholes, large numbers of small potholes, high drop-offs, missing traffic safety signs, and missing safety guardrails and parapets that result in a 100% deduction for the 1 km segment in which the noncompliance is encountered. Although this may seem very high, with a total road length of 70 km, the total deduction is only 1.4% of the total monthly payment (equivalent to about \$560). For all the other performance standards, the deduction percentages are much lower, ranging from 5% to 15%. For a 70 km road, such a deduction is equivalent to 0.07%–0.21% of the full monthly payment (about \$30–\$85).

The importance of the different defects does not seem to be sufficiently taken into account in defining the deduction percentages. The 2017 pilot has a higher deduction percentage for dirty mileposts than for blocked culverts, while the 2020 pilot applies a deduction for waste on the shoulder that does not form a safety hazard that is twice as high as for retaining walls with structural damage or instability. When the deduction percentages are converted to deduction amounts based on the contract price, it becomes evident that some performance standards have deduction amounts that are far too low in view of the safety impact or the repair costs involved.

The 2017 and 2020 pilots both have a performance standard related to road usability, requiring that the road is kept open and passable at all times. The 2017 pilot uses a standard deduction percentage of 5% of the total monthly payment, which appears to be applied for each kilometer and (part of a) day that the road is not passable (although the contract is not very clear on this). This is equivalent to slightly

more than \$400 per day that the road is blocked. The 2020 pilot introduces a specific formula (Figure 7) that multiplies the monthly payment per kilometer by the number of kilometers that are impassable, and divides this by 30. The resulting deduction is applied for each hour that the road is impassable (except when works are ongoing to open up the road). However, most blockages will occur in specific locations, meaning that at most 1 km will be affected. The deduction will be equal to \$18, applied each hour that the road is blocked. On a daily basis (24 hours), this works out to a similar amount as the 2017 pilot (even though the monthly payment per kilometer for the 2017 pilot is much lower than for the 2020 pilot). These deduction amounts are again quite low when compared to the impact of road closures on road users.

Figure 7: Formula for Calculating Deduction for Road Usability Performance Standard

$$PR = (A \times B) / 30$$

PR = payment reduction, A = monthly payment per kilometer, B = number of blocked kilometers.

Source: Roads Department.

The 2020 pilot also includes a performance standard for roughness, also with a specific formula for determining the deduction percentage. The formula is equivalent to the actual roughness minus the target roughness, divided by the target roughness. So, if the target roughness is 2.4 m/km and the actual roughness is 2.6 m/km, the deduction percentage is 8%. This deduction percentage is applied to the 1 km segment that is found to be noncompliant, and would be equivalent to a deduction amount of about \$45. This has no relation to the cost of applying a seal or overlay to reduce the roughness for that 1 km segment. For each subsequent month that the noncompliance is not corrected, the deduction is increased by 100%. However, after 12 months, the total sum of monthly deductions over that period would still amount to only \$3,500 (compared to \$104,000 in monthly payments for that 1 km segment received in the same period). Such low deductions are unlikely to motivate a contractor to carry out the required works, while at the same time the contractor will increase its bid price to ensure that the risks of such costs are covered.

Figure 8: Formula for Calculating Deduction for Road Roughness

$$\frac{IRI^a - IRI^p}{IRI^p}$$

IRI^a = actual roughness, IRI^p = planned target roughness.

Source: Roads Department.

Where contractors fail to comply with the performance standards for an extended period of time, the 2017 pilot includes different tools to promote compliance. First, any noncompliances that are not corrected within the response time and for which the deduction has already become permanent will have that deduction doubled in the following inspection. In addition, if the contractor exceeds a specified number of noncompliances per year, the contract may be terminated. The threshold for the allowable maximum number of noncompliances increases each year, from 100 in year 1 to 160 in year 2 and to 200 in year 3.

In the 2020 pilot, noncompliances that have not been corrected within 30 days after expiration of the response time are subject to liquidated damages using the following formula. This basically means that the deductions are doubled 30 days after the expiration of the response time, and doubled again every consecutive 30 days that the noncompliance is not corrected. The liquidated damages applied to a noncompliant 1 km segment may exceed 100% of the monthly payment for that 1 km segment (thus affecting the monthly payment for other 1 km segments). The liquidated damages can add up to large amounts if the noncompliance is left uncorrected, forming a strong incentive for the contractor to correct any noncompliances, even when the deduction percentages are low. A deduction percentage of 5% for a noncompliance in a 1 km segment would amount to a deduction of \$36. Assuming a response time of 30 days, the monthly deduction would increase to \$1,150 after 6 months (with a cumulative deduction over the 6-month period of nearly \$2,700). It would continue to increase exponentially, reaching nearly \$74,000 in month 12 (with a cumulative deduction over the 12-month period of nearly \$150,000).

Figure 9: Formula for Calculating Liquidated Damages

$$PR = 2^n \times PR_u$$

whereby $n = (J-1)/30$

PR = actual payment reduction, PR_u = payment reduction unit rate, J = number of days since expiration of response time.

Sources: Contract documents.

Procurement and Contract Costs

The SLA was directly awarded to the Osh–Batken–Isfana Road Administration (UAD) without any competitive bidding. This merely introduced a different payment modality for the work already being done by the UAD. At the same time, the SLA resulted in a significantly increased amount of funding available to the UAD. The SLA increased the funding level from a baseline of \$80,000–\$242,489, but this remained far below the amount required to fully comply with the performance standards. Based on the 407 km length of the road under maintenance, the contract amount is equivalent to just under \$600/km/year. This cost does not appear to include salary costs and also does not include equipment depreciation costs (only fuel and materials required for carrying out maintenance activities). Nevertheless, it was clearly underfunded, considering that it included routine maintenance and repair as

well as winter maintenance. New equipment that was supposed to be used in the implementation of the maintenance and repair activities was only provided toward the end of the SLA and could not be used during the implementation of the SLA. The limited funding and the lack of equipment likely contributed to the underperformance of the SLA and the fact that it was not extended.

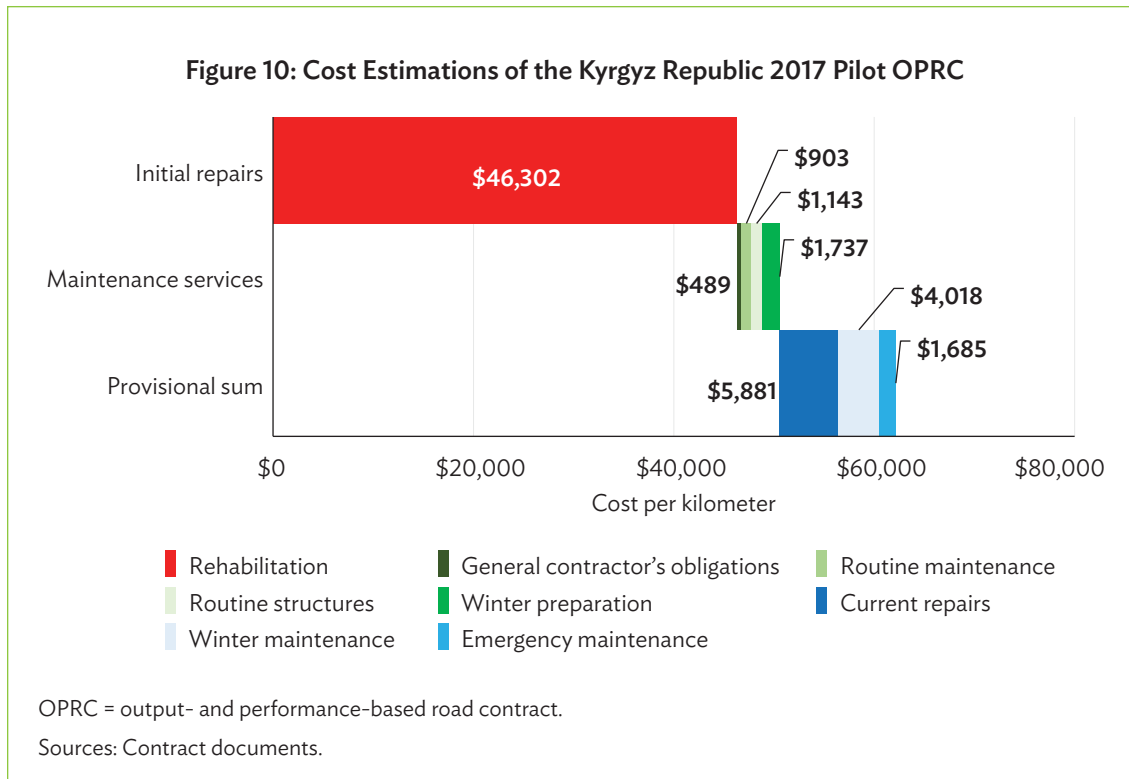
The 2017 OPRC made use of the ADB standard bidding document for small works, with the performance standards, maintenance specifications, and other aspects of the performance-based component of the contract included as part of the employer's requirements. After the first tender failed, the second tender was successful and resulted in a contract award to a domestic private sector contractor for a total contract amount of Som296,914,349 (\$4.3 million at the date of signing). Despite the initial repairs only covering a limited portion of the contracted road length, the repair costs made up nearly three-quarters of the contract amount. Volume-based current repairs of the pavement, winter maintenance, emergency maintenance, and dayworks made up an additional 19% of the contract amount under a provisional sum. The actual performance-based component of the contract made up slightly more than Som20 million, equivalent to only 7% of the total contract amount of just under Som300 million. On an annual basis, this amounted to slightly more than \$1,400/km/year. The volume-based current repairs of the pavement averaged just under \$2,000/km/year, while snow and ice removal averaged slightly more than \$1,300/km/year and emergency maintenance averaged \$560/km/year. Excluding the rehabilitation works and the provisional sum for emergency maintenance, the average contract costs for maintenance and repair amounted to just more than \$4,700/km/year which is in line with other countries. However, as can be seen clearly in Figure 10, a large portion of these costs is included under the volume-based provisional sum instead of the performance-based maintenance services.

Table 20: Contract Costs for the 2017 Pilot Contract
(\$)

Item	Payment Basis	Amount	Amount/km	%
Rehabilitation works	Unit costs	\$3,171,670	\$46,302	74%
General contractor's obligations	Lump-sum/km/month	\$33,491	\$489	1%
Routine road maintenance	Lump-sum/km/month	\$61,884	\$903	1%
Routine structure maintenance	Lump-sum/month	\$78,297	\$1,143	2%
Winter maintenance preparation	Lump-sum/month	\$118,951	\$1,737	3%
Pavement current repairs	Unit costs	\$402,840	\$5,881	9%
Winter maintenance	Unit costs (km-days)	\$275,238	\$4,018	6%
Emergency and dayworks	Unit costs	\$115,393	\$1,685	3%
Total		\$4,257,764	\$62,157	100%

km = kilometer.

Sources: Contract documents.



The 2020 OPRC pilots made use of the ADB standard bidding documents for large works, including the Fédération Internationale Des Ingénieurs-Conseils (FIDIC [International Federation of Consulting Engineers]) general conditions of contract. The contracts were tendered competitively as two separate lots. The performance standards and other aspects of the performance-based component of the contract were included as part of the specifications. Both contracts were awarded to a PRC-based contractor for an amount of \$40.2 million (\$22.7 and \$17.5 million).

The 2020 OPRC pilot included full rehabilitation of the entire 70 km road length, including widening of some sections. Of the total contract sum of \$40.2 million, \$36.5 million was for the rehabilitation works and related dayworks, contingencies, and value-added tax (VAT), forming 91% of the total contract amount. Given the extensive rehabilitation, it was to be expected that the cost per kilometer of the maintenance services would be lower than in the 2017 pilot, since there were no segments with old pavement remaining. However, the price for the performance-based maintenance for the two lots amounted to \$3.0 million including VAT, making up 8% of the contract sum and equivalent to just under \$8,700/km/year based on 70 km and a 5-year implementation period for the maintenance services. Despite the full rehabilitation at the start of the contract, the annual maintenance and repair costs per kilometer are nearly 85% higher than the \$4,700/km/year under the 2017 pilot (including both the performance-based and volume-based maintenance services). Contrary to the 2017 pilot, this performance-based payment includes all summer and winter maintenance and current repairs, explaining some of the price difference. The price difference is also partially expected to be because of the requirement to keep the roughness under a certain limit. Although the likelihood of actually having to carry out resealing or overlays within the 5-year contract period is low, the costs of doing so will be

high and this risk will be reflected in the contractor's bid price. In this case, a provisional sum for periodic maintenance may have been a better approach, reducing the risk for the contractor and the resulting bid price. The provisional sum for emergency maintenance amounted to \$0.7 million including VAT, equivalent to \$1,900/km/year.

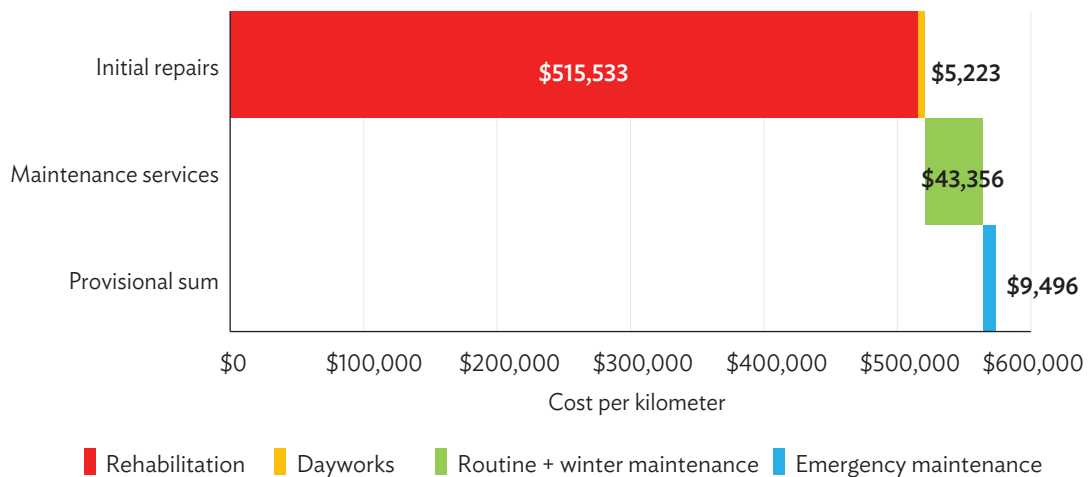
Table 21: Contract Costs for the 2020 Pilot Contracts
(\$)

Item	Lot 1 – 43 km Amount	Lot 2 – 27 km Amount	Lot 1 + 2 Amount/km	%
Rehabilitation	\$16,354,552	\$12,648,477	\$413,738	72%
Dayworks (rehabilitation)	\$177,456	\$149,425	\$4,663	1%
Performance-based maintenance	\$1,571,628	\$1,141,978	\$38,710	7%
Provisional sum emergency maintenance	\$298,876	\$295,477	\$8,479	1%
Physical contingencies (10%)	\$1,840,251	\$1,423,536	\$46,559	8%
12% value-added tax	\$2,429,132	\$1,879,067	\$61,458	11%
Total	\$22,671,896	\$17,537,959	\$573,607	100%

km = kilometer.

Sources: Contract documents.

Figure 11: Contract Costs per Kilometer for the Kyrgyz Republic 2020 Pilot Contracts
(\$)



Sources: Contract documents.

With the longer duration of 2 years of rehabilitation works followed by 5 years of performance-based maintenance services, the 2020 pilot contract allowed bidders to submit separate bid prices for each year of performance-based maintenance. This allows the contractor to take account of the gradual deterioration of the road (and resulting increase in maintenance needs) as well as possible inflation costs, resulting in the prices for maintenance services increasing in future years. The average annual cost increase of the maintenance services amounts to 7.2%, although this annual cost increase is lower for the first years and higher for the latest years. The bid prices for the maintenance services for the two lots by year of operation are listed in Table 22.

**Table 22: Annual Performance-Based Maintenance Costs
by Year for the 2020 Pilot Contracts**

Year	Lot 1 – 43 km (\$)	Lot 2 – 27 km (\$)	%
Year 1	\$278,023	\$203,937	100%
Year 2	\$288,918	\$211,277	104%
Year 3	\$310,708	\$225,958	111%
Year 4	\$332,499	\$240,640	119%
Year 5	\$361,479	\$260,165	129%
Total	\$1,571,628	\$1,141,978	

km = kilometer.

Sources: Contract documents.

MONGOLIA

Mongolia has one ongoing OPRC under the ADB-funded Regional Road Development and Maintenance Project, which was signed in 2021 and will run until 2026. The contract covers 58 km of road from Khuiten Valley to Arvaikheer, with a contract duration of 5 years for rehabilitation and subsequent performance-based maintenance.

Contract Scope

The contract is carried out as an OPRC, including full rehabilitation of the road over a period of 24 months, followed by 36 months of performance-based maintenance. The rehabilitation of the road is paid on a volume basis, according to unit rates and the volume of work completed. The subsequent routine maintenance is initiated only after completion of the rehabilitation works and issuance of the taking over certificate, with payments made on a performance basis against a fixed monthly payment against compliance with the performance standards. Winter maintenance is also included under the performance-based payment, with its own performance standard. Emergency maintenance is included as a provisional sum and paid on a volume basis.

Table 23: PBRM Contracts in Mongolia

Pilot Section	Length	Years	Months	Type	RH	PM	RM	WM	EM	Status
Khuiten Valley- Arvaikheer	58 km	2021– 2026	24+36	OPRC	VB	-	PB	PB	VB ^a	Ongoing

 Initial repairs  Maintenance services  Provisional sum

EM = emergency maintenance, OPRC = output- and performance-based road contract, PB = performance-based payments, PM = periodic maintenance, PBRM = performance-based road maintenance, RH = rehabilitation, RM = routine maintenance, VB = volume-based payments, WM = winter maintenance.

^a Paid from provisional sum, against work order.

Source: Consultant's processing of pilot data.

Performance Standards

The bidding documents include specifications for the performance-based maintenance, listing 15 so-called routine maintenance performance measures (RMPM) as presented in Appendix 8. These performance standards are very similar to those used in the Guria OPRC in Georgia in 2020. Each RMPM actually covers a wide range of defects and consists of different performance standards and

related thresholds. However, the inspection and deduction percentages are related to the RMPMs as a whole, instead of to the individual performance standards included under each RMPM. As a result, only one noncompliance can be recorded for each RMPM per 1 km segment or per structure.

For most RMPMs, the compliance is assessed per 1 km segment of road. However, for bridges (RMPM-4), incident response (RMPM-6), road signs (RMPM-8), traffic islands (RMPM-11), crash barriers (RMPM-12), handrails (RMPM-13), and winter maintenance (RMPM-15), the compliance is assessed for the contracted road section as a whole (or the sample length being inspected).

For each RMPM, the specifications include a description of the activities to be undertaken and the performance standards to be complied with. However, the performance standards do not always properly reflect the activities to be undertaken. This is especially visible for the bridges, where the performance standards only relate to graffiti, unreported damages, and debris, while activities also include concrete repairs up to 1 cubic meter, vegetation control, deck repairs, railing and parapet repairs, scour repairs, approach road and embankment repairs, and painting. This disconnect, between the activities the contractor is responsible for and the performance standards that are to be applied in the inspections, is likely to lead to disputes regarding the level of compliance.

The thresholds of the performance standards are generally acceptable, including clear definitions of the maximum number and dimensions of potholes. Cracking and raveling are defined in a percentage of the pavement area, resulting in a threshold of 5%, equivalent to 300 m² per kilometer for a 6 m-wide road. Such use of percentages is not recommended because even low percentages often result in unacceptable thresholds. These are also difficult to verify during inspection.

Some performance standards are written more as activities, and it is not always clear what the threshold is and how this is to be assessed. Some also relate to activities that are to be done only once or twice a year, and it is not clear how the monthly inspections will assess compliance. Although the requirements are considered appropriate, the performance standards would benefit from rewording to make them easier to assess during the monthly inspections.

The specifications speak of a contract quality assurance management plan and a winter maintenance plan, but the preparation and compliance of these plans is not linked to any performance standard, and it is not clear how compliance will be enforced.

Inspections

The contractor is required to have a dedicated self-control unit that will monitor compliance with the performance standards and that will prepare the monthly statement. The contractor is also required to have regular road patrols every 48 hours, and in case of snow and ice every 12 hours. Evidence of patrols must be provided upon request in the form of Global Positioning System logs.

The general specifications for performance-based maintenance allow the formal inspections to be carried out on one or more samples of the contracted road, each with a minimum length of 5 km. This is to be applied only if the contractor achieves full compliance and 100% payment for 3 consecutive months, after which the minimum length to be inspected is reduced by 10% of the contracted length

(from the initial 100% of the contracted length). This may be repeated in subsequent months, until the inspection length reaches a minimum of 40% of the contracted road length. If the contractor does not achieve full compliance and full payment, the inspection length is increased by 10% of the contracted length. Despite this option being available, the particular specifications stipulate that, for this particular contract, the inspection length will be equal to 100% of the contracted length for all inspections.

The contract foresees monthly formal inspections, in which the compliance of each 1 km segment is assessed for all performance standards. For certain performance standards, the compliance is assessed for the contracted road length as a whole, while for others the compliance is assessed per structure (e.g., bridges). In this specific contract, some performance standards were excluded, and only the included performance standards were assessed. The specifications include an inspection form that allows the user to indicate, for each 1 km segment and each performance standard, whether the performance was compliant or noncompliant. A remarks column allows the reason for any noncompliance to be explained.

Response Times and Reaction Times

Although the specifications include response times (Appendix 8), these are not applied as regular response times. The response times listed in the specifications are quite long (1–12 months) and refer to the maximum time any defect may remain untreated, regardless of whether this exceeds the threshold of the performance standard. As such, they are not directly related to the performance standards and inspections, but are included to ensure that even small defects are corrected over time. If defects are not corrected within the stipulated response times, the contract may be terminated.

The contract does not include any response times within which to correct identified defects and avoid deductions from becoming permanent. The specifications are very clear that the thresholds indicated in the performance standards are not intervention levels, and that the contractor is expected to intervene in advance of the thresholds being exceeded. Any noncompliance with the performance standards results in immediate application of deductions.

Payments and Deductions

The contract makes use of a so-called network performance score (NPS), for which the formula is given in Figure 12. This is similar to the general approach to determining the compliant length, whereby the noncompliant length for each performance standard is multiplied by the relevant deduction percentage, and the resulting deduction lengths are added up for all RMPMs and deducted from the total contracted length. What the NPS introduces is an additional factor with which the deduction length for each performance standard is multiplied. This factor is equal to 1.5 for all RMPMs, except winter maintenance (RMPM-15), where the factor is equal to 5.0 for the months from November to April and zero for the rest of the year. It is not clear why the factor is 1.5 instead of 1.0 for the other RMPMs. Although the factor influences the NPS, it does not appear to have an effect on the deductions. The sum of the noncompliant length and the deduction percentage is divided by the inspected length, allowing the formula to be used when the inspection only covers a sample of the total contracted length.

Figure 12: Formula for the Calculation of the Network Performance Score

$$\text{NPS} = 100\% - \sum_{\text{RMPN-1}}^{\text{RMPN-15}} \frac{\text{non-compliant length}}{\text{inspected length}} * \text{deduction percentage} * \text{factor}$$

NPS =: network performance score.

Sources: Bidding documents.

The deduction percentages are presented in Appendix 8. The deduction percentages vary by contract, depending on the RMPMs included. In the signed contract, the percentages for pavement maintenance, bridge maintenance, marker post maintenance, and winter maintenance were increased, while the deduction percentages for vegetation control, pavement markers, roundabouts, crash barriers, and handrails were set to zero (these RMPMs were not included in the signed contract). What is evident is that the sum of the deduction percentages is always equal to 100%. This means that the maximum deduction that could theoretically be applied would be 100%. However, in practice, a deduction of 100% could only be applied if the performance would be noncompliant for all RMPMs in all 1 km segments of the road. Even if the contractor would carry out no work whatsoever, it would take a very long time before this would happen, certainly longer than the contract duration.

The desire to have the sum of the deduction percentages add up to 100% is unfounded. In PBRM contracts, the contractor is required to ensure compliance with all performance standards in all parts of the contracted road length. Noncompliance should be the exception rather than the rule. As such, any noncompliance should result in a significant deduction, providing a clear financial incentive to the contractor to comply with the performance standards. If there are many noncompliances, the contract should be terminated because it is evident that the contractor is not performing properly. This is reflected in the contract, which stipulates that the contract may be terminated if the NPS falls below 50% for any 3 months in a 6-month period. However, the NPS is calculated by multiplying the percentage of noncompliant road length by the deduction percentage. With an average deduction percentage of 7% and a factor of 1.5, this means that an NPS of 50% is equivalent to 467% of the road length being noncompliant, implying that the entire road length is noncompliant for several performance standards. This is far from a desirable service level.

The low deduction percentages also mean that there is not very much incentive for the contractor to comply with the performance standards in a timely manner. Noncompliance with the pavement performance standards (RMPM-1) in 10% of the contracted road length would only result in a 3% deduction to the monthly payment (and this is the RMPM with the highest deduction percentage). For noncompliance with the drainage performance standards in 10% of the contracted road length, the deduction would only be 0.5% of the monthly payment. Even if the noncompliance with the drainage performance standards was for the entire road length, the deduction would only be 5% of the monthly payment. The deduction percentages need to be increased significantly. For serious defects, they should be in the order of 50%, while for less important defects they should be in the order of 10%–20%.

Procurement and Contract Costs

The contract was initially packaged as 2 lots of 30.4 km and 27.2 km with 20 months of rehabilitation and 36 months of performance-based maintenance. The tender was unsuccessful, however, and the contract was subsequently repackaged as a single lot of 57.6 km with 24 months of rehabilitation and 36 months of performance-based maintenance. The contract was tendered internationally under a single-stage, one-envelope bidding procedure. Bidders were required to have an average annual turnover of \$5.4 million to have carried out contracts of \$10 million of a similar nature, and to have completed contracts of at least 30 km of rehabilitation (2 lanes) and 60 km of maintenance (2 years). Under the previous tender with 2 lots, these amounts were \$3 million (20 km) and \$5 million (30 km). Upon retendering, the contract was successfully awarded to a PRC-based contractor for a contract amount of just under \$14 million, equivalent to \$241,000/km. Most of this cost is for the rehabilitation works, although a detailed division of costs could not be obtained.

TAJIKISTAN

Tajikistan carried out two OPRCs with a total length of 149 km under the ADB-funded CAREC Regional Road Corridor Improvement Project between 2013 and 2016 in the international corridor running from Dushanbe to Karamyk at the border with the Kyrgyz Republic (73 km from Vahdat to Obigarm and 76 km from Nurobod to Nimich). This project was originally foreseen to finance five PBRM contracts in Tajikistan and another five contracts in the Kyrgyz Republic, but in the end only two contracts in Tajikistan were awarded. A midterm review was carried out after 2 years of implementation, which concluded that the performance was very satisfactory and was appreciated by the Ministry of Transport (MOT), the contractor, and the road users.

Based on the good performance, it was decided to implement a second pilot that involved two PBMCs with a total length of 176 km carried out under the ADB-funded CAREC Corridors 3 and 5 Enhancement Project between 2018 and 2021. These two PBMCs included a third section of the Dushanbe–Karamyk road (89 km from Sayron to Karamyk) as well as a section of republican road (87 km from Vose to Khovaling) that had been recently rehabilitated under the same project. An additional PBMC was awarded in 2020 for the 43 km Khovaling–Kangurt road that had been rehabilitated at a later date under the same project. Although that third PBMC did not fall under the project scope, it did make use of the same PBMC bidding and contract documents.

Contract Scope

The first two OPRCs were carried out in road sections that had been rehabilitated 6–8 years earlier, after which routine maintenance had been carried out by the state-owned maintenance enterprises (GUSADs). As a result of the older age, the pavements were deteriorated, and these road sections required some initial repairs to be carried out. The contracts were carried out as OPRCs with initial repairs paid on a volume basis, followed by routine maintenance services that were paid on a performance basis. The initial repairs included periodic maintenance to a portion of the road as well as repairs to structures. Winter maintenance was not included under the performance-based maintenance activities and was financed from a provisional sum against work orders issued by MOT (works could be approved by smartphone text, followed by a formal work order within 48 hours), with payments on a volume basis according to unit costs per kilometer. A second provisional sum was used to finance any emergency maintenance or repairs that were necessary because of unforeseen events and that exceeded the responsibility of the contractor under the performance-based routine maintenance services. Where such works were carried out under the provisional sum, they were paid on a volume basis using unit rates, and required a work order to be issued before works could be started. The contracts were each for 36 months from the start of works. The maintenance services overlapped with the initial repairs, giving an added incentive to the contractor to complete the initial repairs and comply with the performance standards.

Table 24: PBRM Contracts in Tajikistan

Pilot Section	Length	Years	Months	Type	RH	PM	RM	WM	EM	Status
Vahdat–Obigarm	73 km	2013–2016	36	OPRC	-	VB	PB	VB ^a	VB ^a	Completed
Nurobod–Nimich	76 km	2013–2016	36	OPRC	-	VB	PB	VB ^a	VB ^a	Completed
Sayron–Karamyk	89 km	2018–2021	48	PBMC	-	-	PB	VB ^a	VB ^a	Completed
Vose–Khovaling	87 km	2018–2021	48	PBMC	-	-	PB	VB ^a	VB ^a	Completed
Khovaling–Kangurt	43 km	2020–2023	36	PBMC	-	-	PB	VB ^a	VB ^a	Ongoing

Initial repairs
 Maintenance services
 Provisional sum

EM = emergency maintenance, km = kilometer, OPRC = output- and performance-based road contract, PB = performance-based payments, PBMC = performance-based maintenance contract, PBRM = performance-based road maintenance, PM = periodic maintenance, RH = rehabilitation, RM = routine maintenance, VB = volume-based payments, WM = winter maintenance.

^a Paid from provisional sum, against work order.

Source: Consultant's processing of pilot data.

The second set of PBRM contracts was carried out in road sections that had been rehabilitated recently or had received an overlay under the same project and, as a result, no initial repairs were included in the contract. The rehabilitation works for the first two roads were completed in 2017, with the PBMCs starting in 2018 after the end of the defect liability period. The rehabilitation works for the third road were completed in 2019, and the PBMC started in 2020. Initial repairs were not included in the PBMCs, and the contracts only included routine maintenance services paid on a performance basis. Winter maintenance was not included under the performance-based maintenance activities and was paid on a volume basis from a provisional sum according to work orders issued by MOT. The contracts included a second provisional sum for emergency works, which also required work orders to be eligible for payment. The contracts were each for 3 years from the start of works. The contracts included the option of extending for a further 3 years, but the first two contracts were only extended for 1 year.

The initial repairs under the OPRCs were defined in the bidding documents. This included periodic maintenance and repairs to sections of pavement, repairs to localized pavement damages, slope protection measures, improvements to the drainage system, and repairs to guardrails and fencing. These activities were carried out on the basis of unit rates that are included in the bill of quantities, with payment against the volumes of work completed. All other existing damages not expressly mentioned under the initial repairs had to be repaired under the maintenance services as part of the lump-sum paid for these services.

Winter maintenance in all five PBRM contracts included three activities: (i) snow removal from the road surface, (ii) spreading of grit and salt on the road surface, and (iii) removal of snow and ice from the road shoulders and drainage system. These activities did not fall under the performance-based maintenance services and were paid separately based on the length of road that was treated (unit costs per kilometer). Payments were made from a provisional sum and required work orders before the winter maintenance activities could be started. The bill of quantities included estimated volumes of winter maintenance per

month, covering 4–5 passes of snow removal from the road surface, 1–2 passes spreading grit and salt, and 0–1 passes removing snow and ice from the shoulder each month. The winter maintenance was limited to a 5-month period each year, from 15 November to 15 April when snowfall was likely.

Any large damages caused by unforeseen events could be carried out as part of the emergency works, paid from a second provisional sum. Smaller damages to the road that occurred during the contract duration fell under the lump-sum payment for maintenance services. However, where the damages were because of unforeseen circumstances and the volume of damages exceeded certain thresholds, the contractor was entitled to carry out the repairs as part of the emergency works. The thresholds applied for different types of damage are listed in Table 25.

Table 25: Thresholds for Emergency Works Paid from the Provisional Sum

Defect	Threshold Value
Landslide	3,000 m ³
Damaged culvert	1 culvert
Damaged asphalt concrete pavement	4 m ³
Damaged road base	20 m ³
Damaged concrete	10 m ³
Damaged embankment	200 m ³

m³ = cubic meter.

Sources: Contract documents.

Performance Standards

The performance standards used in the different contracts are presented in Appendix 9. The same standards were applied in the two OPRCs and the three PBMCs. There are 25 performance standards, grouped into 3 categories related to (i) road usability, (ii) road comfort, and (iii) road durability.

The road usability standard includes only one performance standard that requires the road to be open to traffic at all times, with a maximum interruption of 24 hours. The reaction time forms the actual performance standard. Strangely enough, the performance standard also defines a response time of 2 days, thus resulting in an enforceable reaction time of 72 hours before a deduction is applied and becomes permanent.

The road comfort standards include 13 performance standards that may impact on traffic. The first of these relates to the average travel speed over the entire road section under contract, which has to be 60 km/hour or higher. Measurement of compliance is complicated because this requires the full road length to be travelled without stopping. The duration for travelling the entire road segment is compared to the target time for travelling the same section at 60 km/hour (1 km per minute).

The subsequent nine performance standards in this category relate to potholes, vegetation, obstacles, signs, pavement markings, guardrails, and guideposts. These performance standards are inspected for each 1 km segment of road, determining whether the 1 km segment is compliant or not. The exception is the performance standard related to signs, where each sign is assessed individually.

The remaining three performance standards in this category relate to winter maintenance, even though this is paid separately on a volume basis from a provisional sum. The performance standards for winter maintenance are also inspected for each 1 km segment of road, determining whether the 1 km segment is compliant or not. Since winter maintenance requires work orders, the inspection will be limited to those sections of road where winter maintenance has been approved. This complicates the application of performance standards, since performance also depends on whether and when a work order has been issued to carry out the work.

The road durability standards include performance standards aimed at preventing damages. This includes the sealing of cracks, repairs to raveling and delamination, repairs to edge drops, cleaning of culverts and side drains, cleaning of bridge drainage and watercourses, reporting of larger damages to bridges, addressing standing water on the road surface and shoulders, and repairing of erosion. Most performance standards are inspected for each 1 km segment of road, but for bridges and culverts the inspection is per bridge or culvert.

In some of the performance standards, the thresholds are set very low, and do not reflect an acceptable service level. In the case of potholes, for example, a maximum of 5 potholes of up to 0.5 m² are allowed in any 1 km segment. Although this may seem reasonable, 0.5 m² is equivalent to a pothole with a diameter of 80 cm. Even if the rectangular shape around the pothole is taken as is the case in these contracts, 0.5 m² is still equivalent to a square of 70 cm x 70 cm. This is a large pothole, and up to five such potholes in each kilometer of road cannot be considered reflective of good performance.

In other performance standards, the threshold is set very high with zero-tolerance levels. For instance, there can be no obstacles within 0.5 m of the pavement edge, no dirty or damaged road signs, no dirty or damaged guideposts, and no debris within 100 m upstream of a bridge. Such zero-tolerance performance standards are difficult and costly to comply with, and a certain level of tolerance is generally preferable. At the same time, many of these performance standards are related to road safety, and the tolerance cannot be set very high.

Some of the performance standards are not clearly defined. An example is the obstruction of culverts and side drains of, respectively, 20% and 50%. From the text, it is not clear whether this refers to the percentage of the length or the percentage of the cross section. Although it is assumed to be the latter, poor definition of the performance standard can lead to disputes with the contractor.

There are also some performance standards that do not necessarily form part of routine maintenance, and where the repairs can be very costly and lead to high bid prices. This is the case with the road markings that must be easily visible from a distance of 100 m, but also for standing water on the pavement. Noncompliance may be easy to address by cleaning the markings or removing any material on the shoulder that prohibits the flow of water away from the road pavement. However, this can also require costly repainting of markings or reconstruction of depressed pavement sections. Since it is not

clear from the performance standards what will be required, contractors will likely wish to cover the risks by increasing their bid prices. A better definition of the performance standards and the limitation of responsibility of the contractor may lead to lower bid prices.

As part of the contract, the contractor is also required to prepare several documents, including a quality assurance plan, a health and safety management plan, an emergency procedures and contingency plan, a traffic management plan, and a handover report at the end of the contract. The contractor is further required to provide inventory, condition, and traffic data for the contracted road section to the Regional Road Departments every 12 months. However, there are no performance standards defined in relation to the preparation of or compliance with these documents and data requirements, and it is not clear how these requirements are enforced under the contract.

Inspections

The OPRCs and PBMCs included formal monthly inspections to check compliance with the performance standards. The contractor was required to submit a monthly statement indicating the level of compliance with the different performance standards, which was verified during the formal inspection. Within 3 days after receipt of the contractor's monthly statement, the project manager would set a date for the formal inspection, informing the contractor at least 48 hours in advance. The formal inspection was carried out by the contractor's control unit together with the project manager. Based on the type and number of noncompliances identified during the inspection, the monthly statement as submitted by the contractor could be amended. The amended monthly statement formed the basis for the payment for that month. In the case of noncompliances identified during the formal inspection, the contractor was provided a response time to correct the defect and comply with the performance standard. This required additional follow-up inspections to check whether the identified noncompliances had been addressed within the allocated response time.

Apart from the formal inspections and follow-up inspections, the project manager could also carry out informal inspections at any time. Any noncompliances identified during those informal inspections had to be reported to the contractor in writing within 24 hours so that they could be addressed. These informal inspections did not have an immediate effect on payments, except in the case of obstructions, obstacles, or snow on the road, in which case these had to be removed within the defined response times (ranging from 4 hours to 2 days). Other noncompliances were reviewed again in the next formal inspection.

The contracts also included a requirement for a hotline that road users could call to report damages and defects. The contractor was required to place signs with the hotline telephone number at least every 10 km. All reports had to be recorded, indicating the type of defect reported, the date and time of the report, the type of response carried out, and when the reported defect had been corrected. The hotline was not linked to any performance standard or payment deductions, and in the first pilot it took about 2 years before the hotline was in place.

Response Times and Reaction Times

The OPRCs and PBMCs included response times for all performance standards within which the contractor was required to correct any noncompliances identified during the inspections. If the noncompliance was corrected within the response time, the applied deduction would be repaid in the next monthly payment. The response times used in the contracts are presented in Appendix 9. These vary by performance standard, generally involving 1, 2, or 4 weeks. Follow-up inspections were carried out to verify that the defect had been properly addressed within the response time. Because of the varying response times, multiple follow-up inspections could be required in a single month, increasing the burden of inspections for the project manager.

The response times applied were long in some cases. For instance, where side drains were silted up, culverts were (partly) blocked, or the bridge drainage was not working properly, the contractor was given 4 weeks to rectify the situation. These are defects that are relatively easy to correct, but at the same time can have disastrous consequences if they are not corrected in time. The definition of the length of the response times seems quite arbitrary in many cases.

Most of these response times involve defects that occur gradually and that can be predicted, allowing the contractor to intervene before the allowable threshold is exceeded. For instance, in the case of potholes, patching can be carried out before the allowed number or size of potholes is exceeded. Similarly, vegetation can be cut before the maximum allowable length is exceeded. For such performance standards, response times are not necessary, and the contractor should be required to comply with the performance standards at all times, with deductions applied immediately in case of noncompliance.

Prediction of damages becomes an issue when the thresholds are set very low or when the defects can occur suddenly. For instance, the performance standard regarding obstacles on the road does not allow any vehicles, soil, rocks, or other debris to be on the road. Such a zero-tolerance threshold does not allow contractors to predict the gradual increase of the defect and plan for timely intervention. In some cases, it is possible to increase the thresholds slightly to provide the contractor with time to react to a defect before it exceeds a threshold. Where it is not possible to increase the threshold for the performance standard as this would result in an unacceptable defect, the reaction time within which the defect is to be corrected should actually make up the performance standard. This reaction time is different from the response time, which is the time from the identification of the defect during the formal inspection until the correction of the identified defect. In the case of sudden defects, the performance standard should define the reaction time within which the defect is to be corrected calculated from the time of occurrence of the defect (or the first identification of the defect). This does not require a formal inspection and can be the result of an informal inspection by the project manager, a survey by the contractor, or even a hotline notification by road users.

This is already applied under the contract in the case of the road usability standard, for instance. Here the reaction time is set at 24 hours from the first identification of any interruption in the road. However, a response time of 2 days is also defined, which is confusing as this implies that the contractor has a further 2 days to open up the road if they do not manage to do so in the first 24 hours (total 72 hours). Here, the reaction time should be the performance standard as is the case currently, but there should be no separate response time and a penalty should be immediately applied whenever the reaction time defined in the performance standard is exceeded.

Winter maintenance is also a typical activity where the performance standard should be defined in terms of reaction times. In Tajikistan, the performance standard instead defines only the resulting condition, and the time for achieving this is defined as a response time, causing confusion about how this is to be applied. Instead, the reaction time should be defined as the performance standard (e.g., removal of any snow and ice on the road surface where this is more than 15 cm within 8 hours after snowing has ended).

Other performance standards, where a zero-tolerance level is required or where allowable defects can be exceeded suddenly, can similarly include such reaction times. Response times would then no longer be relevant, and penalties would be applied whenever a performance standard is not complied with (whether this is a reaction time, or excess of an allowable volume or number of defects).

Payments and Deductions

According to the contract documents, the contractors received various types of payments. The initial repairs included in the first pilot were paid on a volume basis according to the unit costs included in the bill of quantities that forms part of the contractor's bid, with payments made in line with the completed volumes of works. For emergency repairs, the payments are also volume-based in accordance with the volume of work completed in line with the work order. The bill of quantities included the unit rates, but the work volumes were estimations and actual volumes depended on the emergency works that were required during the contract implementation, as defined in work orders issued by the project manager. For the winter maintenance activities, payments also require a work order to allow payment from the provisional sum. In this case, the payments involve lump sums per kilometer of road, and not per volume of snow and ice removed.

For the performance-based maintenance services, the contractor received a fixed monthly payment as agreed in the contract. This payment did not depend on the volume of work carried out, and only depended on the level of compliance with the performance standards. Where certain standards were not complied with, a deduction was made to the fixed monthly payment. If the contractor managed to correct the defects and comply with the performance standards within the response time set for each noncompliance, the deduction was repaid to the contractor and added to the next monthly payment. If the contractor did not manage to correct certain noncompliances before the end of the response time, the deductions for these noncompliances became permanent, and could no longer be recuperated by the contractor.

During the first months of contract implementation, deductions were not applied. This allowed the contractor to become familiar with the inspection process. In the first two pilot contracts, this period also served to allow the contractor to correct existing defects in the contracted road sections caused by backlog maintenance in previous years. For the first two pilot contracts, the road usability standard became effective starting in month 3, while the other standards gradually became effective starting in month 5, with an ever-increasing percentage of compliance required before deductions were applied, reaching 100% compliance by month 10. In the second set of pilot contracts, the contracted road sections were in much better condition and the contractor was required to fully comply with the performance standards from month 4 onward.

Table 26: Required Level of Compliance with Performance Standards

Month	Nurobod–Nimich + Vahdat–Obigarm (2013–2016)			Sayron–Karamyk + Vose–Khovaling (2018–2021)		
	Road Usability	Road Comfort	Road Durability	Road Usability	Road Comfort	Road Durability
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	100%	-	-	100%	-	-
4	100%	-	-	100%	100%	100%
5	100%	20%	20%	100%	100%	100%
6	100%	40%	30%	100%	100%	100%
7	100%	60%	40%	100%	100%	100%
8	100%	80%	50%	100%	100%	100%
9	100%	90%	60%	100%	100%	100%
≥10	100%	100%	100%	100%	100%	100%

Sources: Contract documents.

The deduction percentages applied for noncompliance with the different performance standards are presented in Appendix 9. For most of the performance standards, the inspection looks at the compliance for each 1 km segment of road. In case of noncompliance, the deduction percentage is applied only to that 1 km segment of road. The calculation of the deduction is made by multiplying the number of 1 km segments that are noncompliant, with the deduction percentage for the performance standard concerned. For instance, if there are three 1 km segments where the number of potholes exceeds the threshold of 5 potholes, the deduction length will be $3 \text{ km} \times 5\% = 0.15 \text{ km}$. This deduction length is then subtracted from the total contracted length to determine the compliant length eligible for payment in that month. The total deduction amount is equal to the deduction length divided by the contract length. For a contract length of 76 km, the deduction amount would be equal to $0.15 \text{ km} / 76.0 \text{ km} \times 100\% = 0.2\%$ of the fixed monthly payment.

In the case of signs, bridges and culverts, the deductions were calculated per sign, bridge, or culvert rather than per 1 km segment. However, the deduction percentages were used to convert the noncompliant signs, bridges or culverts into a deduction length. For instance, if there were 7 culverts where the level of obstruction exceeded 20%, the deduction length would be equal to $7 \text{ culverts} \times 1\% = 0.07 \text{ km}$. For a contract length of 76 km, the deduction amount would be equal to $0.07 \text{ km} / 76.0 \text{ km} \times 100\% = 0.09\%$ of the fixed monthly payment. Because there can easily be more than one sign per kilometer of road, the deduction length for signs can become quite high. If the noncompliance is measured in terms of the number of signs, bridges, and culverts that are noncompliant, it would be more logical to also calculate the deduction length in terms of the percentage of the total number of signs, bridges, and culverts that

were noncompliant. For example, with 7 noncompliant culverts, the deduction would be $7 \text{ culverts} \times 1\% = 0.07 \text{ culverts}$. If the contract included a total of 140 culverts, the deduction amount would be equal to $0.07 \text{ culverts} / 140 \text{ culverts} \times 100\% = 0.05\%$ of the fixed monthly payment.

For signs and culverts, a more common approach is to simply include these in the compliance evaluation per 1 km segment. If any sign or culvert is found to be noncompliant, that 1 km segment is defined as noncompliant for that performance standard. Since almost all 1 km segments will include signs and culverts, this is an easier approach. For bridges this approach is less suitable since these will only be present in some 1 km segments, and it is more common and preferable to apply a deduction per bridge.

In the case of the road usability standard, a different approach is used where the deduction is applied for each (part of a) day that the road is not passable beyond the first 24 hours of interruption. This has a deduction percentage of 1% that is applied to the entire fixed monthly payment (not per 1 km segment). For instance, an interruption that lasts for 7.5 days from the first occurrence (including the initial 24-hour reaction time), would result in a deduction amount of $7 \text{ days} \times 1\% = 7\%$ of the fixed monthly payment. This shows the large importance given to this performance standard.

The average speed is the other performance standard where a different approach is used. For this performance standard, the number of minutes to travel the entire length of the road section under contract is measured and compared to the time that would be required to travel the road section at a speed of 60 km/hour (1 km per minute). The deduction is calculated by multiplying the number of minutes in excess of the target time by the deduction percentage of 1%, which is again applied to the full fixed monthly payment. For instance, for a section length of 76 km, the target time for travelling the section at 60 km/hour would be 76 minutes. If the time measured during the inspection is 83 minutes (equivalent to 55 km/hour), the deduction amount would be $7 \text{ minutes} \times 1\% = 7\%$ of the fixed monthly payment.

What is immediately evident from the examples above is that the deduction amounts for the deductions applied per 1 km segment or per sign, bridge, or culvert are significantly lower than the deduction amounts applied to the entire road. This can be justified because a full blockage of the road, of course, is more serious than a single pothole in excess of the defined maximum. However, the examples above also show that the deduction percentages applied to the 1 km segments and individual signs, culverts, and bridges are very low. The deduction amounts should be higher than the repair costs to correct the defects. Otherwise, there is little incentive for contractors to carry out the required repairs. The total of the deduction percentages for all performance standards together is 110%, most of which are applied to 1 km segments or individual signs, bridges, and culverts. Only if the contractor does not comply with all performance standards, and for all 1 km segments and all signs, bridges, and culverts, would the full monthly payment be deducted. Even if the contractor does no work at all, they will still be entitled to a partial payment as they will still comply with most performance standards in most 1 km segments. It will take many years without maintenance before noncompliance is reached for all performance standards in all 1 km segments. This is clearly not appropriate, and the deduction percentages need to be significantly higher to result in full deduction of the monthly payment much sooner in case of poor performance.

The low deduction percentages are also evident in the inspection results from the first pilots. A midterm evaluation carried out for these contracts in 2015 found that, in the first month of operation, up to 79% of 1 km road segments were noncompliant for one or more performance standards in the Nurobod-Nimich contract, while in the Vahdat-Obigarm contract, 100% of the 1 km segments were found to be noncompliant for one or more performance standards. Despite this very low level of compliance, the calculated deduction amount was slightly more than 20% in the case of Nurobod-Nimich, and slightly more than 23% in the case of Vahdat-Obigarm. This means that, at the start of the contract, when the initial repairs had not yet been carried out and backlog maintenance had not yet been addressed, the contractor was still eligible to 77%–80% of the fixed monthly payment for maintenance services. This clearly shows that the deduction percentages applied are much too low, resulting in significant payments even when no work is carried out.

The road conditions had improved significantly 2 years later, but still 11% of the 1 km road segments were found to be noncompliant in the case of Nurobod-Nimich, and 57% of the 1 km road segments in the case of Vahdat-Obigarm (mainly unsealed cracks). The actual level of noncompliance is likely higher, as some 1 km segments may be noncompliant for different performance standards. This is not evident from the compliance reports. Although conditions had certainly improved over time, actual performance was still far from fully compliant with the performance standards. The deduction amount for the two contracts had reduced to slightly more than 2% for Nurobod-Nimich, and just under 8% for Vahdat-Obigarm. Despite the road conditions still not complying with the performance standards in large portions of the road 2 years after the start of the contract, the deduction amounts were extremely low.

The low levels of deductions are also reflected in the performance rating introduced in the inspection forms, which are based on a so-called network condition score. This network condition score is equivalent to the approved payment percentage (approved payment after deductions divided by fixed monthly payment) rather than the percentage of the road length that is fully compliant. As such, the network condition score provides a much more positive image than the actual compliance with the performance standards does, since noncompliant lengths are reduced by multiplication with the very low deduction percentages. For instance, the network condition score for Nurobod-Nimich in the first month of operation was 79.95%, while less than 21% of the road length was found to be fully compliant with the performance standards. The lowest performance rating of *unsatisfactory* involves a network condition score of less than 75%, implying a deduction amount exceeding 25% of the fixed monthly payment. This means that a contractor with unsatisfactory performance could potentially still be receiving up to 75% of the fixed monthly payment.

Table 27: Performance Ratings and Compliance Ratings

Performance Rating	Excellent	Fair	Poor	Unsatisfactory
Network condition score rating	95%–100%	85%–95%	75%–85%	<75%
Deduction amount	0%–5%	5%–15%	15%–25%	>25%

Source: Midterm review.

Although the calculated deduction amounts were low, actual deductions applied to payments were even lower since most deductions were repaid in the next monthly payment. With 66.7% of the contract period completed after 2 years, performance-based payments under the Nurobod–Nimich contract amounted to 66.5% of the contracted amount, equivalent to 99.7% of the maximum possible payment (0.3% permanent deduction). This implies that almost all identified noncompliances were corrected during the subsequent response periods, and that most calculated deductions were repaid in following months. In the case of Vahdat–Obigarm, the performance-based payments amounted to 69.4% of the contracted amount, actually exceeding the maximum possible payment. Given the low level of compliance at the end of the evaluation period, it can be concluded that deductions were not properly applied and did not result in lower payments to the contractors. This was especially the case for crack sealing and visibility of road markings, which had not been addressed since the start of the contracts and where calculated deductions had not led to payment deductions.

Part of the problem was that the contract with the consultants that had supported the design of the performance-based pilots ended 3 months after the start of the OPRCs. Because of the gradual introduction of deductions, the consultants could not support MOT staff in the application of deductions when this became necessary. As a result, the application of deductions has been poor. Even though the calculated deductions are reflected in the inspection reports, actual payments have remained close to 100%. The low deduction percentages, together with poor implementation of the deductions, have undermined the performance-based payment system in Tajikistan and have reduced the incentive for contractors to respond rapidly to existing defects.

According to the contract documents, failure to address identified noncompliances would result in increased deductions the following month, without any limitation. However, the contract documents do not stipulate exactly how this increase will take place. It may be assumed that the deduction percentage will be doubled in the second month, tripled in the third month, etc. This is a common approach applied in other countries, but it is not clear from the contract documents how the increased deduction is to be calculated in Tajikistan. The increased deductions do not appear to have been applied in any of the pilots. The contract documents also do not define a specific termination clause in case of continued failure to address identified noncompliances, as is common in other PBRM contracts.

A specific case in the Tajikistan pilots is winter maintenance. Performance standards are defined for 3 winter maintenance activities, together with relatively high deduction percentages of 7%–10% for each 1 km segment that is noncompliant. This deduction is made to the fixed monthly payment, while the payment for the winter maintenance activities is done separately from a provisional sum, with payments on a lump-sum basis according to the number of kilometers in which each activity is carried out (as approved in the work order). Initially, it was considered to make winter maintenance part of the performance-based component of the contract, but because of a lack of historical snowfall data, it was decided to base the payments on unit rates under a provisional sum and against work orders. The performance standards thus only serve as an incentive to the contractor to have sufficient equipment and staff in place to ensure that compliance with the requirements to remove snow and ice, and spread grit and salt have been met within the allowable time. Payment from the provisional sum for the work actually carried out does not appear to have been affected by the level of compliance with the performance standard. This can be very confusing and, in practice, the winter maintenance payments have not been applied as planned.

Although the contracted years had seen below-average snowfall, the use of the provisional sum for winter maintenance was close to estimated levels. In the Nurobod–Nimich contract, the payments for winter maintenance referred to the volumes of work approved in the work orders, although it appears that these approved volumes were on the high side, actually exceeding the planned amounts (71.5% expenditure after 66.7% of time). In the Vahdat–Obigarm contract, the payments for winter maintenance did not make any reference to work orders, and instead the average lump-sum amount per month was used for each monthly payment. Here, it appears that fixed monthly payments have been applied in the same way as for the performance-based routine maintenance. It is not clear whether the performance standards have been applied to these fixed monthly payments for winter maintenance, or whether these have only been applied to the performance-based payments.

Procurement and Contract Costs

The five pilot contracts were financed from government counterpart funding and were contracted using government procurement modalities. Although in Tajikistan routine and winter maintenance of public roads are carried out in-house through state-owned maintenance enterprises (GUSADs), the five PBRM contracts, including the three PBMCs that only included routine, winter, and emergency maintenance, were tendered to the private sector through open bidding. The contracts were for 3 years and could be extended for a further 3 years. All five contracts were awarded to domestic contractors.

All initial repairs and emergency works involve a defect liability period of 180 days. All payments included retentions of 5% of the payment amount, half of which was repaid upon completion of the works, and the other half after the defect liability period. Although this is clear for the initial repairs and emergency works, it is not clear how this was applied to the maintenance services, including winter maintenance, where there is no defect liability period.

A performance security of 3% over the entire contract amount was required for the full contract duration, including for winter maintenance and emergency works that are financed under provisional sums. The contracts stipulate that, in case of termination, 10% of the value of incomplete works will be charged to the contractor as liquidated damages for the additional cost of the employer for completing the works to the required standard. This appears to imply that 10% of the costs of maintenance activities required to bring the road to a standard complying with the performance standards will be charged to the contractor. This may be financed from the performance security or the retention payments, or the contractor may be required to pay this.

The bidding and contract documents appear to be based on ADB's standard bidding documents for small works, although they have been significantly modified. This includes modifications to the standard portions of the bidding documents such as the Instruction to Bidders and the General Conditions of Contract. Although this is allowed, it is not a preferred approach because bidders will need to carefully review all clauses to see how the changes may affect them. The changes can also be made to the Bid Data Sheet and the Particular Conditions of Contract that serve to modify and provide contract-specific information to, respectively, the Instruction to Bidders and the General Conditions of Contract. This would make the changes more visible and would make it easier for bidders to understand the ramifications.

The contract costs for the two OPRCs and two of the PBMCs are presented in Table 28, distinguished by type of activities. The first two pilot contracts had significantly larger contract amounts, despite involving slightly shorter road lengths. In part, this is because of the initial repairs that were included in the first two pilots, although these formed less than one-third of the total costs.

Table 28: Total Contract Costs
(TJS)

Activity	Nurobod–Nimich (73 km, 2013–2016)		Vahdat–Obigarm (76 km, 2013–2016)		Sayron–Karamyk (89 km, 2018–2021)		Vose–Khovaling (87 km, 2018–2021)	
Initial repairs	2,925,602	31%	1,533,416	16%	-	0%	-	0%
Routine maintenance	3,581,412	38%	3,447,360	37%	1,500,785	40%	1,899,209	60%
Winter maintenance	1,759,491	19%	2,355,696	25%	1,533,984	41%	850,290	27%
Emergency works	1,156,400	12%	1,975,580	21%	724,152	19%	400,631	13%
Total (TJS)	9,422,905	100%	9,312,052	100%	3,758,921	100%	3,150,130	100%
Total (\$)	\$1,979,602		\$1,956,313		\$427,150		\$357,970	

km = kilometer, TJS = somoni.

Sources: Contract documents.

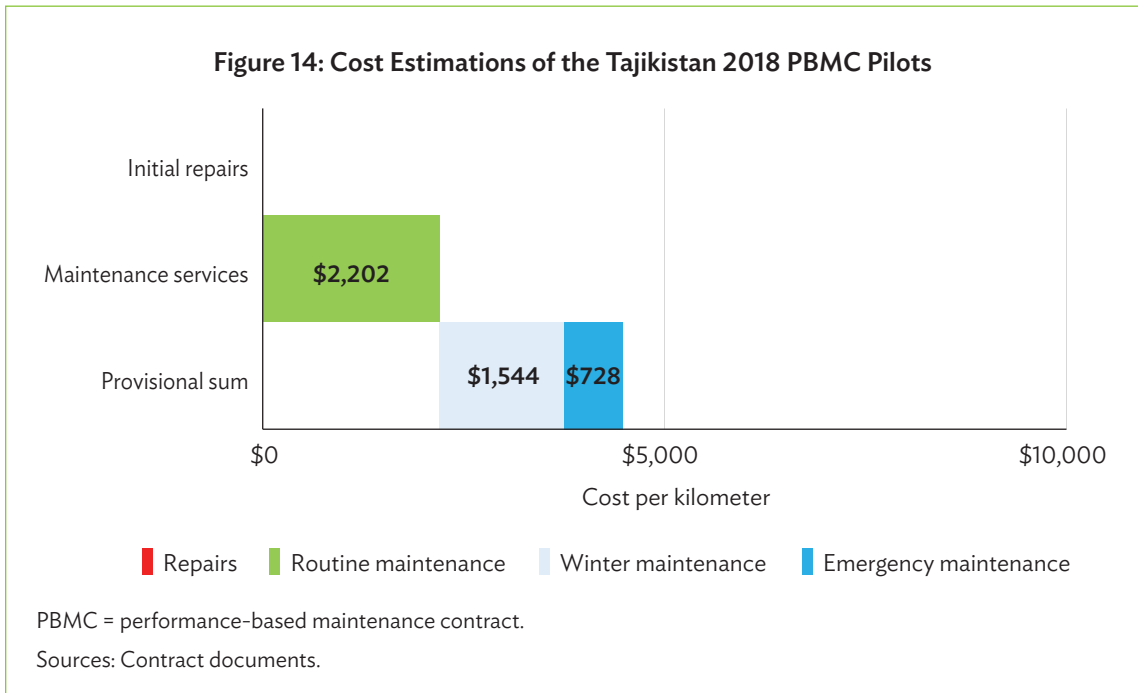
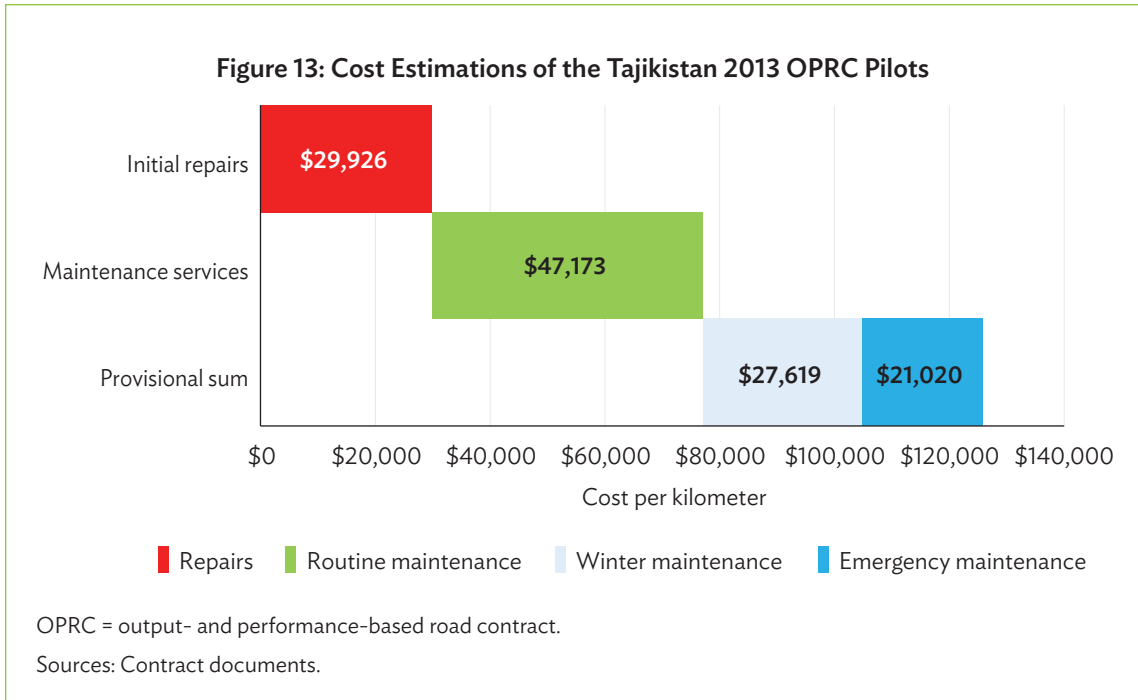
The difference becomes more evident when looking at the costs per kilometer per year (Table 29). For routine maintenance, winter maintenance, and emergency maintenance, the costs per kilometer per year went down significantly in the later contracts, forming slightly more than 20% of the costs in the earlier contracts. Again, this can be partly explained by the older road sections included under the

Table 29: Contracted Costs per Kilometer per Year
(\$)

Activity	Nurobod–Nimich (73 km, 2013–2016)		Vahdat–Obigarm (76 km, 2013–2016)		Sayron–Karamyk (89 km, 2018–2021)		Vose–Khovaling (87 km, 2018–2021)	
Initial repairs	\$2,806	31%	\$1,413	16%	-	0%	-	0%
Routine maintenance	\$3,436	38%	\$3,176	37%	\$641	40%	\$829	60%
Winter maintenance	\$1,688	19%	\$2,171	25%	\$655	41%	\$371	27%
Emergency works	\$1,109	12%	\$1,820	21%	\$309	19%	\$175	13%
Total	\$9,039	100%	\$8,580	100%	\$1,605	100%	\$1,375	100%

km = kilometer.

Sources: Contract documents.



contracts that required more routine maintenance and possibly emergency maintenance. For winter maintenance, it would appear that better data on snowfall allowed the estimated volumes to be reduced. The significant reduction in costs per kilometer per year also suggests that bidders had also become more familiar with the approach based on the first pilot, and were better able to assess the risks involved.

Apart from the initial repair costs, the costs for routine maintenance, winter maintenance, and emergency maintenance averaged \$6,700/km/year in the first 2 pilot contracts, reducing to just under \$1,500/km/year for the second 2 pilot contracts. The actual expenditure of the first 2 pilot contracts was lower in United States dollar terms because the exchange rate dropped from an initial rate of TJS4.8 per \$1 at the start of the first pilot contracts in July 2013 to TJS7.7 at the end of the contract in July 2016. The exchange rate impact was not as great for the second pilot contracts, with exchange rates dropping from TJS8.8 at contract signing in January 2018 to TJS11.3 in January 2021. The contracts did not include any price adjustments, and the risks of the devaluation lay completely with the contractors. Actual expenditure was also lower because some initial repairs, emergency works, and winter maintenance were not carried out, leaving some funds unused. Deductions applied to the payments for maintenance services that were not repaid in subsequent months became permanent, and further reduced expenditure compared to the contracted amount.

Of the total \$3.9 million contracted for the first 2 OPRCs under the CAREC Regional Road Corridor Improvement Project, in the end only \$0.8 million was spent according to the project completion report. The midterm review reported about 70% expenditure, and it is expected that the contracted amount will have been largely spent by the end of the contract. However, the devaluation of the somoni during the contract period meant that expenditure in United States dollar terms was significantly lower, although this does not appear to fully explain the very low expenditure reported. Under the CAREC Corridors 3 and 5 Enhancement Project, a total \$3.3 million was reported spent, despite the contracted amount only being \$0.8 million. Although this second pilot included a contract extension of the first two contracts, as well as a third unforeseen contract, this does not fully explain the much higher expenditure.

LESSONS

This final chapter looks at the lessons from the various PBRM contracts reviewed in this report. It compares several aspects of the different PBRMs and draws conclusions that may be used to improve on the PBRM experiences in the countries concerned, but that may also form the basis for piloting PBRMs in other countries.

Contract Scope

The PBRM contracts reviewed in this report are listed in Table 30, indicating the scope of works included under each contract. The contracts have been organized according to type of contract (SLA–PBMC–OPRC), the percentage of the road length receiving initial repairs (as indicated in one of the columns), and the duration of the contract. The contract scope is not just about deciding which activities will be included in the contract, but also about how each activity will be remunerated. A proper balance needs to be found between volume-based payments and performance-based payments, ensuring that the benefits of performance-based maintenance are achieved, while avoiding that the risks for the contractor become too high and lead to high bid prices and cancelled tenders. This also needs to determine whether the activities are best financed under the contract amount or through a provisional sum. This section will look at the types of PBRMs that have been used, the main activities included under PBRM contracts, and how the payment for these activities is best addressed; and finally the duration of the PBRM contracts and the length of road included.

Table 30: PBRM Contracts and Scope of Works

Country	Pilot Section	Length	Years	Years	Type	%IR	RH	PM	RM	WM	EM	Status
KGZ	Osh–Batken–Isfana	407 km	2014–2015	1	SLA	-	-	-	PB	PB	VB ^a	Completed
AZE	M2 Baku–Yevlach	264 km	2019–2021	2	SLA	-	-	-	PB	PB	VB ^a	Completed
AZE	M2 Yevlach–Georgia	229 km	2019–2021	2	SLA	-	-	-	PB	PB	VB ^a	Completed
AZE	M4 Baku–Yevlach	253 km	2019–2021	2	SLA	-	-	-	PB	PB	VB ^a	Completed
PRC	Yunnan G320, S324	107 km	2016–2020	3	SLA	-	-	-	PB	-	VB ^a	Completed
TAJ	Khovaling–Kangurt	43 km	2020–2023	3	PBMC	-	-	-	PB	VB ^a	VB ^a	Ongoing

continued on next page

Table 30 *continued*

Country	Pilot Section	Length	Years	Years	Type	%IR	RH	PM	RM	WM	EM	Status	
TAJ	Vose–Khovaling	87 km	2018–2021	4	PBMC	-	-	-	PB	VB ^a	VB ^a	Completed	
TAJ	Sayron–Karamyk	89 km	2018–2021	4	PBMC	-	-	-	PB	VB ^a	VB ^a	Completed	
TAJ	Vahdat–Obigarm	76 km	2013–2016	3	OPRC	5%	-	VB	PB	VB ^a	VB ^a	Completed	
TAJ	Nurobod–Nimich	73 km	2013–2016	3	OPRC	5%	-	VB	PB	VB ^a	VB ^a	Completed	
GEO	Mtskheta–Mtianeti	142 km	2020–2026	5	OPRC	14%	VB	-	PB	PB	VB ^a	Cancelled	
KGZ	Karabalta–Sussamyr	69 km	2018–2020	3	OPRC	25%	VB	VB	PB	VB ^a	PB	VB ^a	Completed
GEO	Guria	240 km	2020–2026	5	OPRC	28%	VB	VB	PB	PB	VB ^a	Cancelled	
GEO	Kakheti	117 km	2016–2021	5	OPRC	32%	VB	(PB)	PB	PB	VB ^a	Completed	
PRC	Anhui G206, S233, S246	63 km	2021–2026	2+3	OPRC	100%	VB	-	PB	VB ^a	VB ^a	Ongoing	
PRC	Yunnan G323	57 km	2015–2020	1+4	OPRC	100%	VB	VB	PB	-	VB ^a	Completed	
PRC	Anhui G205	89 km	2020–2025	2+3	OPRC	100%	VB	-	PB	VB ^a	VB ^a	Ongoing	
PRC	Anhui S215, G233	65 km	2021–2026	2+3	OPRC	100%	VB	-	PB	VB ^a	VB ^a	Ongoing	
MON	Ulaanbaatar–Arvaikheer	58 km	2021–2026	2+3	OPRC	100%	VB	-	PB	PB	VB ^a	Completed	
PRC	Anhui G312, S210, S213	65 km	2021–2026	2+3	OPRC	100%	VB	-	PB	VB ^a	VB ^a	Ongoing	
PRC	Anhui S303, S229	81 km	2021–2026	2+3	OPRC	100%	VB	-	PB	VB ^a	VB ^a	Ongoing	
PRC	Anhui S601	125 km	2021–2026	2+3	OPRC	100%	VB	-	PB	VB ^a	VB ^a	Ongoing	
KGZ	Balykchy–Kochkor	43 km	2020–2027	2+5	OPRC	100%	VB	PB	PB	PB	VB ^a	Ongoing	
KGZ	Kochkor–Epkın	27 km	2020–2027	2+5	OPRC	100%	VB	PB	PB	PB	VB ^a	Ongoing	

Initial repairs
 Maintenance services
 Provisional sum

%IR = percentage of road length receiving initial repairs, AZE = Azerbaijan, GEO = Georgia, KGZ = Kyrgyz Republic, km = kilometer, MON = Mongolia, OPRC = output- and performance-based road contract, PB = performance-based, PBMC = performance-based maintenance contract, PBRM = performance-based road maintenance, PM = periodic maintenance, PRC = People's Republic of China, RH = rehabilitation, RM = routine maintenance, SLA = service level agreement, TAJ = Tajikistan, VB = volume-based, WM = winter maintenance.

^a Carried out under a provisional sum.

Source: Consultant's processing of data.

Performance-based maintenance contract. PBMCs are the most basic of PBRM contracts, focusing only on the performance-based component and excluding (significant) initial repairs that are paid on a volume basis as is the case with OPRCs. PBMCs tend to be limited to routine maintenance, current repairs, and winter maintenance, complemented by a provisional sum for emergency maintenance. Because no initial repairs are included, the duration tends to be shorter than with OPRCs since the contractor cannot be certain of the quality of the pavement, and because the pavement is already a bit older. Contract durations for PBMCs are often 3–5 years. PBMCs can be applied in a large part of the road network that is in good-to-fair condition and that only requires routine maintenance and current repairs to avoid accelerated deterioration of the road and especially of the pavement. Winter maintenance is included where relevant, either on a performance basis or (partly) as a provisional sum.

More attention should be given to piloting PBMCs, focusing on routine maintenance, current repairs, and winter maintenance.

Although routine maintenance, current repair, and winter maintenance are carried out every year and are the most common maintenance types, PBMCs are not very common. Under the reviewed experiences, only Tajikistan implemented PBMCs. This included three PBMCs without initial repairs, as well as two OPRCs with very limited initial repairs (less than 5% of the road length) that have a high degree of similarity with PBMCs. It is not clear why the number of PBMCs is so limited, as one would expect this type of contract to be more common than OPRCs that are only applied if the road is in fair-to-poor condition and (significant) initial repairs are required. It is likely that the reason lies in the financing of these pilots, since governments are reluctant or unable to borrow money from development partners to finance routine maintenance, current repair, and winter maintenance. In some cases, even periodic maintenance (midterm repair) cannot be financed through development partner loans. As a result, contracts that consist only of these activities are not generally approved for development partner financing. Even the Tajikistan PBMCs were fully financed by the government for this reason. Because the long-term maintenance of the road network cannot depend only on OPRCs that include (significant) initial repairs, it is recommended to give more attention to piloting PBMCs to complement the OPRCs. Such PBMCs also provide a greater opportunity to involve domestic contractors than the OPRCs that tend to be beyond the capacity of most domestic contractors because of the scope of the initial repairs.

Service level agreement. SLAs are a particular form of PBMCs. They too focus on performance-based routine maintenance and current repairs, often including winter maintenance either on a performance basis or under a provisional sum. However, SLAs are not tendered competitively, but are instead directly awarded and negotiated with the state-owned maintenance entities that are traditionally responsible for the maintenance of the roads concerned. As such, they tend to be fully financed by government, although provision of equipment to these entities may be financed by development partners). Initial repairs are not included, or only to a very limited degree in line with the capacities and responsibilities of these maintenance entities. SLAs are especially relevant in the CAREC region because many CAREC member countries carry out the routine maintenance, current repairs, and winter maintenance through state-owned maintenance entities. This includes Azerbaijan, the PRC, Kazakhstan, the Kyrgyz Republic, Mongolia, Tajikistan, Turkmenistan, and Uzbekistan. Only Afghanistan³, Georgia, and Pakistan carry out all road maintenance through competitive bidding with the private sector. In countries with state-owned maintenance entities, the introduction of PBRM contracts that are tendered competitively can form a problem. Often, the state-owned maintenance entities are not eligible to participate under the development partner procurement procedures. Where a different contractor is awarded the contract,

³ ADB placed on hold its regular assistance in Afghanistan effective 15 August 2021.

this forms a problem for the maintenance entity that is traditionally responsible for the road concerned because it loses part of its work volume, with implications for staffing, equipment use, maintenance stations, funding, etc.

The SLAs form a suitable alternative to the PBMCs, allowing the benefits of performance-based payments to be achieved while avoiding issues in directly opening the contracts up to competition from the private sector. The SLAs also allow commercial principles, as well as a more contractual relationship between the maintenance entities and the agency or ministry responsible for roads, to be introduced. This can form the basis for gradual institutional reform of the road sector, possibly leading to the corporatization of the maintenance entities and in the longer term maybe even privatization. Some countries are already moving in this direction, with Kazakhstan corporatizing all its maintenance entities into a single state-owned company, recently followed by the Kyrgyz Republic. Uzbekistan has corporatized and privatized many of its construction enterprises, and is considering how to deal with its maintenance enterprises. The move toward corporatization and opening up the maintenance contracts to competition is a difficult one. Before fully opening up to competition, it is important that the relationship between the maintenance enterprises and the entity responsible for road management is first commercialized, followed by a gradual opening up to competition, thus allowing these enterprises to become familiar with commercial contracts, bidding, and competition. The experience with SLAs has been limited to Azerbaijan, the PRC, and the Kyrgyz Republic. The experiences have not been very well documented and have not always been successful because of problems in design or implementation. It is recommended to pay more attention to SLAs as a means of introducing PBRMs in countries where road maintenance is traditionally carried out through state-owned maintenance entities. This may also form a first step toward commercialization and possible institutional reform.

SLAs provide an opportunity to introduce commercial principles in the relationship with state-owned road maintenance entities.

Output- and performance-based road contract. OPRCs are the most common type of PBRMs reviewed in this report. They combine volume-based initial repairs with a subsequent period of performance-based maintenance services involving routine maintenance and current repairs. Winter maintenance is included under the performance-based maintenance services or financed under a provisional sum. In the OPRCs, the contractor has an incentive to ensure that good quality initial repairs are carried out because this will reduce the amount of maintenance to be subsequently carried out, resulting in decreased costs and increased profits. Although this is true, it depends on the nature of the initial repairs and the duration of the performance-based maintenance. The reviewed contracts include 16 OPRCs, of which 6 contracts involve initial repairs of only part of the road length (5%–32%) and the remaining 10 contracts include full rehabilitation of the entire road length. In the OPRCs with only partial initial repairs, the maintenance services are required from the start of the contract, at least for those road sections that do not receive initial repairs. In the OPRCs with full rehabilitation, the maintenance services are only started after the rehabilitation works have been completed. In these contracts, the duration of the maintenance services is shorter than the total contract duration.

If full rehabilitation is carried out for the entire road length, followed by 3 years of performance-based maintenance services,⁴ the incentive for the contractor to ensure high quality of the rehabilitation works will be limited since maintenance requirements in the first 3 years will be minimal. If the initial repairs

⁴ Note that the maintenance service period is different from the DNP. Under the DNP, the contractor is only responsible for repairing defects caused by poor construction, not for defects caused by poor maintenance or emergency events.

OPRCs require a proper balance between the scope of initial repairs and the duration of the subsequent performance-based maintenance services.

are constricted to simple seals or only a portion of the road length, or if the duration of the performance-based maintenance services is extended to 5 years or even more, then this effect becomes more pronounced. On the other hand, if the duration of the maintenance services is very long and the initial repairs are limited, the risk of having to carry out a large volume of current repairs will increase and lead to high costs. In OPRCs, it is important to properly balance the scope of the initial repairs with the duration of the performance-based maintenance services. This has not always been successfully done in the reviewed OPRCs. Most OPRCs have a duration of 5 years, but the first 2 years involve full rehabilitation and periodic maintenance works, leaving only 3 years of performance-based maintenance services. Such a short duration of maintenance services after extensive initial repairs is not long enough to show the benefits of performance-based maintenance and is more similar to an extended defects liability period. It may even result in higher costs than traditional contracting approaches since the contractor needs to cost for the risks related to weather and unforeseen events. For OPRCs involving extensive initial repairs, the duration of the maintenance services after completion of the initial repairs should initially be 5 years. The duration may later be extended as more experience exists with the approach. The 2020 OPRCs in the Kyrgyz Republic are an example, including 2 years to complete full rehabilitation, followed by 5 years of performance-based maintenance services.

OPRCs involving initial repairs of only a portion of the road length require a differentiated approach to the start of the maintenance services.

A further complication with OPRCs exists when the initial repairs only cover certain portions of the contracted road length. For the portions receiving initial repairs, the contract will be a real OPRC, while for the other portions that do not receive initial repairs, the contract will be more like a PBMC. The total duration of the performance-based maintenance is often the same for the entire contract, meaning that the duration is either too short for those segments receiving intensive initial repairs, or too long for those segments not receiving initial repairs. Examples are the OPRCs in Tajikistan that included only very limited initial repairs (5% of the road length) and a contract duration of only 3 years, and the OPRCs in Georgia where the coverage of the initial repairs varied from 14% to 32% of the road length, and the contract duration was set at 5 years. The initial repairs will require time to complete, during which the maintenance services will not be carried out yet (or only to a limited extent), while for those segments without initial repairs the maintenance services will start immediately. For example, a road with rehabilitation of 50% of the length during the first 2 years and a total 5-year duration implies only 3 years of maintenance services for the rehabilitated segments, which is very short. At the same time, the segments not receiving initial repairs will be subject to 5 years of maintenance services, which may be considered long (although this depends on the initial road condition). This balancing of the differing needs has been shown to be an issue in the reviewed PBRM contracts. Some contracts let the maintenance services start immediately for all road segments in an attempt to motivate the contractor to quickly complete the initial repairs, although this results in significant deductions to the payments for maintenance services as long as the initial repairs are not completed. Other contracts have the maintenance services start only after the initial repairs are completed, although this jeopardizes the maintenance of those segments that do not receive initial repairs. This requires a differentiated approach, where the maintenance services start immediately in certain road segments, and start later in other road segments. This needs to be properly reflected in the contract, including a description how the inspections and deductions will be applied to the different segments.

Rehabilitation (capital repair). Where rehabilitation of part or all of the contracted road length was included under so-called OPRCs, this was carried out as part of the initial repairs at the start of the contract and paid on a volume basis. The volume of work required can be determined with relatively high accuracy

based on the existing road conditions at the start of the contract, making this type of work suitable for volume-based payments. The advantage of combining volume-based rehabilitation with the performance-based maintenance is that the contractor then has an incentive to ensure high-quality work to reduce future maintenance needs. However, this is only the case with longer durations of performance-based maintenance after completion of the rehabilitation works (5 years or more), and shorter durations should be avoided if rehabilitation works are carried out. The volume-based payment may either be on the basis of unit rates as defined in a bill of quantities, or according to lump sums per kilometer of road completed in line with agreed standards. The OPRC experiences in the CAREC region suggest that a payment based on unit rates is preferred to keep good control over the construction quality.

If rehabilitation is included in the OPRC, it should be paid on a volume basis according to unit rates, and should be followed by at least 5 years of performance-based maintenance services.

Periodic maintenance (midterm repair). Periodic maintenance of part or all of the contracted road length can be carried out at the start of the contract, but can be alternatively planned during the course of the contract. Where this was carried out at the start of the contract in the reviewed contracts, this was paid on a volume basis since the volumes of work can be accurately determined based on existing road conditions. A few contracts included periodic maintenance during contract implementation under the performance-based payments, but this approach was not found to be very satisfactory and, in Georgia, was later changed to volume-based payments under a provisional sum. Inclusion of periodic maintenance under the performance-based component of the contract is not recommended because this significantly increases the risk for the contractor and will lead to higher bid prices, regardless of whether the periodic maintenance is carried out or not. If the periodic maintenance is included under a provisional sum with volume-based payments against a work order, this reduces the risk for the contractor, while still allowing periodic maintenance to be carried out under the same contract. The volume-based payment may be either on the basis of unit rates or according to lump sums per kilometer. The OPRC experiences in the CAREC region suggest that, for periodic maintenance, the payment according to lump sums per kilometer is acceptable and easier to apply.

If periodic maintenance is included, it should be paid on a volume basis according to lump sums per kilometer. Periodic maintenance in later years should be under a provisional sum.

Routine maintenance and current repair. Routine maintenance and current repairs to the pavement and structures form the basis of PBRMs and were included under the performance-based component of all the reviewed PBRM contracts, including OPRCs, PBMCs, and SLAs. Only in the 2017 OPRC in the Kyrgyz Republic was current repair included under a provisional sum with volume-based payments, but this was changed to performance-based payments in later contracts. Although the exact volumes of different activities each year cannot be predicted with very high accuracy, the overall costs can be predicted quite well, making it suitable for performance-based payments. For older pavements, it may be necessary to limit the responsibilities of the contractor by including a provisional sum for periodic maintenance (pavement renewals).

Routine maintenance and current repairs should be paid on a performance basis.

Winter maintenance. Winter maintenance can be harder to predict because the amount of snowfall and temperatures can vary significantly from 1 year to the next. However, with longer contract durations, these effects tend to average out, and inclusion in the performance-based portion of the contract is possible. In the reviewed contracts, there are two approaches used, with just over half the contracts including volume-based payments for winter maintenance under a provisional sum, while the other contracts involved performance-based payments for winter maintenance. Although it is preferable to include winter maintenance in the performance-based component of the contract, in cases where

Winter maintenance may be paid on a performance basis or under a provisional sum on a volume basis. A combination is recommended to achieve the benefits of performance-based maintenance while, at the same time, limiting the risk for the contractor.

little information is available on snowfall and temperatures, or where PBRMs are only just being introduced, it is an option instead to include some of the winter maintenance activities under a volume-based provisional sum as has been the case in several CAREC countries. Where winter maintenance is included under performance-based payments, the risk to the contractor of severe or extended snowfall and low temperatures should be reduced by limiting the responsibility in such cases and allowing such extreme events to be addressed through emergency maintenance.

Emergency maintenance. All reviewed contracts included a provisional sum for emergency maintenance, with payments made on a volume basis according to unit rates. This approach has been proven to work well and should be continued. This approach ensures a rapid response to the emergency event because it does not require new procurement, only a work order. Further, it makes the same contractor responsible for all maintenance in the road concerned thus avoiding disputes that may arise if different

contractors are involved. It also limits the risk for the contractor of extreme events, leading to lower bid prices and costs. This requires a clear definition of thresholds for the provisional sum for emergency maintenance to be applied, below which the contractor will be responsible for addressing any damages as part of the performance-based maintenance services. Examples of such thresholds as applied in the reviewed contracts are in Table 31, showing large differences. It is important that these thresholds are not set too low because this will result in the frequent use of the provisional sum. But thresholds should also not be set too high because this will imply large risks for the contractor and lead to higher bid prices. The emergency maintenance may also be expanded to include some other repairs and extreme winter weather events, further limiting the risks for the contractor.

Emergency maintenance should be paid on a volume basis under a provisional sum.

Table 31: Thresholds for Use of the Provisional Sum for Emergency Maintenance

Damage to Road	PRC 2015	KGZ 2017	KGZ 2020	TAJ 2013+2018
Slides of material onto the road	200 m ³	300 m ³	1,000 m ³	3,000 m ³
Damaged pipe culvert	1	1 per 5 km	1	1
Damaged wing walls	1			
Damaged railing including rail post	10 m	-	25 m	
Damaged asphalt concrete	500 m ²	20 m ³	4 m ³	4 m ³
Damaged base course	50 m ³	50 m ³	20 m ³	20 m ³
Damaged cement concrete	5 m ³	5 m ³	10 m ³	10 m ³
Damaged embankment	100 m ³	300 m ³	200 m ³	200 m ³

KGZ = Kyrgyz Republic, km = kilometer, m = meter, m² = square meter, m³ = cubic meter, PRC = People's Republic of China, TAJ = Tajikistan.

Sources: Contract documents.

Bridge maintenance. Bridge maintenance is often omitted from PBRM contracts. Where it is included, it is often included as part of the overall routine maintenance of the road. However, the specific nature of bridge maintenance deserves a separate performance-based payment for routine bridge maintenance activities. This makes it easier to adjust the inspections and payments according to the number of bridges in a contracted road section, and allows it to be used in parallel with the traditional approach for performance-based maintenance based on 1 km segments. The scope should be limited to routine maintenance and a limited volume of repairs, with more comprehensive repairs to be paid on a volume basis under a provisional sum (possibly combined with emergency maintenance).

Bridge maintenance should be included under a separate performance-based payment.

Contract duration. Another important aspect to take into consideration when designing a PBRM contract is the contract duration. This should not be too long because this increases the risks to the contractor and leads to high bid prices, but it should also not be so short that the benefits of performance-based contracting are not achieved. Especially where new pavements are involved or large volumes of initial repairs are included in the contract, the duration should not be too short. In such cases, the volume of routine maintenance will likely be limited, but the contractor will still need to price for the eventuality of defects occurring, leading to higher costs than traditional contracts where this risk lies with the client. If the contract duration is extended, the volume of routine maintenance needs will increase, and the risk factor plays a smaller role. For older pavements and contracts without significant initial repairs, the duration of the performance-based maintenance should be between 3 years and 5 years. In contracts involving new pavements or significant initial repairs, the duration should be longer, between 5 years and 10 years. In the reviewed experiences, the average duration of the SLAs was 2 years, ranging from 1 year to 3 years. The few PBMC experiences in Tajikistan had durations of 3 years, with some contracts extended for an additional fourth year. The reviewed OPRCs had an average duration of just under 5 years, but this included the time used for the initial repairs, effectively reducing the period of performance-based maintenance to only 3 years or 4 years. Especially if extensive initial repairs are included, this is considered to be too short. The latest OPRCs in the Kyrgyz Republic include a dedicated period of 5 years for performance-based maintenance, which starts only after the completion of the initial repairs (carried out during the first 2 years). PBRM contracts should always include the option to extend the maintenance services if both contractor and employer agree.

The duration of the performance-based maintenance will depend on the pavement condition at the start of the contract, as well as the degree of initial repairs included in the contract, and may range from 3 years to 10 years.

Road length. The road length included in the contract, together with the volume of initial repairs, to a large extent, will determine the size of the contract. In turn, this will determine whether domestic contractors have the capacity to bid for and implement the contract. Although it is possible to involve international contractors in the implementation of PBRM contracts, for the performance-based components of these contracts, it is preferable to involve domestic contractors to ensure that capacities and experience remain in the country for future contracts. This means that the road length should not be too large, especially if significant initial repairs are planned because this will effectively exclude the domestic contractors from being eligible to bid. The experiences in the CAREC region show relatively long lengths for the SLAs signed with existing state-owned maintenance entities, averaging more than 250 km per agreement (and reaching more than 400 km in the Kyrgyz Republic). The size of these agreements is mainly determined by the length of roads that these entities are already responsible for, and the scope of works excludes significant initial repairs. In the case of the OPRCs and

The contract packaging and the length of roads to be included should take account of existing capacities and interest in the (domestic) construction industry.

PBMCs, the average is just under 100 km, ranging from slightly more than 27 km to 240 km. The very short road lengths may not attract contractors with the required capacities, while very large road lengths may introduce unacceptable risks and will quickly be beyond the capacity of domestic contractors. The tender of two short road sections in Mongolia failed, while a single contract of the two road sections was later awarded successfully to an international contractor. In Georgia, the tendering of a very large road length also failed because of very high bid prices. A proper market analysis of the domestic and international contracting industry is recommended before a decision is made on the packaging of the contracts and the length of roads to be included under each contract.

Performance Standards

Changes to the performance standards should be kept to a minimum to allow contractors to familiarize themselves.

The review of the PBRM contracts shows a wide variety in performance standards being used. Only in the case of the 2016 OPRC in Georgia and the 2020 OPRC in the Kyrgyz Republic do we see that, largely, the same performance standards have been used with only minor changes to thresholds. Even within a single country, the performance standards tend to change from one project to the next. The exception is Tajikistan, where the same performance standards have been used in all five contracts in both projects. The constant changes to the performance standards in different countries and projects does not necessarily involve improvements and tweaking of existing standards, but appears

to be the result of different consultants with different previous experiences with PBRM contracts, bringing examples with them from other countries. The constant changes to the performance standards make it very difficult for contractors to bid for such contractors because, for each new contract, they will have to estimate the costs and risks involved to prepare their bid prices. A degree of consistency in the performance standards being used is recommended. For this reason, this report includes in the appendixes the performance standards applied in the different contracts reviewed so that these may be used as the basis for future contracts.

Having said that, this does not mean that the performance standards should remain unchanged. Most of the performance standards reviewed in this report have aspects that need to be improved. However, this can be done by addressing individual performance standards and amending the indicator or threshold, without completely changing the approach. Each performance standard should consist of an indicator that defines what is to be assessed, and a threshold that indicates the boundary of compliance. As mentioned at the start of this report, it is important that the performance standards are SMART. Each performance standard should be (i) “Specific,” clearly defining what will be assessed; (ii) “Measurable,” allowing an objective assessment to be carried out; (iii) “Achievable,” resulting in satisfactory road conditions at an acceptable cost; (iv) “Relevant,” contributing to the improvement of road conditions if complied with; and (v) “Time-bound,” indicating clear time frames by which compliance is required.

Each performance standard should be checked to verify that it is specific, measurable, achievable, relevant, and time-bound, amending it where necessary.

In its appendixes, this report includes a collection of performance standards as used in the different countries and contracts. These may form the basis for new contracts and changes to existing contracts, allowing different performance standards for similar defects to be compared and the best one to be selected. In drawing up the performance standards, each standard should be reviewed to determine whether it is indeed SMART. Where this is found not to be the case, it should be amended or replaced by a different performance standard.

One important note is regarding the preparation of reports and plans at the start of the contract and on a regular (monthly) basis, as well as the collection of inventory, condition, and traffic data on a regular basis. These are management activities that the contractor often needs to carry out as part of the contract. However, in many contracts these activities have not been linked to performance standards, making them difficult to enforce. Including specific performance standards for road management allows deductions to be applied in case of noncompliance.

Inspections

The system of inspections applied in the different PBRM contracts is largely the same. Most contracts include formal monthly inspections, as well as informal inspections carried out at any time. The main difference between the contracts is how these formal and informal inspections contribute to the deductions applied to the monthly payments in case of noncompliance. Some contracts are very rigid and only apply deductions based on the formal monthly inspections, while informal inspections only serve to inform the contractor of existing defects. Other contracts are very flexible and apply deductions based on informal inspections carried out at any time during the month. The preferred approach applied in most contracts is to include certain performance standards that are subject to deductions based on formal inspections, and others that are subject to deductions based on informal inspections. However, this difference is not always clearly defined in the contracts concerned, and this needs to be improved.

Performance standards that depend on informal inspections generally involve defects that occur suddenly and that have a severe impact on trafficability or safety. Examples are the road usability standards that are related to road blockages, missing or damaged guardrails and parapets that form a safety hazard, or snow and ice that limit the trafficability or pose a safety hazard. In these cases, the objective is to remove the obstacle or the safety hazard in a short period of time, making the formal monthly inspections less suitable. In these cases, informal inspections need to form the basis for assessment of compliance and possible deductions. Since the objective is to address these defects within a short period, the performance standard should also define a reaction time within which this should be achieved. The informal inspections will include a first inspection where the defect is identified, as well as a second inspection to verify whether the defect has been properly addressed within the allocated reaction time.

Informal inspections are required for those defects that occur suddenly and that need to be corrected within a defined reaction time after the threshold has been exceeded.

The formal inspections will still be required for those performance standards that do not involve defects that occur suddenly. For instance, for potholes that gradually increase in size and number, or for vegetation that grows in length, the contractor is able to address the defects before these exceed the threshold and result in a noncompliance with the performance standard. For such performance standards, the monthly formal inspections are well suited to determine if there are any noncompliances.

Monthly formal inspections are required for those defects that occur gradually and can be corrected before the threshold is exceeded.

The inspections in PBRM contracts should continue to include both formal and informal inspections, both of which may lead to deductions to the monthly payment. Each type of inspection should be linked to specific performance standards. Most performance standards will be assessed during the formal inspections, at which time any noncompliances will be identified and may

lead to deductions being applied. For these performance standards, the informal inspections will not have an impact on deductions, and will only serve to inform the contractor of any defects. A limited set of performance standards linked to defects that occur suddenly and that have significant impacts on trafficability and safety may be assessed during informal inspections. These performance standards should include clear reaction times as part of the indicator and threshold, and it is this reaction time and the subsequent condition of the defect that will be assessed. For these performance standards, the deductions may be applied as a result of informal inspections. This approach is already applied in several of the contracts reviewed, although the type of inspection is not always clearly defined, and the performance standards are not always included in the right group. The performance standards linked to informal inspections also often lack reaction times, making it difficult to assess them properly.

Hotlines should be established to allow road users to report defects.

In ensuring compliance with the performance standards, the involvement of road users can also be very useful. This involves the establishment of a hotline where road users can report any defects or other problems. The contractor should be required to set up such a hotline, and to inform road users through signs at regular intervals (every 10 km–20 km). The contractor should be required to record all reported defects, as well as the time when the defect has been reported and when it has been corrected. Such hotlines may potentially lead to deductions in the case of performance standards linked to informal inspections. At the very least, the recorded defects should be made available to the employer to verify whether they have been successfully addressed.

Response Times and Reaction Times

As explained at the start of this report, a distinction should be made between response times that define the time allocated to the contractor to correct any noncompliances identified during the monthly formal inspection before the applicable deduction becomes permanent, and reaction times that define the time allocated to the contractor to correct any identified or reported noncompliances before an immediate deduction is applied.

Response times should be removed for defects that occur gradually, and deductions should be applied immediately.

Many PBRM contracts include response times for the different performance standards. However, for many performance standards, response times are not relevant as the defect evolves gradually and the contractor is able to address it before it exceeds the threshold. The defined threshold is not an intervention threshold, and the intervention should take place before the threshold is exceeded. A noncompliance identified during a formal inspection implies a failure on the part of the contractor to address the defect in time, and should result in an immediate deduction. If the performance standard defines the maximum size or number of potholes, the contractor should start patching the potholes before this maximum size or number is exceeded. If the formal inspection ascertains that it is exceeded, it means the contractor did not take the opportunity to patch the potholes before the threshold was exceeded and should receive an immediate deduction. The use of response times for such defects has been shown to result in situations where contractors do not carry out any maintenance until the formal inspection, and then only address the identified noncompliances, making use of the response times to do so without penalty. This undermines the concept of PBRM contracts where the contractor is supposed to be responsible for monitoring road conditions and planning maintenance activities, taking over part of the management burden from the employer and ensuring a timely response to defects. The response times also require

follow-up inspections to check compliance, increasing the management burden. For such performance standards, this report strongly recommends the removal of response times, and the application of immediate deductions in case of noncompliances that are identified during monthly formal inspections. In Georgia, there has been an attempt to apply this approach, although the tender was not successful and the performance could not be assessed. In Mongolia, the contractor was required to correct any defects before the formal inspection. Although the contract included response times, these were used to ensure that all defects were addressed during the contract, even where these did not exceed the allowable threshold.

A different situation exists for performance standards linked to defects that occur suddenly or that have very low thresholds that can be suddenly exceeded. Here, it is not possible for the contractor to anticipate when the defect will exceed the allowable threshold, and the contractor will only be able to address the defect once the threshold has been exceeded. In these cases, it is necessary to provide time to the contractor to react and correct the defect. This reaction time should form part of the performance standard because the performance of the contractor will be assessed both on the basis of the resulting condition of the road and the time required to correct the defect. These reaction times will be especially relevant for defects that occur suddenly and that have a significant impact on trafficability or safety of the road. This will only involve a limited number of performance standards (e.g., road blockages, landslides, damaged or missing safety measures, snowfall, and ice). The reaction times will range from several hours to several days. This means that the formal inspections that occur every month are not suitable for assessing compliance, and that the compliance should be assessed through informal inspections (and possibly hotlines) as mentioned earlier. The reaction time will start from the first moment that the defect is identified (by the contractor, employer, or road users) and reported to the contractor. The inspection will verify that the defect is corrected within the allocated reaction time. If this is not the case, an immediate deduction should be applied (and repeated in case of continued failure to correct the defect). In this case too, the response times are not relevant and should be removed and replaced by reaction times that form part of the performance standard.

For defects that occur suddenly, reaction times should be used instead of response times, and these should form part of the performance standard.

Payments and Deductions

Most reviewed PBRM contracts apply the common approach to payments and deductions as described at the start of this report. Inspections are carried out for each 1 km segment, which is determined to be either compliant or noncompliant for each performance standard. In case of noncompliance with a performance standard for a particular 1 km segment, the deduction percentage defined for the performance standard concerned is multiplied by the monthly payment per kilometer (fixed monthly payment divided by the contracted road length) to calculate the deduction amount for that 1 km segment. This has the advantage that the deduction amounts in monetary terms are independent of the contracted road length, and only depend on the average cost per kilometer and the deduction percentage. The same deduction percentages can be applied in different contracts and in roads of different lengths, allowing a standardized approach to be applied across the country. A couple of different service levels with differing performance standards and deduction percentages may be defined that can be applied to different road classes.

Deductions should be applied by 1 km segment rather than the entire contracted road length.

The common approach for calculating the deduction amount is to multiply the deduction percentage of any noncompliant performance standards by the length of the segment (generally 1 km except for the end segments) to calculate the deduction length. The deduction lengths for all performance standards and all 1 km segments are added together to calculate the total deduction length, which in turn is multiplied by the monthly payment per kilometer to calculate the total deduction amount. Although this approach is acceptable, it would be preferable to directly multiply the deduction percentage by the monthly payment per kilometer, making the process more transparent and easier to understand. What should especially be avoided is the use of the term “compliant length,” which is defined as the total contracted road length minus the deduction length. Multiplication of this “compliant length” by the monthly payment per kilometer results in the amount payable to the contractor in a given month (equivalent to the fixed monthly payment minus the deduction amount). The term “compliant length” is often confused with the length of road that is compliant, whereas the “compliant length,” in fact, is considerably longer, implying a better performance. This is because the deduction length is not equivalent to the length of road that is noncompliant, and is instead equal to the length of noncompliant road multiplied by one or more deduction percentages. Generally, the deduction length is shorter than the noncompliant length. The term “compliant length” should be avoided or, alternatively, replaced by the term “payment length” that better reflects what that length represents.

Although most deductions are calculated for each 1 km segment, this is not the case for all performance standards. Some performance standards are not easy to link to a specific 1 km segment or have implications beyond the 1 km segment where they are located. For instance, road usability standards related to blockages in the road have an effect beyond the 1 km segment of the blockage and, as a result, the deduction percentages are often applied to the monthly payment for the entire contracted road length. Performance standards related to management activities, such as reports, compliance with plans, or collection of inventory and traffic data, cannot be directly linked to any specific 1 km segment and are also applied to the full monthly payment. This introduces a complication however, since the contracted road lengths are not always the same. Longer roads will, in general, be more likely to have noncompliances such as blockages. At the same time, the monthly payment for longer roads will also tend to be higher. This means that there is a greater risk of deductions and that the applied deduction percentages will also result in higher deduction amounts. This penalizes contractors with longer road lengths. It also means that the deduction amount will be different if a road is packaged as one contract, or as two separate contracts, even if the total contract amount and the cost per kilometer are the same. However, applying an approach based on 1 km segments as described above is not straightforward for such performance standards. The recommended solution to this problem is to apply monetary values to the deductions instead of using deduction percentages. This is already applied in the 2016 OPRC in Georgia in the case of MPMs as shown in Appendix 4. This avoids any effect of the length of the road on the deduction amount, and also clarifies the implications of any noncompliance in monetary terms.

This approach should actually be considered for all performance standards. The review of the different PBRM contracts and their application of deductions has shown that the use of deduction percentages tends to result in very low deduction amounts in the order of \$10–\$20 per noncompliant 1 km segment for a specific performance standard, forming a very small portion of the monthly payment per kilometer. There is a tendency to limit the deduction percentages so the total of the deduction percentages for all performance standards together amounts to 100%. The idea appears to be that this avoids the risk of a contractor being deducted more than 100% of the monthly payment for any 1 km segment.

However, this means that a full deduction will only be applied if the contractor does not comply with all performance standards in that 1 km segment. This is very hard to achieve and would likely only happen after several years of no maintenance at all. The deduction percentages should be much higher than they currently are, varying from 10% for minor defects to 50% and possibly even more for important defects with high repair costs and important implications for trafficability, safety, or sustainability of the road. The deduction amount should be in line with the costs involved in repairing the defect and with the costs to road users as a result of blockages or accidents. The deduction percentages that are applied can be improved, increasing these where necessary, but the problem remains that it is not directly clear what these deductions mean in monetary terms. A related problem is that the use of percentages also introduces an incentive to reduce the bid price for the performance-based maintenance services (transferring these costs to the initial repairs), thus reducing the deduction amounts that may be applied.

To address all these issues, this report recommends that all deduction percentages be replaced by deduction amounts, expressed in monetary terms using the main currency of the contract. These deductions can be determined based on the repair costs and the costs to road users of the defects concerned. They can be defined in the bidding documents and repeated in the contract documents. They would be subject to price increases in the same way as the bid prices of the contractor. One drawback is that the deduction amounts would need to be adjusted every few years for use in new contracts to correct for inflation, something that is not necessary with deduction amounts that account for inflation through the changes to the bid prices. It is expected that the use of deduction amounts expressed in monetary terms will result in a system that is much more transparent regarding the monetary implications of any noncompliance and that is easier to apply. Any noncompliances identified during inspections would immediately result in the deduction amount linked to the performance standard concerned. There would no longer be a need for different procedures to be applied for deductions applied per 1 km segment and deductions applied to the entire road length. As a result, the current situation would be avoided where the late submission of a report results in a much higher deduction than the presence of a large pothole, simply because the monetary implications were unclear regarding the different deduction percentages and their application to 1 km segments or to the full road length.

Deductions should be expressed in monetary terms instead of in percentages to facilitate comparison with repair costs and road user costs, improve understanding, and simplify calculation of deductions.

Regardless of the approach applied, a certain flexibility or leniency is required for new PBRM contracts, allowing the contractor to become accustomed to the approach and to address any maintenance backlogs before becoming subject to deductions. This should cover the first 3 months–6 months and can involve a total waiver of all deductions or a waiver of deductions below a certain amount or where the level of compliance exceeds a certain threshold. Examples of different approaches are described in the different country chapters. Outside of this initial period, it is important that deductions are properly applied in line with the inspection results. Where the inspections identify noncompliances, these should result in deductions. Having said that, it is not strictly necessary to have 100% compliance, and the deduction calculation can be set up in such a way that a minor degree of noncompliance still results in full payment. This level of leniency should be kept limited and should always result in acceptable road conditions. The use of awards to stimulate continued good performance is also recommended. This can take the form of an additional bonus payment after several consecutive months of full compliance, or it could be in the form of a reduction of the compliance requirement above which the full payment is made (as applied in Mongolia).

Apart from providing leniency in the case of good performance, it is necessary to include penalties in case of continued poor performance. In its simplest form, this takes the form of contract clauses that allow the employer to terminate the contract in case of continued failure to address the identified noncompliances. However, this is not a desirable result because a new contract will need to be tendered. A better approach is where the deduction increases each time the deduction is repeated. This has the disadvantage that the deduction cannot exceed the amount of the monthly payment. The use of liquidated damages as applied in Georgia and the Kyrgyz Republic provides more leverage because these can go beyond the amount of the monthly payment, if necessary. The formula used in these two countries involves an exponential increase in the liquidated damages for each repetition of the deduction. This repetition is every month in case of performance standards linked to formal inspections, while for performance standards linked to reaction times, it is repeated every few hours or days (depending on the length of the reaction time). It is suggested to adjust the formula to account for this as shown in Figure 15.

Figure 15: Formula for Calculating Liquidated Damages

$$PR = 2^n \times PR_u$$

for performance standards linked to monthly formal inspections, n = number of formal inspections since first identification for performance standards linked to reaction times, n = number of reaction times since first identification

PR = actual payment reduction, PR_u = payment reduction unit rate.

Source: Consultant's processing.

Procurement and Contract Costs

All OPRCs and PBMCs were procured through national or international competitive bidding. Contract amounts vary from just under \$360,000 to nearly \$24 million. In nearly all cases, the contracts were awarded to domestic contractors, with the 2020 OPRCs in the Kyrgyz Republic and the contract in Mongolia forming the only exceptions. In both cases, this involved two contracts that were awarded to the same contractor (in Mongolia the initial tender was unsuccessful and the two contracts were packaged as one contract for the second, successful, tender). These contracts involved relatively large contract amounts attractive to international contractors. In the case of the SLAs, these were all awarded directly to state-owned maintenance entities without competition. As such, the PBRM contracts appear to benefit domestic contractors and maintenance entities, except where the contract size becomes too large and domestic contractors are no longer able to qualify.

The contract amounts are indicated in Table 32 for those contracts for which data could be obtained. Where data was available, the distribution of the total contract amount between the volume-based initial repairs, the performance-based maintenance services, and the volume-based provisional sum are also indicated. The contracts are organized by contract type (SLA–PBMC–OPRC), and subsequently by contract amount. Table 13 clearly shows that the OPRCs tend to have much larger contract amounts as a result of the initial repair costs that make up most of the cost. The contract costs are not easily compared because the length of road and the duration vary considerably.

Table 32: PBRM Contract Costs

Country	Type	Length	Months	Total	Initial Repairs (length %)		Maintenance Services		Provisional Sum	
				Cost	Activity	Cost	Activity	Cost	Activity	Cost
KGZ	SLA	407 km	12	n/a	-	-	RM+WM	n/a	EM	n/a
AZE	SLA	264 km	24	\$3,956,880	-	-	RM+WM	n/a	EM	n/a
AZE	SLA	229 km	24	n/a	-	-	RM+WM	n/a	EM	n/a
AZE	SLA	253 km	24	n/a	-	-	RM+WM	n/a	EM	n/a
PRC	SLA	107 km	36	\$1,011,103	-	-	RM	\$1,011,103	EM	n/a
TAJ	PBMC	43 km	36	n/a	-	-	RM	n/a	WM+EM	n/a
TAJ	PBMC	87 km	48	\$357,970	-	-	RM	\$215,819	WM+EM	\$142,150
TAJ	PBMC	89 km	48	\$427,150	-	-	RM	\$170,544	WM+EM	\$256,606
GEO	OPRC	142 km	60	n/a	RH (14%)	n/a	RM+WM	n/a	EM	n/a
GEO	OPRC	240 km	60	n/a	RH (28%)	n/a	RM+WM	n/a	EM	n/a
TAJ	OPRC	76 km	36	\$1,956,313	PM (5%)	\$322,146	RM	\$724,235	WM+EM	\$909,932
TAJ	OPRC	73 km	36	\$1,979,602	PM (5%)	\$614,622	RM	\$752,397	WM+EM	\$612,582
KGZ	OPRC	69 km	36	\$4,257,764	RH+PM (25%)	\$3,171,670	RM+WM	\$292,623	RM+WM+EM	\$793,472
PRC	OPRC	63 km	60	\$8,800,000	RH (100%)	n/a	RM	n/a	WM+EM	n/a
PRC	OPRC	57 km	60	\$9,320,936	RH+PM (100%)	\$7,151,445	RM	\$1,436,334	EM	\$733,157
PRC	OPRC	89 km	60	\$12,774,916	RH (100%)	n/a	RM	n/a	WM+EM	n/a
PRC	OPRC	65 km	60	\$13,930,000	RH (100%)	n/a	RM	n/a	WM+EM	n/a
MON	OPRC	58 km	60	\$13,978,999	RH (100%)	n/a	RM+WM	n/a	EM	n/a
PRC	OPRC	65 km	60	\$14,007,786	RH (100%)	n/a	RM	n/a	WM+EM	n/a
GEO	OPRC	117 km	60	\$16,715,816	RH (32%)	\$13,255,421	RM+WM	\$3,009,832	EM	\$450,563
KGZ	OPRC	27 km	84	\$17,537,959	RH (100%)	\$15,928,011	PM+RM	\$1,279,015	WM+EM	\$330,934
PRC	OPRC	81 km	60	\$17,540,000	RH (100%)	n/a	RM	n/a	WM+EM	n/a
KGZ	OPRC	43 km	84	\$22,671,896	RH (100%)	\$20,576,930	PM+RM	\$1,760,223	WM+EM	\$334,741
PRC	OPRC	125 km	60	\$23,729,084	RH (100%)	n/a	RM	n/a	WM+EM	n/a

AZE = Azerbaijan, GEO = Georgia, KGZ = Kyrgyz Republic, MON = Mongolia, n/a = not applicable, OPRC = output- and performance-based road contract, PBMC = performance-based maintenance contract, PBRM = performance-based road maintenance, PM = periodic maintenance, PRC = People's Republic of China, RH = rehabilitation, RM = routine maintenance, SLA = service level agreement, TAJ = Tajikistan, WM = winter maintenance.

Source: Consultant's processing of data.

Figure 16 shows the costs per kilometer, distinguishing between initial repairs, maintenance services, and provisional sums, where possible. The least expensive are the PBMCs and SLAs, varying from slightly more than \$4,000/km in Tajikistan to \$15,000/km in Azerbaijan. The Tajikistan contract involves a basic 2-lane highway, whereas the Azerbaijan contract involves a 4–6-lane motorway. In the OPRCs, the ones with limited initial repairs naturally have the lowest costs, ranging from slightly more than \$25,000/km in Tajikistan to slightly more than \$140,000/km in Georgia. The difference in cost is caused by the degree of initial repairs (varying from 5% of the road length in Tajikistan to 32% in Georgia) and the duration of the contract (3 years in Tajikistan and 5 years in Georgia). The costs per kilometer of the OPRCs involving full rehabilitation of the entire road lie above this, ranging from just under \$140,000/km in the PRC to nearly \$650,000/km in the Kyrgyz Republic. Although the contract duration plays a role here, the main influence is the cost per kilometer of the rehabilitation. Especially the 2020 OPRCs in the Kyrgyz Republic have very high costs per kilometer for rehabilitation. The costs per kilometer for the maintenance services are also high, likely because of the potential need for periodic maintenance as part of the performance-based maintenance services. This is an exception, however, and most OPRCs with full initial rehabilitation range from \$140,000/km to \$240,000/km.

The large portion of OPRC costs made up by initial repairs (>75%) makes it difficult to determine the benefits of performance-based maintenance.

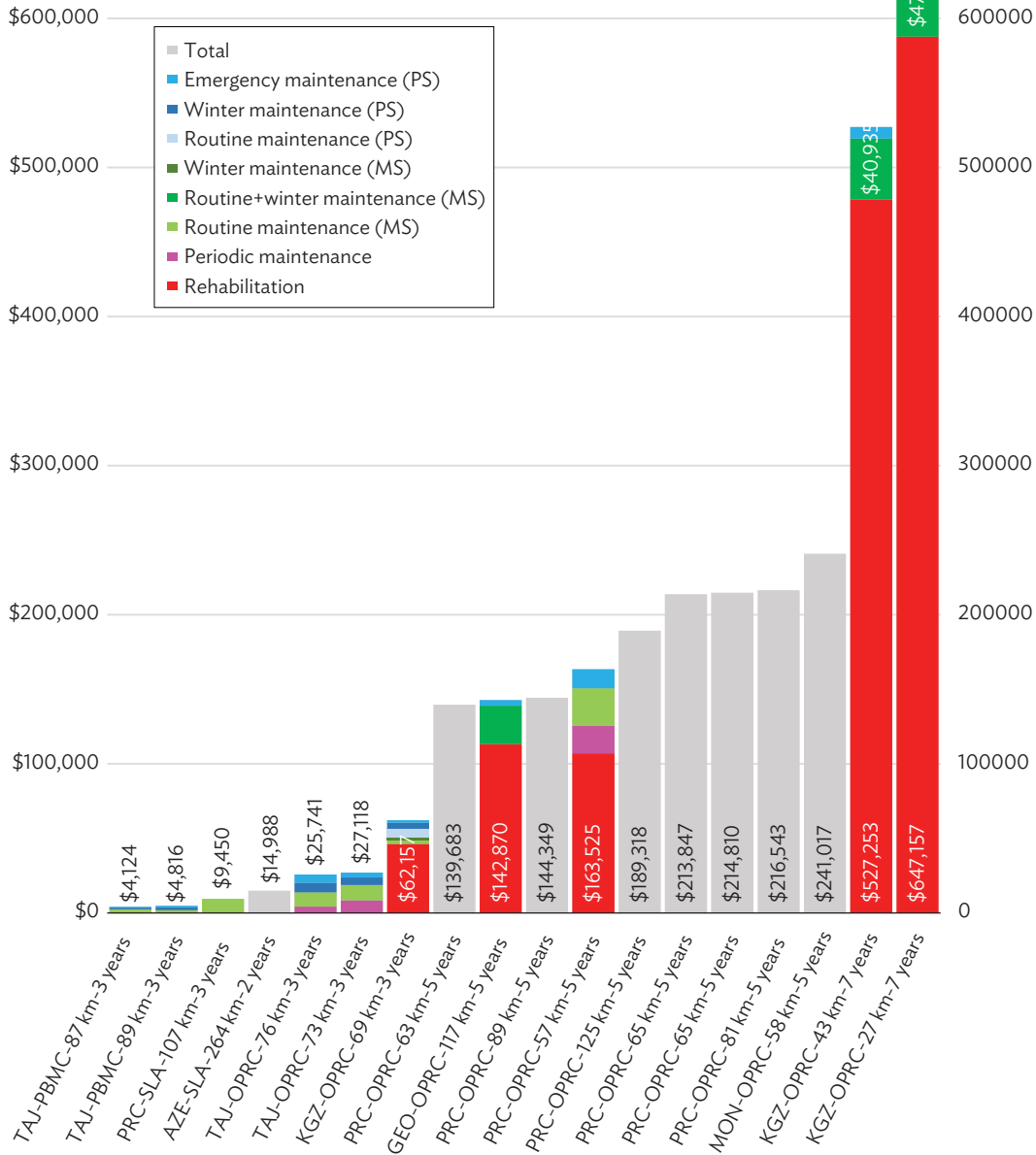
What this clearly shows is that, in the case of the OPRCs, the performance-based maintenance services and the provisional sums make up a very small portion of the contract amount. Only in the case of the 2013 OPRCs in Tajikistan, where the initial repairs were very limited, do the initial repairs make up less than three-quarters of the total contract amount. With the initial repairs making up such a large portion of the total contract amount, it is questionable to which degree these contracts are able to properly show the benefits of PBRM. The figure also shows significant differences in the amounts for the performance-based maintenance services and the provisional sums in the different contracts, but this is, to a large extent, because of the differences in contract duration. To reduce the influence

of the contract duration, Figure 17 shows the costs per kilometer per year for the performance-based maintenance services and for the provisional sums. It must be noted that in the presented contracts, winter maintenance is included under the provisional sums except in the case of the Azerbaijan SLA where it is included under the performance-based maintenance services, and the two PBRM contracts in the PRC where winter maintenance is not included at all because of the subtropical climate.

What is interesting are the far lower costs per kilometer per year for the two PBMCs in Tajikistan. This involves recently rehabilitated roads, whereas the two OPRCs in Tajikistan involved older roads with only limited rehabilitation and periodic maintenance, partly explaining the reason for the lower costs. But also compared to other countries, the PBMC costs are very low. In part, this is expected to be because of the fact that this involved a second batch of pilot contracts, continuing with the same approach as used in the first batch of OPRCs, thus ensuring a certain degree of familiarity with the approach and the way payments and deductions were dealt with.

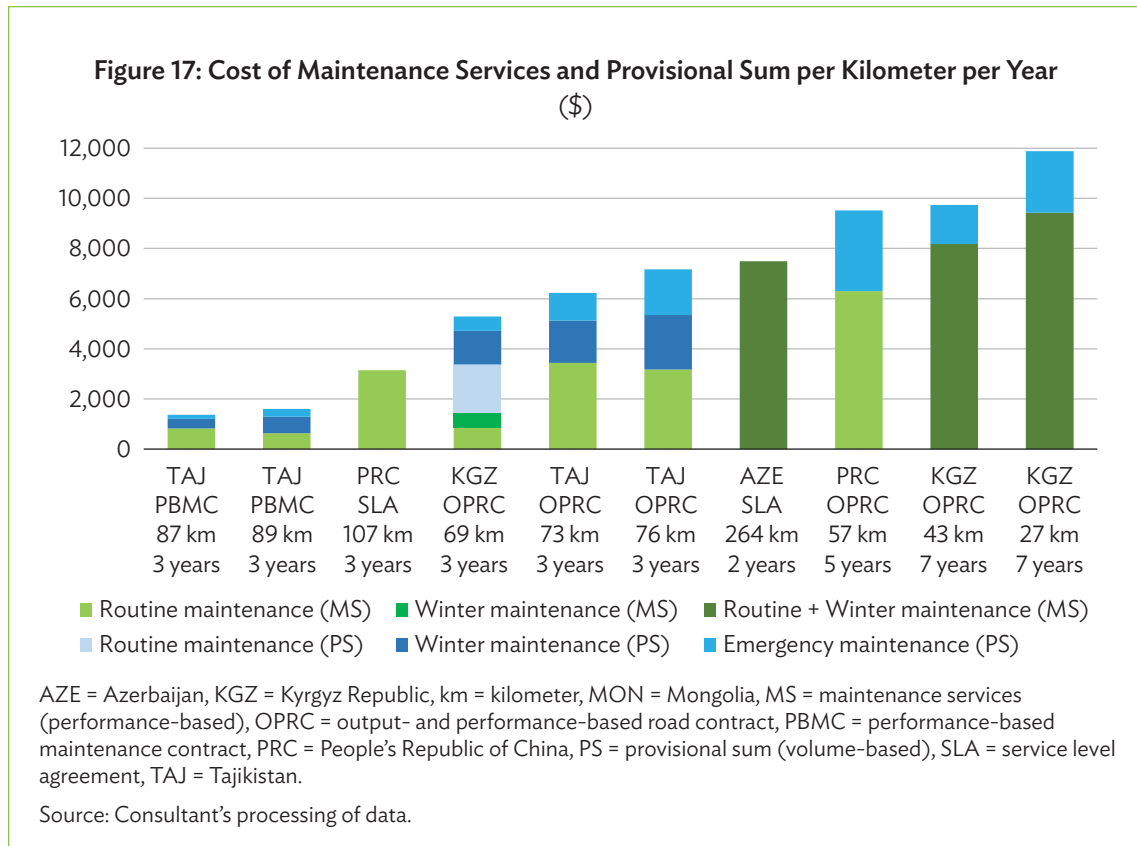
Regarding the SLAs, a straightforward conclusion is not possible. The costs per kilometer per year for the SLA in the PRC were lower than for the OPRC, but the SLA did not cover the salary and overhead costs of the state-owned maintenance entity that were covered under different government budget lines. In the case of the SLA in Azerbaijan, the costs did include salaries and overheads (although equipment was provided separately), but the contract involved a motorway with 4 lanes–6 lanes instead of 2-lane highways as in the other examples, explaining the higher costs involved.

Figure 16: PBRM Contract Costs per Kilometer



AZE = Azerbaijan, GEO = Georgia, KGZ = Kyrgyz Republic, km = kilometer, MON = Mongolia, MS = maintenance services (performance-based), OPRC = output- and performance-based road contract, PBMC = performance-based maintenance contract, PBRM = performance-based road maintenance, PRC = People's Republic of China, PS = provisional sum (volume-based), SLA = service level agreement, TAJ = Tajikistan.

Source: Consultant's processing of data.



Longer durations of the maintenance services result in higher average costs per kilometer per year because of the ageing pavement and the increased uncertainties.

An important conclusion from Figure 17 is that the annual maintenance costs tend to increase with the duration of the contract. What this implies is that the further into the future the performance-based maintenance is planned, the greater the uncertainty about the maintenance needs and the larger the perceived uncertainties and risks. This issue is not as strong in volume-based contracts. Although the total cost will go up because of inflation, the uncertainty about the volume of works required in future years will have less effect on bid prices since the payment is according to the volume of work carried out.

A clear example is given by the OPRCs in the Kyrgyz Republic. The first contract involved only limited rehabilitation and periodic maintenance of a small portion of the road length, whereas the second and third contracts involved full rehabilitation of the entire road length. Contrary to expectation, however, the second and third contracts actually have significantly higher costs per kilometer per year. Although inflation may have some effect, there were only 2 years between the start of the different contracts. The main difference is the duration of the contract and the maintenance services. In the first contract, the duration was only 3 years, with the initial repairs taking up part of the first year. For the other two contracts, the duration was 7 years, with 2 years for the rehabilitation and 5 years of subsequent maintenance services. Both the longer duration of the maintenance services and the fact that these started further in the future means that the uncertainty was much greater. Having said that, the fact is that these other two contracts involved very large contract amounts and international contractors, which likely also played a role in the costing. Smaller contract amounts that would have allowed greater involvement of domestic contractors may have led to lower costs per kilometer per year.

Replication and PBRM Action Program

PBRM pilots have been carried out in the six CAREC countries that were reviewed. Additional PBRM contracts have been carried out in Afghanistan⁵, although these are older and were completed more than 10 years ago (and have not been included in this review). PBRM contracts are also planned in Kazakhstan and Pakistan, but these are yet to be tendered. Discussions are ongoing for the piloting of PBRMs in Uzbekistan. As such, piloting of PBRMs in the CAREC region is reaching a stage where the next question is how to facilitate replication at the national level and under government systems.

Up till now, none of the CAREC countries have moved toward replication of the PBRM contracts under government systems. Although several PBRMs have been fully financed from government funding, this has taken place within the context of development partner projects. Georgia has reported incorporating some aspects of the PBRMs that were carried out, extending their area-based maintenance contracts from 1 year to 3 years, and incorporating some periodic maintenance works as part of the scope. However, payments remain volume-based despite an acknowledgment of the benefits of the performance-based approach.

It appears that existing legislation often forms a major obstacle for replication of the approach under government funding. This may involve legislation that prevents multiannual contracts or complicates the earmarking of budgets for contracts that extend beyond the financial year. It also involves legislation that defines how road maintenance is to be carried out and paid for. For instance, this may stipulate that maintenance is to be carried out by state-owned maintenance entities, or that payments should be done based on the volume of work completed. Kazakhstan and Uzbekistan are examples of countries where this has even prevented the piloting of PBRMs up till now. Other countries face similar issues when wanting to replicate the approach under government systems. In some cases, there are no specific legal barriers, but the obstacle is instead formed by uncertainty about how such PBRMs will be treated. In Georgia, for instance, contractors and government staff were worried that the performance-based payments would not be accepted by the Ministry of Finance because of a lack of evidence of the volume of work carried out against the payment received, and that performance-based payments could lead to corruption charges. This caused considerable delays to the initial piloting of the approach.

A next step in the promotion and replication of PBRMs is to carry out a detailed assessment of existing laws, presidential decrees, government resolutions, ministerial orders, norms, and standards to identify any obstacles to the replication of PBRMs under government systems. This will need to happen on a country-by-country basis, although many of the members of the former Soviet Union will have similar legislation and may benefit from findings from other countries. Based on the obstacles identified, legal amendments may need to be prepared and processed by government. In some cases, this may be relatively simple, involving changes to ministerial orders and procedures, but in other cases it may require amendments to presidential decrees or even laws. Such legal amendments will take time to process, and it is important that the process of identifying such obstacles is started as soon as possible to keep the momentum of the PBRM pilots. Apart from removing the obstacles to PBRMs, such legal amendments should also include provisions that promote

A detailed assessment should be carried out of the legal and normative framework in each country, within which the PBRMs are to be implemented, identifying any obstacles to replication under government systems.

⁵ ADB placed on hold its regular assistance in Afghanistan effective 15 August 2021.

and facilitate the implementation of PBRMs, avoiding situations as described above where progress is delayed because of uncertainty about how PBRMs will be treated and seen by other entities.

Some countries, like the Kyrgyz Republic, have already started such a process. In 2018, the Ministry of Transport and Roads issued a ministerial order describing the PBRM approach and even listing performance standards with five different thresholds corresponding to different service levels. However, both the 2018 OPRC and the 2020 OPRCs applied different approaches, and do not seem to adhere to the ministerial order. A ministerial order is likely not the most suitable format for promoting PBRMs, and a presidential decree would maybe have had more effect. However, such a legal instrument should not go into the details of the performance standards, which should be addressed separately in the contract or specific standards or guidelines.

Studies should be carried out in the CAREC countries to compare the costs and performance of PBRM contracts and traditional road maintenance contracts.

At the same time that possible obstacles to the replication of PBRMs are identified and addressed, further study is also required of the benefits of PBRM contracts. This document has reviewed 24 PBRM contracts to describe their scope and the issues being faced. A next step will be to compare the performance of these PBRM contracts to more traditional road maintenance contracts in the same countries. This should compare not only the costs involved, but also the resulting road conditions. International studies suggest that PBRM contracts result in reduced costs per kilometer per year compared to traditional approaches because contractors have more incentives and flexibility to work efficiently.

At the same time, international studies note that, initially, the costs of PBRM contracts can be higher than traditional contracts because contractors lack experience with such contracts and incorporate risks in their bid prices. This appears to have happened in Tajikistan, where the costs in the second round of PBRM contracts was significantly lower than in the first round of PBRM contracts. Carrying out such studies in the CAREC countries can be very useful in understanding the exact benefits of the PBRM approach.

Individual CAREC countries may prepare PBRM action programs to determine the steps to be undertaken and the support required over the next 10 years.

To support and promote the replication of PBRMs, this report further recommends that each of the CAREC countries that are interested in PBRMs can prepare an action program. This PBRM action program would cover a period of 10 years and would define the different activities to be undertaken, the time frame for doing so, the responsible entities, and any support to be provided by different development partners (either in the form of financial support or technical assistance). Such an action program would distinguish between activities related to initial introduction of PBRMs, such as implementing pilots or providing introductory training to government staff and contractors, and activities aimed at the replication of the approach, such as legislative amendments and comparative studies.

Such a PBRM action program may be prepared by the government entity that is responsible for roads, and subsequently issued through a presidential decree or government resolution, ensuring the agreement and support of other ministries and entities such as the ministry of finance. Such a PBRM action program can help improve coordination between government entities and with different development partners, and can set clear time frames for achieving progress.

APPENDIXES

The following appendixes provide examples of performance standards as used in the different country experiences reviewed in this report. The performance standards have been partly rewritten and reformatted to make them easier to compare. However, no changes have been made to the subject of the indicator or the threshold applied, or to any of the deduction percentages.

APPENDIX 1: Performance Standards for Azerbaijan

Item	Threshold	Response Time	Deduction Point
Roadway and other paved areas			
Potholes on travelled lanes > 20 cm in any dimension	<ul style="list-style-type: none"> No potholes allowed 	48 hours	1 per day
Potholes on other paved areas, including sidewalks > 10 cm in any dimension	<ul style="list-style-type: none"> No potholes allowed 	7 days	1 per day
Quality of patches	<ul style="list-style-type: none"> Level difference not exceeding 3 mm 	14 days	1 per day
Linear cracks wider than 3 mm	<ul style="list-style-type: none"> Less than 20 m total length per lane in any 1 km segment 	7 days	1 per day
Alligator cracking, raveling, bleeding, or stripping of aggregate on road surface	<ul style="list-style-type: none"> Less than 10 m² in any 1 km segment per lane 	14 days	1 per day
Rutting and other surface deformation	<ul style="list-style-type: none"> No rutting deeper than 15 mm No more than 50 m of rutting between 10 mm and 15 mm deep in any 1 km segment per lane 	14 days	1 per day
Skid resistance	<ul style="list-style-type: none"> Coefficient of friction should exceed 0.35 	28 days	1 per day
Height of shoulders vs. height of pavement	<ul style="list-style-type: none"> Difference in height of pavement and shoulders less than 15 mm 	14 days	1 per day
Edge damage	<ul style="list-style-type: none"> Encroachment should not exceed 10 cm 	14 days	1 per day

continued on next page

Table continued

Item	Threshold	Response Time	Deduction Point
Vegetation control			
Vegetation on road formation, including slopes, shoulders, and medians	<ul style="list-style-type: none"> Height of vegetation (except trees) must be less than 20 cm on shoulders and medians, and less than 50 cm otherwise to an extent of 5 m from the outer edge of the pavement. The vegetation must not disturb drainage nor hide signs. 	7 days	1 per day
Removal of cuttings	<ul style="list-style-type: none"> From the time of cutting 	14 days	1 per day
Road surface cleanliness and safety			
Obstruction-free travelled lanes (cases when the objects pose danger to traffic safety)	<ul style="list-style-type: none"> The road surface and shoulders must be clean and free of tree branches, soil, and animal carcasses 	1 hour	1 per hour
Considered as obstructions for the criterion of maintenance response	<ul style="list-style-type: none"> Immobilized vehicles or large obstructions Hazardous material 	24 hours	1 per day
Cleanliness of the pavement surface and shoulders (cases when the objects do not pose danger to traffic safety)	<ul style="list-style-type: none"> No unsightly material, including garbage more than 10 cm in any dimension on/in pavement, shoulder, or drainage facilities 	48 hours	1 per day
Signing and safety devices			
Regulatory, warning, or directional road signs condition	<ul style="list-style-type: none"> Signs are present, complete, clean, and visible Signs are not deformed or misaligned 	48 hours	1 per day
All other signs	<ul style="list-style-type: none"> Signs are present, complete, clean, visible; not deformed, not misaligned 	7 days	1 per day
Condition of temporary signs	<ul style="list-style-type: none"> All signs foreseen in the temporary signing plan must be present and visible 	1 hour	1 per day
Condition of pavement markings, rumble strip, and other horizontal signing	<ul style="list-style-type: none"> All markings are visible at 100 m 	7 days	1 per day
Condition of guardrails and other safety barriers	<ul style="list-style-type: none"> No section is missing, misaligned, or damaged; >95% of bolts fixed securely 	48 hours	1 per day
Condition of guideposts and guide barriers (not providing containment)	<ul style="list-style-type: none"> Guideposts and guide barriers must be present, clean, visible, and undamaged 	14 Days	1 per day
Electrical and mechanical systems			
Lighting completeness	<ul style="list-style-type: none"> Lighting system must be working without black spots 	7 days	1 per day
Lighting in tunnels and inhabited areas; traffic lights	<ul style="list-style-type: none"> Lighting system must be working without black spots 	48 hours	1 per day

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Table continued

Item	Threshold	Response Time	Deduction Point
Lighting post condition (including traffic lights)	<ul style="list-style-type: none"> Lighting posts must be present, clean, visible, and undamaged 	7 days	1 per day
Luminaires condition	<ul style="list-style-type: none"> Luminaires must be present, clean, undamaged, and functioning correctly 	7 days	1 per day
Substation functionality	<ul style="list-style-type: none"> Substation correctly providing electrical power 	24 hours	1 per day
Lighting cabinet functionality	<ul style="list-style-type: none"> Lighting cabinet electrically supplied circuits must be working correctly 	24 hours	1 per day
Pumping systems functionality	<ul style="list-style-type: none"> Pumping system must be working correctly 	24 hours	1 per day
Fire-fighting systems functionality	<ul style="list-style-type: none"> Fire-fighting system must be working correctly, with all the equipment in place and operational 	24 hours	1 per day
Communications systems functionality	<ul style="list-style-type: none"> Communications system must be working correctly 	24 hours	1 per day
Monitoring systems functionality	<ul style="list-style-type: none"> Monitoring systems must be functioning correctly 	24 hours	1 per day
Auxiliary power systems functionality	<ul style="list-style-type: none"> Auxiliary power system must be working correctly 	24 hours	1 per day
Winter maintenance			
Restoration of the normal traffic movement after a snowfall	<ul style="list-style-type: none"> The depth of snow on at least one travelled lane should be less than 5 cm 	2 hours and while snowing	1 per hour
Prevention of ice	<ul style="list-style-type: none"> Ice area not exceeding 5% in open lanes 	2 hours and while freezing	1 per hour
Ensuring continuity of traffic after roadway is cleared and daytime temperatures rise above freezing	<ul style="list-style-type: none"> The roadway, shoulders, and drainage should be clean of snow and ice 	48 hours after freezing	1 per day
Drainage			
Condition of culverts (including inlet and outlet ditches of 3 m on each end)	<ul style="list-style-type: none"> Less than 10 % of capacity (cross-section) of each culvert is obstructed 	7 days	1 per day
Standing water on the roadway surface	<ul style="list-style-type: none"> No standing water >15 mm deep on the surface within 2 hours after rainfall 	7 days	1 per day
Standing water on other paved areas	<ul style="list-style-type: none"> No standing water >15 mm deep on the surface within 4 hours after rainfalls 	7 days	1 per day
Condition of lined and unlined drains, ditches, channels, gullies, and curbs adjacent to the roadway	<ul style="list-style-type: none"> Less than 10 % of the capacity of each facility is obstructed 	7 days	1 per day

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Table continued

Item	Threshold	Response Time	Deduction Point
Erosion, deformation or other damage to drainage structures	<ul style="list-style-type: none"> Structurally sound and not allowing seepage 	14 days	1 per day
Earthworks and roadside			
Erosion, deformation, or other damage in or adjacent to cut/fill slopes	<ul style="list-style-type: none"> No structural damage or eroded sections 	14 days	1 per day
Potholes on unpaved shoulder > 15 cm in any dimension	<ul style="list-style-type: none"> No potholes allowed 	7 days	1 per day
Potholes, depression, erosion, deformation, or other damage in other unpaved areas	<ul style="list-style-type: none"> Erosion gully or other deformation should be less than 20 cm 	14 days	1 per day
Structures			
Safety condition of all structures	<ul style="list-style-type: none"> No safety hazards 	4 hours	1 per hour
Step height at bridge joints	<ul style="list-style-type: none"> Any step height should be under 10 mm 	28 days	1 per day
Sealing of bridge joints	<ul style="list-style-type: none"> All joints should be sealed 	28 days	1 per day
Condition of bearings	<ul style="list-style-type: none"> All bearings should be intact and free from movement restriction 	28 days	1 per day
Condition of connections of steel parts	<ul style="list-style-type: none"> Connections should be structurally sound and free of corrosion 	14 days	1 per day
Graffiti	<ul style="list-style-type: none"> Bridge should be clean of graffiti 	28 days	1 per day
No exposure of foundations	<ul style="list-style-type: none"> The foundations must not be visible 	14 days	1 per day
No exposure of reinforcement steel	<ul style="list-style-type: none"> No steel reinforcement must be visible 	14 days	1 per day
Width of cracks in concrete	<ul style="list-style-type: none"> Cracks exceeding 3 mm should be sealed 	14 days	1 per day
Traffic incident response measures			
Presence on the spot of response crew for incident affecting service level and safety	<ul style="list-style-type: none"> All traffic accidents and other incidents involving potholes, obstructions must be removed or signaled, damage to guardrails 	1 hour	1 per hour
Buildings and miscellaneous facilities			
Structural integrity	<ul style="list-style-type: none"> No safety hazards 	4 hours	1 per hour
Fire-fighting systems functionality	<ul style="list-style-type: none"> Fire-fighting system must be working correctly, with all the equipment in place and operational 	24 hours	1 per day
Heating, ventilation, and A/C systems functionality	<ul style="list-style-type: none"> All the systems must be fully operational 	24 hours	1 per day
Lighting systems functionality	<ul style="list-style-type: none"> Lighting system working without black spots 	24 hours	1 per day
Plumbing functionality	<ul style="list-style-type: none"> All the systems must be fully operational 	24 hours	1 per day

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Table continued

Item	Threshold	Response Time	Deduction Point
Garbage cans not overflowing	<ul style="list-style-type: none"> Garbage cans must be regularly cleaned 	48 hours	1 per day
Septic tanks not overflowing	<ul style="list-style-type: none"> Septic tanks must be regularly cleaned 	24 hours	1 per day
Management performance			
Operational plan	<ul style="list-style-type: none"> Plan submitted on time and in full 	1st day of year	1 per day
Monthly report	<ul style="list-style-type: none"> Submitted on time and in full, including all specified subsections (compliance and activity report) 	7th day of month	1 per day
Ad hoc reports	<ul style="list-style-type: none"> Submitted for each traffic accident and on other occasions as specified in approved operational plan 	As specified	1 per day

A/C = alternating current, cm = centimeter, km = kilometer, m = meter, m² = square meter, mm = millimeter.

Source: Contract document.

APPENDIX 2: Performance Standards for the People's Republic of China (Yunnan Province)

Item	Threshold	Deduction Percentage
Road usability		
Road usability	<ul style="list-style-type: none"> The road must be open to traffic and free of interruptions at all times. Road closures are only permitted for a maximum of 6 hours in the following cases: <ul style="list-style-type: none"> an accident or breakdown which renders the road impassable to other road users; localized flooding at a drift, bridge, or culvert location during the flood event itself (the 6 hours start from the moment the flood water level recedes below the level of the road); and a landslide which renders the road impassable to road users. 	20%
Other contractor requirements		
Reporting	<ul style="list-style-type: none"> Provide with each monthly statement, updated versions of the progress report, the work plan, and the cash flow 	5% (full payment)
Compliance with plans	<ul style="list-style-type: none"> Ensure full compliance with the quality assurance plan, the health and safety management plan, the emergency procedures and contingency plan, and the traffic management plan, as well as with the provisions contained in the environmental management plan 	5% (full payment)
Right-of-way and roadbed		
Drains and ditches	<ul style="list-style-type: none"> No more than 10% of the cross section of a drain or ditch is obstructed at any location Lined ditches do not have structural damage and are firmly contained by surrounding soil or material 	30%
Vegetation control	<ul style="list-style-type: none"> Height is <10 cm within 5 m of the edge of the pavement or side drain No vegetation obstructs the view of road signs No vegetation is located in structures or sealed surfaces Vertical clearance of vegetation over the pavement is >6 m 	20%
Retaining walls	<ul style="list-style-type: none"> Retaining walls are stable and without damage, and weep holes are clear 	10%
Slopes and fences	<ul style="list-style-type: none"> Slopes are intact with no loose rocks and free of erosion Fences are in good repair with no missing sections 	10%
Greening	<ul style="list-style-type: none"> Trees, flower beds are properly tended and fertilized and trees are whitewashed as needed 	10%
Carriageway and shoulders		
Block/alligator cracks	<ul style="list-style-type: none"> No cracks >3 mm wide Total area of cracks is ≤ 20 m² per 1 km section 	50%
Longitudinal/transverse cracks	<ul style="list-style-type: none"> No unsealed cracks >3 mm wide Total length of unsealed cracks is ≤ 100 m per 1 km section 	50%
Potholes	<ul style="list-style-type: none"> No potholes >15 cm diameter or >3 cm depth Total number of potholes is ≤ 5 per 1 km section 	50%
Raveling	<ul style="list-style-type: none"> Total area of raveling is ≤ 20 m² per 1 km section 	50%
Rutting	<ul style="list-style-type: none"> No ruts >3 cm deep Total length of rutting is ≤ 25 m per 1 km section 	50%

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Table continued

Item	Threshold	Deduction Percentage
Depressions	<ul style="list-style-type: none"> No depressions >3 cm depth Total area of depressions is ≤ 20 m² per 1 km section 	50%
Shoving	<ul style="list-style-type: none"> No shoving >3 cm height difference Total area of shoving is ≤ 20 m² per 1 km section 	50%
Bleeding	<ul style="list-style-type: none"> Total area of bleeding is ≤ 20 m² per 1 km section 	50%
Edge break	<ul style="list-style-type: none"> No loose or breaking pavement edges Pavement width is at least 95% of design width as mentioned in contract 	50%
Shoulder	<ul style="list-style-type: none"> Shoulders not >3 cm lower than pavement and shoulders not higher than pavement Maximum continuous length permitted with defects = 25 m 	30%
Cleanliness	<ul style="list-style-type: none"> No soil, debris, trash, other objects, or oil/chemical spills on pavement or shoulder 	10%
Bridges, culverts, tunnels		
Bridges	<ul style="list-style-type: none"> Guardrails are present and not deformed All metal parts of the overall structure are painted or, otherwise, protected and free of corrosion The bridge deck is clean and the deck material is fully intact and bolted down The drainage system is in good condition and fully functional Expansion joints are clean and in good condition There are no obstacles to the free flow of water under the bridge and up to 100 m upstream The clearance under the bridge is according to design There is no erosion around bridge abutments and piers 	50%
Culverts	<ul style="list-style-type: none"> No more than 10% of the cross section is obstructed at any location in the culvert There is no structural damage and culverts are firmly contained by surrounding soil or material 	20%
Tunnels	<ul style="list-style-type: none"> Lighting, ventilation, and emergency equipment are fully operational The drainage system is in good condition and fully functional Footpaths are clear of debris and in good repair External structures are in good repair and clear of vegetation Entrances are painted reflective paint and clearly visible at night 	50%
Traffic engineering		
Signs	<ul style="list-style-type: none"> Information signs are present, complete, clean, legible, and structurally sound Warning and traffic signs are present, complete, clean, legible, structurally sound, and clearly visible at night 	20%
Horizontal demarcation	<ul style="list-style-type: none"> Horizontal demarcation is present, legible, and firmly attached to pavement 	20%
Guardrails	<ul style="list-style-type: none"> Guardrails are present, clean, and without structural damage No guardrail sections are missing 	20%
Lighting	<ul style="list-style-type: none"> Lighting is functioning with no more than 5% of total lights unserviceable 	20%
Traffic Signals	<ul style="list-style-type: none"> Traffic signals are functioning with no lights unserviceable 	50%
Kilometer posts	<ul style="list-style-type: none"> Kilometer and guidance posts are present, complete, clean, legible, and structurally sound 	10%

cm = centimeter, km = kilometer, m = meter, m² = square meter, mm = millimeter.

Source: Contract document.

APPENDIX 3: Performance Standards for Georgia (Kakheti)

Item	Threshold	Response Time	Applicable in Winter	Safety Measure	Deduction Percentage
Performance standards with 100% penalty					
Potholes	• No potholes with a diameter > 20 cm	0 days	Yes	Yes	100%
	• No more than five potholes and/or edge breaks	0 days	Yes	Yes	100%
Drop-off	• No drop-off with a height difference > 75 mm	0 days	Yes	Yes	100%
Safety	• No missing traffic sign related to safety elements	0 days	Yes	Yes	100%
	• No missing guardrails and parapets related to safety elements	0 days	Yes	Yes	100%
Pavement					
Potholes, edge break	<ul style="list-style-type: none"> • No potholes with a diameter > 20 cm in any 1 km section of the road surface • No more than five potholes and/or edge breaks in any 1 km section of the road surface • No edge breaks are permitted with width > 75 mm in any 1 km section of the road surface 	10 days	Yes	Yes	10%
Cracking	• There shall not be unsealed cracks more than 5 mm wide in any 1 km section of the road surface	2 days	No	-	6%
Rutting	• There shall not be ruts more than 30 mm deep in any 1 km section of the road surface	30 days	No	-	6%
Raveling	<ul style="list-style-type: none"> • There shall be no raveling of asphaltic surface layers in rehabilitated segments • Raveling of maintenance segments shall not be more than 5% of the surface area 	30 days	No	-	5%
Shoulder					
Cleanliness	• The road surface and shoulders must always be clean and free of soil, debris, trash, and other objects - when safety hazard (indicating that the obstacle on the road forms a safety hazard)	12 days	Yes	Yes	8%
	• The road surface and shoulders must always be clean and free of soil, debris, trash, and other objects - when no safety hazard (indicating that the obstacle does not form a safety hazard)	10 days	Yes	-	

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Item	Threshold	Response Time	Applicable in Winter	Safety Measure	Deduction Percentage
Drop-off	<ul style="list-style-type: none"> Acceptable length with drop-off > 25 mm and < 75 mm, 100 m/km 	15 days	No	-	8%
Drainage					
Ditches	<ul style="list-style-type: none"> Road side ditches and lined drains must be clean, lining without any significant damage, and no standing water Other ditches when standing water 	3 days	Yes	-	6%
Culverts	<ul style="list-style-type: none"> Culverts shall be clean and without structural damage 	7 days	Yes	-	6%
Roadside					
Vegetation control	<ul style="list-style-type: none"> Permitted maximum height of any grass or weeds on shoulders, medians, road formation, and traffic islands and behind safety fencing up to 3 m from outside edge of shoulders shall be < 0.20 m tall 	30 days	Yes	Yes	5%
Safety					
Signs	<ul style="list-style-type: none"> Signs have to be present, complete, clean, legible, and structurally sound; and clearly visible at night - no safety element Signs have to be present, complete, clean, legible, and structurally sound; and clearly visible at night - safety element (may be temporary replacement) 	1 day	Yes	Yes	10%
Guardrails and parapets	<ul style="list-style-type: none"> No guardrails that are not level, damaged, rusted, not well painted - provide emergency safety measures until permanent repair No guardrails that are not level, damaged, rusted, not well painted - permanent repairs 	2 days	Yes	Yes	10%
Road markings	<ul style="list-style-type: none"> Traffic markings must have a visibility > 70% 	14 days	Yes	-	8%
Structures					
Retaining walls	<ul style="list-style-type: none"> Retaining walls must be free from structural damage or instability without damage or blockage to drainage - structural damage or instability Retaining walls must be free from structural damage or instability without damage or blockage to drainage - damage or blockage to drainage 	60 days	Yes	-	3%
		15 days	Yes	-	

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Item	Threshold	Response Time	Applicable in Winter	Safety Measure	Deduction Percentage
Bridges	<ul style="list-style-type: none"> Bridge bearings and expansion joints must be free of dirt and debris Properly sealed Free draining riverbeds 	30 days	No	-	3%
Steel structures	<ul style="list-style-type: none"> Steel structures must be sound, safe, and corrosion free Paint shall be kept in good condition 	14 days	No	-	3%
	<ul style="list-style-type: none"> Steel structures major repairs to structures or paint 	90 days	No	-	
Concrete structures	<ul style="list-style-type: none"> Concrete structures must be free of damage, no spalling, no exposed reinforcement, no signs or rebar corrosion – minor repairs 	14 days	Yes	-	3%
	<ul style="list-style-type: none"> Concrete structures must be free of damage, no spalling, no exposed reinforcement, no signs or rebar corrosion – major repairs 	60 days	No	-	
Winter maintenance					
Snow depth	<ul style="list-style-type: none"> Average loose snow depth on carriageway during snowfall < 5 cm 				5% daily
Slush	<ul style="list-style-type: none"> Average slush depth on carriageway < 5 cm 				5% daily
Snow clearance	<ul style="list-style-type: none"> Time for clearance of loose snow from carriageway after snowfall < 4 hours 				5% daily
	<ul style="list-style-type: none"> Time for clearance of loose snow from hard shoulder and service area after snowfall < 8 hours 				
Friction	<ul style="list-style-type: none"> Time for provision of acceptable friction after precipitation or frost < 2 hours Acceptable friction on carriageway, hard shoulder, and service area after time for clearance of snow and ice has expired 				5% daily
Snow free	<ul style="list-style-type: none"> Snow and ice-free surface of carriageway shall apply when the road surface is warmer than -4°C Snow and ice-free surface of hard shoulder and service area shall apply when the road surface is warmer than 0°C Time to achieve a snow and ice-free carriageway surface when the road surface becomes warmer than the temperature above < 3 hours 				5% daily

cm = centimeter, km = kilometer, m = meter, mm = millimeter.

Source: Contract document.

APPENDIX 4: Management Performance Measures for Georgia (Kakheti)

Item	Service Level	Tolerance Permitted	Unit Rate for Noncompliance
Program of performance	Submission 28 days after contract signature or by start date, whichever is later; to include all details required by contract	Must be submitted by due date	GEL200 for each day of delay
Approved program of performance	Submission not more than 14 days after receipt of the employer's comments on initial submission	Revision and resubmission must be completed within 14 days after the official letter informing of comments.	GEL200 for each day of delay
Section design report	Preliminary submission at least 14 days prior to programmed date for commencement of construction activities on section; submission of approved report not later than 14 days after receipt of project manager's comments.	Modification must be completed within 14 days after the official letter informing of comments.	GEL500 for each day of delay in submission
Final design report	Submission and approval of the final design report, including all drawings. This report must be submitted within 1 month after the design for the last section has been approved following the schedule proposed for detailed design.	Initial submission: no tolerance. Final report must be completed and submitted within 30 days after the official letter informing of comments.	GEL500 for each day of delay
Rehabilitation monthly report	Submission and approval of monthly report summarizing activities carried out, progress, difficulties, updated work plan, etc. This report must initially be submitted within the first 10 days after each month of works.	Initial submission by due date. Revision and resubmission must be completed within 7 days after the official letter informing of comments.	GEL100 for each day of delay
Maintenance monthly report	Submission and approval of monthly report summarizing activities carried out, progress, difficulties, updated work plan, etc. This report must initially be submitted within the first 10 days after each month of works.	Initial submission by due date. Revision and resubmission must be completed within 7 days after the official letter informing of comments.	GEL100 for each day of delay
Environmental and social quarterly report	Submission and approval of quarterly report summarizing activities carried out, progress, difficulties, updated work plan, etc. This report must initially be submitted within the first 10 days after each quarter of works.	Initial submission by due date. Revision and resubmission must be completed within 14 days after the official letter informing of comments.	GEL 200 for each day of delay

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Item	Service Level	Tolerance Permitted	Unit Rate for Noncompliance
Safety monthly report	Submission and approval of monthly report detailing all safety-related events, summarizing activities carried out, progress, difficulties, etc. This report must initially be submitted within the first 10 days after each month of works.	Initial Submission by due date. Revision and resubmission must be completed within <i>7 days</i> after the official letter informing of comments.	GEL100 for each day of delay
Inventory report (yearly)	Submission and approval of inventory report, including the updating of the information stored at Roads Department every year.	Initial submission by due date stipulated by employer. Modification must be completed within <i>30 days</i> after the official letter informing of comments.	GEL500 for each day of delay
Annual work program and rolling three-year program approval	The annual work program and rolling 3-year program must be submitted by the first 5 days of the contract year applicable and updated monthly.	Initial submission by due date. Modifications must be completed and submitted within <i>15 days</i> after the official letter informing of comments.	GEL100 for each day of delay
Annual traffic count and axle load reports	Each report to include complete details of all counts to date. Analysis of trends and projections of future traffic on year-by-year basis to end of required life for each road section. Reports must include full details of any axle load surveys undertaken to date with analysis of trends and present and future pavement loadings in equivalent standard axle basis to end of required life for each road section.	To be submitted within 30 days of due date and revised report to be submitted within <i>15 days</i> after receipt of comments	GEL100 for each day of delay
Sectional completion reports	Report must provide complete details of design and works for the affected section.	To be submitted within 45 days of completion of takeover of a whole section; modifications to be completed and submitted within <i>14 days</i> after receipt of comments	GEL500 for each day of delay
Rehabilitation completion report	Report must provide complete details of design and works of rehabilitation.	To be submitted within 30 days of completion of final takeover of all sections; modifications to be completed and submitted within <i>30 days</i> after receipt of comments	GEL500 for each day of delay. Performance Guarantee will not be released until final submission is accepted.

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Item	Service Level	Tolerance Permitted	Unit Rate for Noncompliance
Contract handover report	Complete description of maintenance activities, construction details, ongoing problems and requirements, current pavement condition, and strength and roughness with trends; overall network condition; projections of future maintenance requirements	To be submitted 30 days before completion of contract; modifications to be completed and submitted within 15 days after receipt of comments	GEL500 for each day of delay. Performance Guarantee will not be released until final submission is accepted.
Final report	A brief summary of the entire contract, outcomes achieved, lessons, good practices, and recommendations to the employer for improvements for any future output- and performance-based road contract projects	To be submitted within 30 days after completion of contract; modifications to be completed and submitted within 15 days after receipt of comments	GEL1,000 for each day of delay. Performance Guarantee will not be released until final submission is accepted.

Source: Contract document.

APPENDIX 5: Performance Standards for Georgia (Guria)

Item	Weight	Sub-Weight
Road user service and comfort performance measures		
Pavement maintenance (RUS&CPM-1)	2	1
Unsealed shoulder maintenance (RUS&CPM-2)	1	1
Drainage maintenance (RUS&CPM-3)	2	1
Routine maintenance of bridges and other structures (RUS&CPM-4)	2	1
Incident response and emergency works (RUS&CPM-5)	2	1
Vegetation control (RUS&CPM-6)	1	1
Roadside signs maintenance (RUS&CPM-7)	2	1
Pavement marking (RUS&PM-8)	2	1
Safety barriers maintenance (RUS&CPM-9)	1	1
Other road furniture maintenance (RUS&CPM-10)	2	1
Road durability performance measures		
Minimum annual asset preservation quantities in accordance with the approved work plan (RDPM-1)		Applied to liquidated damages
Pavement roughness (RDPM-2)	5	Number of months delay
Roadway cut and embankment slopes (RDPM-3)	5	Number of weeks delay
Management performance measures		
Contractor's quality assurance management plan (MPM-1)	2	Number of weeks delay in submission
Contractor's work programs (MPM-2)	2	Number of weeks delay in submission
Contractor's reports (MPM-3)	2	Number of weeks delay in submission multiplied by number of reports
Road safety and traffic management plan (MPM-4)	2	Number of weeks delay in submission + number of days of noncompliance with plan
Inventory database management (MPM-5)	2	Number of weeks delay in submission
Environmental and social management plans (MPM-6)	2	Number of weeks delay in submission multiplied by number of reports
Repeat MPM noncompliance from previous month	4	Number of months since first identification

MPM = management performance measures, RDPM = road durability performance measures, RUS&CPM = road user service and comfort performance measures.

Source: Contract document

APPENDIX 6: Performance Standards for the Kyrgyz Republic (2017)

Item	Threshold	Response Time	Deduction Percentage ^a
General contractor's obligations			
Road usability	<ul style="list-style-type: none"> The road shall be trafficable (km-days) 		5% (10%) full payment
Traffic safety	<ul style="list-style-type: none"> Traffic management arrangements according to standards and rules, or appropriate 		5% (10%) full payment
Administrative duties	<ul style="list-style-type: none"> Respect administrative obligations 		10% (20%) full payment
Submission of reports	<ul style="list-style-type: none"> Submission of reports on time 		5% (10%) full payment
Reporting of defects	<ul style="list-style-type: none"> All defects beyond the responsibility of the contractor are reported to the project manager 		2% full payment
Pavements and shoulders			
Road patrolling	<ul style="list-style-type: none"> The road shall be patrolled at least once a week (once a day in case of snow events) and the patrolling recorded The road surface and up to 0.5 m of the shoulder width must always be clean and free of soil, rocks, debris, trash, and other objects 	7 days (1 day if safety hazard)	10% (20%) 1 km
Potholes	<ul style="list-style-type: none"> Road surface must be maintained free from potholes All potholes >0.5 m² to be repaired Not more than five potholes < 0.5 m² in a section Potholes shall be filled immediately with aggregates or cold asphalt as temporary measure 	7 days (large potholes) 28 days (small potholes)	No volume-based payment
Patching	<ul style="list-style-type: none"> Patches shall be square or rectangular Patches shall be level with surrounding pavement (less than +/- 15 mm difference of level with the adjacent road surface) Patches shall be made using materials similar to those used for the surrounding pavement There shall be no cracked area within 1 m around the patch 	7 days/28 days	No volume-based payment
Isolated cracks	<ul style="list-style-type: none"> All isolated cracks more than 3 mm wide and longer than 20 m must be sealed For isolated cracks, the crack length is defined as the length of the crack plus 0.5 m at each end 	28 days	No volume-based payment

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Item	Threshold	Response Time	Deduction Percentage ^a
Multiple cracks	<ul style="list-style-type: none"> Any 10 m² of road with more than 30% of cracked area must be cut out and patched The cracked area is defined as a rectangle, parallel to the lanes, which fully enclosed the cracked area, which the closest crack is 0.25 m from the edges 	28 days	5% (10%) 1 km
Raveling	<ul style="list-style-type: none"> There shall be not more than 20 m² raveled areas in any section of 1,000 m The raveled area is defined as a rectangle, parallel to the lanes, which fully enclosed the raveled or stripped area, with the closest point of deterioration 0.2 m from the edges 	56 days	5% (10%) 1 km
Loose pavement edges	<ul style="list-style-type: none"> There shall be no loose pavement edges, or pieces of pavement breaking off at the edges 	56 days	5% (10%) 1 km
Rutting	<ul style="list-style-type: none"> There shall be no ruts deeper than 40 mm in any location of any section of 1,000 m Rutting of more than 20 mm shall not be present in more than 10% of any section of 1,000 m 	56 days	5% (10%) 1 km
Shoulder height	<ul style="list-style-type: none"> Difference in height at edge of pavement shall not be more than 5 cm in more than 50 m of cumulated length on any section 	28 days	5% (10%) 1 km
Paved shoulders	<ul style="list-style-type: none"> All deteriorated area (potholes, map cracking) > 1 m² must be repaired All joints and cracks along the pavement edge longer than 30 m must be sealed 	56 days	5% (10%) 1 km
Unpaved shoulders	<ul style="list-style-type: none"> Must always be maintained smooth and of required width No local depression of more than 5 cm, not more than 10 potholes larger than 0.1m² in one section 	28 days	5% (10%) 1 km
Kerbs	<ul style="list-style-type: none"> Missing or deteriorated kerbs replaced 	28 days	5% (10%) 1 km
Signaling and road furniture			
Directional signs	<ul style="list-style-type: none"> Signs have to be present, complete, clean, legible, and structurally sound 	28 days	5% (10%) 1 km
Warning signs	<ul style="list-style-type: none"> Signs have to be present, complete, clean, legible, structurally sound, and clearly visible at night Visibility from a personal vehicle at 100 m distance on straight sections, or according to road alignment 	28 days	5% (10%) 1 km
Traffic ruling signs	<ul style="list-style-type: none"> Signs have to be present, complete, clean, legible, structurally sound, and clearly visible at night 	28 days	5% (10%) 1 km

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Table continued

Item	Threshold	Response Time	Deduction Percentage ^a
Horizontal marking and/or pavement paint	<ul style="list-style-type: none"> Have to be present on more than 80% of any section of 1,000 m according to the traffic plan, legible and firmly attached to pavement The marking must be visible and reflecting during nighttime Visibility from a personal vehicle at 100 m distance on straight sections, or according to road alignment 	56 days	5% (10%) 1 km
Mileposts and guidance posts	<ul style="list-style-type: none"> All posts have to be present, complete, clean, legible, structurally sound, and surface painted or otherwise covered 	28 days	10% (20%) 1 km
Guardrails and Parapets (including handrails on structures)	<ul style="list-style-type: none"> All rails and parapets have to be present, clean, without any significant damage or deformation, without corrosion, and with reflectors where existing 	28 days (7 days if safety hazard)	10% (20%) 1 km
Drainage			
Ditches and vertical drains with lining	<ul style="list-style-type: none"> Must be clean, ensuring free water flow Obstructions equivalent to less than 20% of capacity of any item Damages to lined ditches shall not exceed 30 m of cumulative length on any section of 1,000 m 	28 days	7% (15%) 1 km
Ditches and vertical drains without lining	<ul style="list-style-type: none"> Must be clean and free of obstacles ensuring free water flow Obstructions equivalent to less than 20% of capacity of any item Damages to ditches as erosion of the sides shall not exceed 50 m cumulative length on any section of 1,000 m 	28 days	7% (15%) 1 km
Collectors/Gutters / Manholes	<ul style="list-style-type: none"> Must be clean and free of obstacles, and without structural damage Obstructions equivalent to less than 20% of capacity of any item Must be firmly contained by surrounding soil or material 	28 days	7% (15%) 1 km
Culverts, pipe and similar small drainage structures	<ul style="list-style-type: none"> All drainage structures must be clean and free of obstacles, allowing free flow, and without structural damage Obstructions equivalent to less than 20% of capacity of any item Inlets and outlets shall be free of obstacles and allowing free flow on at least 3 m either side Structures must be firmly contained by surrounding soil or material 	28 days	7% (15%) 1 km
Vegetation control			
Vegetation on shoulders	<ul style="list-style-type: none"> Height must be less than 30 cm Shoulders, medians, traffic islands, grass around rest areas, and parking and bus stops (including around road furniture) 	28 days	5% (10%) 1 km

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Table continued

Item	Threshold	Response Time	Deduction Percentage ^a
Road reserve	<ul style="list-style-type: none"> The road reserve shall be cleaned and litter picked such that no accumulation of debris and litter exceeds 0.2 m³ in any location 	28 days	5% (10%) 1 km
Vegetation on other green areas within the road reserve	<ul style="list-style-type: none"> Height must be less than 40 cm Large, vegetated areas, including grassed surface water channels with longitudinal gradient $\geq 3\%$ 	28 days	5% (10%) 1 km
Visibility cuts	<ul style="list-style-type: none"> Height must be less than 30 cm Vegetation control around edge marker posts, signposts, bridge end and culvert markers, guardrails, sight rails, lighting columns, and bridge abutments 	28 days	5% (10%) 1 km
Vegetation free	<ul style="list-style-type: none"> Height must be less than 20 cm Applies to vegetation control to allow access around culvert ends, culvert headwalls, side drains, culvert waterways, surface water channels with gradient $< 3\%$, weigh pits, kerb and channel, lined channels, bottom or top of retaining walls, and bridge decks 	28 days	5% (10%) 1 km
Growth encroaching into the vegetation-free zone from the side or top	<ul style="list-style-type: none"> Remove all vegetation Applies to vegetation control in the envelope, including trees, scrub, or branches hanging into the vegetation free zone (within 0.5 m of the line of the edge marker posts or to within 6.0 m above the pavement) 	28 days	5% (10%) 1 km
Structures			
Inspection	<ul style="list-style-type: none"> Regular inspection of structures has to be carried out once/year before end of October and formalized in a structure's inspection report 	28 days	10% (20%) full payment
Steel or other metal parts	<ul style="list-style-type: none"> Guardrails must be present and not deformed All metal parts of overall structure shall be painted or otherwise protected and free of corrosion (corrosion protected) Contractor must immediately notify the project manager in case of any condition which threatens structural integrity of the structure 		5% (10%) full payment
Drainage system	<ul style="list-style-type: none"> The drainage system must be in good condition and fully functional allowing free flow of water 	56 days	5% (10%) full payment
Concrete structural parts (on structures and walls)	<ul style="list-style-type: none"> Beams and all other structural parts must be in good condition and fully functional Spalling and local concrete departures if exceeding 0.5 m² area shall be repaired Visible steel shall be protected against corrosion 	56 days	5% (10%) full payment
Masonry structural parts (on structures and walls)	<ul style="list-style-type: none"> Wall, piers, and all other structural parts made of masonry must be in good conditions and fully functional Spalling and local loss of bricks and joints if exceeding 0.5 m² area shall be repaired 	56 days	5% (10%) full payment

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Table continued

Item	Threshold	Response Time	Deduction Percentage ^a
Riverbeds	<ul style="list-style-type: none"> Contractor must ensure free flow of water under bridge and up to 100 m upstream and downstream Contractor must maintain design clearance under bridge Contractor shall take all reasonable measures to control erosion around bridge abutments and piers 	28 days	5% (10%) full payment
Vegetation control and cleaning	<ul style="list-style-type: none"> Contractor must ensure clean and free access under the bridge, and collect litter around the structure 	28 days	5% (10%) full payment
Cuts and embankments			
Embankment slopes	<ul style="list-style-type: none"> Shall be without deformations and erosions in any place 	28 days (7 days if safety hazard)	No volume-based payment
Removal of slides	<ul style="list-style-type: none"> Slides of slopes and rock fall onto the carriageway and the shoulder shall be cleared as part of the road usability measures Slides of slope material onto the road are considered an emergency, if the quantity of the material is above 300 m³ in any occurrence 	Traffic flow to be reestablished within 24 hours	No volume-based payment
Slope cuts	<ul style="list-style-type: none"> Slope cuts must be stable and/or adequate retaining walls and slope stabilization measures must be in place <ul style="list-style-type: none"> Fallen slope material must be removed: <ul style="list-style-type: none"> For quantities below 50 m³: <ul style="list-style-type: none"> from pavement within 12 hours after detection from shoulders within 48 hours after detection. For quantities between 50 m³ and 300 m³ <ul style="list-style-type: none"> from pavement within 24 hours after detection from shoulders within 96 hours after detection 	As per performance standard	No volume-based payment
Slope stabilization using retaining walls	<ul style="list-style-type: none"> Retaining walls shall be tight without missing blocks and parts ensuring slope stability at all times 	56 days	10% (20%) 1 km
Winter maintenance			
Winter preparation	<ul style="list-style-type: none"> 70% of expected required salt and sand available in the maintenance depot before 1 November each year 	7 days	15% (30%) full payment
Winter service preparation	<ul style="list-style-type: none"> All maintenance depots equipped with plant, equipment, and staff Poles and signs erected and information service operational 	7 days	15% (30%) full payment

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Item	Threshold	Response Time	Deduction Percentage ^a
Patrolling during winter season	<ul style="list-style-type: none"> Patrolling carried out daily, road clean and safe, patrol daily updated, and all events recorded All road furniture in place (road signs, parapets, poles) and in good working condition, ensuring safety at all times 	24 hours	15% (30%) full payment
Road surface during fair weather	<ul style="list-style-type: none"> Road surface free from ice and plowed 	12 hours	10% (20%) 1 km
Road surface during precipitation (snow)	<ul style="list-style-type: none"> Maximum average snow depth, 5 cm loose snow (or 3 cm of slush) Maximum time for passability with winter tires and without chains: <ul style="list-style-type: none"> 5 h in plains 8 h in mountains Maximum time of cleaning after precipitation: <ul style="list-style-type: none"> 8 h on traffic lanes 36 h on shoulder, if snow height exceeds 80 cm 24 h parkings and bus stops 	As per performance standard	10% (20%) 1 km
Road surface during precipitation (ice)	<ul style="list-style-type: none"> No ice accepted on the road surface Maximum time of cleaning after precipitation: <ul style="list-style-type: none"> 8 h on traffic lanes 36 h on shoulder, parkings, and bus stops 	As per performance standard	10% (20%) 1 km
Case of very low temperatures (-10°C)	<ul style="list-style-type: none"> Improving of friction using abrasive material Ice allowed as long as temperature stays below -10°C, but continuous gritting and plowing is required Penalty applied only in case of inaction of the contractor 		10% (20%) 1 km
Routine spring cleaning	<ul style="list-style-type: none"> All grit and sand to be removed from the pavement in April, after the end of the effective winter season, with collection of garbage, litter and objectionable materials 	28 days	10% (20%) 1 km

cm = centimeter, h = hours, km = kilometer, m = meter, m² = square meter, m³ = cubic meter, mm = millimeter.

^a Deduction percentages in brackets are applied if the defect is not corrected within the allocated response time. Deductions may be applied to the full monthly payment for the entire contracted road section, or to the monthly payment per 1 km segment. Some works are paid on a volume basis and, in case of noncompliance, the payment for the volume concerned is not made.

Source: Contract document.

APPENDIX 7: Performance Standards for the Kyrgyz Republic (2020)

Item	Threshold	Response Time	Applicable in Winter	Safety	Deduction Percentage
Performance standards with 100% penalty					
Potholes	• No potholes with a diameter > 20 cm	0 days	Yes	Yes	100%
	• No more than five potholes and/or edge breaks	0 days	Yes	Yes	100%
Drop-off	• No drop-off with a height difference > 70 mm	0 days	Yes	Yes	100%
Safety	• No missing traffic sign related to safety elements	0 days	Yes	Yes	100%
	• No missing guardrails and parapets related to safety elements	0 days	Yes	Yes	100%
Pavement					
Roughness	<ul style="list-style-type: none"> • Maximum average roughness over any 1 km carriageway length, 2.4 m/km • Maximum average roughness over any 100 m segment, 2.8 m/km 	30 days	No	-	$\frac{IRI^a - IRI^p}{IRI^p}$
Potholes, edge break	• No potholes are permitted	10 days	Yes	-	12%
	• No edge breaks are permitted with height difference > 70 mm	10 days	No	Yes	
Cracking	• There shall be no unsealed cracks more than 5 mm wide in any 1 km section of the road surface	2 days	No	-	7%
Rutting	• There shall be no ruts more than 30 mm deep in any 1 km section of the road surface	30 days	No	-	7%
Raveling	• There shall be no raveling of asphaltic surface layers in any area	30 days	No	-	5%
Shoulder					
Cleanliness	• The road surface and shoulders must always be clean and free of soil, debris, trash, and other objects – when safety hazard	12 days	Yes	Yes	8%
	• The road surface and shoulders must always be clean and free of soil, debris, trash and other objects – when no safety hazard	10 days	Yes	-	

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Table continued

Item	Threshold	Response Time	Applicable in Winter	Safety	Deduction Percentage
Drop-off	<ul style="list-style-type: none"> Acceptable length with drop-off >30 mm and <70 mm, 100 m/km 	20 days	Yes	-	8%
Drainage					
Ditches	<ul style="list-style-type: none"> Roadside ditches and lined drains must be clean, lining without any significant damage, and no standing water 	3 days	Yes	-	7%
	<ul style="list-style-type: none"> Other ditches when standing water 	7 days	Yes	-	
Culverts	<ul style="list-style-type: none"> Culverts shall be clean and without structural damage 	30 days	Yes	-	7%
Roadside					
Vegetation control	<ul style="list-style-type: none"> Permitted maximum height of any grass or weeds on shoulders, medians, road formation, and traffic islands; and behind safety fencing up to 3 m from outside edge of shoulders shall be <0.40 m tall 	5 days	Yes	-	5%
Safety					
Safety	<ul style="list-style-type: none"> Signs have to be present, complete, clean, legible, and structurally sound; and clearly visible at night – no safety element 	30 days	Yes		10%
	<ul style="list-style-type: none"> Signs have to be present, complete, clean, legible, and structurally sound; and clearly visible at night – safety element (may be temporary replacement) 	1 day	Yes	Yes	
	<ul style="list-style-type: none"> Guardrails have to be present, clean, without any significant damage, without corrosion - provide emergency safety measures until permanent repair, 1 m 	2 days	Yes	Yes	
	<ul style="list-style-type: none"> Guardrails have to be present, clean, without any significant damage, without corrosion – permanent repairs 	14 days	Yes	-	
Road markings	<ul style="list-style-type: none"> Horizontal demarcation and/or pavement paint has to be present, legible, and firmly attached to pavement. Micro spheres must be firm and visible 	60 days	No	-	8%

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Table continued

Item	Threshold	Response Time	Applicable in Winter	Safety	Deduction Percentage
Structures					
Retaining walls	<ul style="list-style-type: none"> Retaining walls must be free from structural damage or instability without damage or blockage to drainage – structural damage or instability 	60 days	Yes	-	4%
	<ul style="list-style-type: none"> Retaining walls must be free from structural damage or instability without damage or blockage to drainage – damage or blockage to drainage 	15 days	Yes	-	
Bridges	<ul style="list-style-type: none"> Bridge bearings and expansion joints must be free of dirt and debris Properly sealed Free-draining river beds 	30 days	No	-	4%
Steel structures	<ul style="list-style-type: none"> Steel structures must be sound, safe, and corrosion free Paint shall be kept in good condition 	14 days	No	-	4%
	<ul style="list-style-type: none"> Steel structures major repairs to structures or paint 	90 days	No	-	
Concrete structures	<ul style="list-style-type: none"> Concrete structures must be free of damage, no spalling, no exposed reinforcement, no signs or rebar corrosion – minor repairs 	14 days	Yes	-	4%
Winter maintenance					
Winter preparation	<ul style="list-style-type: none"> 70% of expected required salt and sand available in the maintenance depot before 1 November each year 	7 days	Yes		15%
Winter service preparation	<ul style="list-style-type: none"> All maintenance depots equipped with plant, equipment, and staff Poles and signs erected and information service operational 	7 days	Yes		15%
Patrolling during winter season	<ul style="list-style-type: none"> Patrolling carried out daily, road clean and safe, patrol daily updated, and all events recorded All road furniture in place (road signs, parapets, and poles) and in good working condition ensuring safety at all times 	24 hours	Yes		15%
Road surface during fair weather	<ul style="list-style-type: none"> Road surface free from ice and plowed 	12 hours	Yes		10%

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Table continued

Item	Threshold	Response Time	Applicable in Winter	Safety	Deduction Percentage
Road surface during precipitation (snow)	<ul style="list-style-type: none"> • Maximum average snow depth, 5 cm loose snow (or 3cm of slush) • Maximum time for passability with winter tires and without chains: <ul style="list-style-type: none"> – 5 h in plains – 8 h in mountains • Maximum time of cleaning after precipitation: <ul style="list-style-type: none"> – 8 h on traffic lanes – 36 h on shoulder if snow height exceeds 80 cm – 24 h parkings and bus stops 	As per performance standard	Yes		10%
Road surface during precipitation (ice)	<ul style="list-style-type: none"> • No ice accepted on the road surface • Maximum time of cleaning after precipitation: <ul style="list-style-type: none"> – 8 h on traffic lanes – 36 h on shoulder, parkings and bus stops 	As per performance standard	Yes		10%
Case of very low temperatures (-10C)	<ul style="list-style-type: none"> • Improving of friction using abrasive material • Ice allowed as long as temperature stays below -10°C, but continuous gritting and plowing is required • Penalty applied only in case of inaction of the contractor 		Yes		10%
Routine spring cleaning	<ul style="list-style-type: none"> • All grit and sand to be removed from the pavement in April, after the end of the effective winter season, with collection of garbage, litter, and objectionable materials 	28 days	Yes		10%

cm = centimeter, h = hours, IR_a = actual roughness, IR_p = planned target roughness, km = kilometer, m = meter, mm = millimeter.

Source: Contract document.

APPENDIX 8: Performance Standards for Mongolia

Item	Threshold	Response Time	Deduction Percentage ^a
RMPM-1: Pavement maintenance	<p>Surface integrity</p> <ul style="list-style-type: none"> No loose bitumen surface material Maximum surface area of raveling or visually evident (≥ 3 mm) cracking less than 5% (crack area is calculated using fixed width of 0.5 m) <p>Potholes</p> <ul style="list-style-type: none"> No more than one pothole with a diameter greater than 150 mm Maximum diameter of any single pothole less than 300mm No pothole shall be more than 50 mm in depth <p>Heaving, rutting, and shoving</p> <ul style="list-style-type: none"> No pavement heaving and/or shoving greater than 50 mm high No pavement rutting greater than 20 mm deep <p>Edge break</p> <ul style="list-style-type: none"> Aggregated longitudinal length of deficient sealed width less 5 m <p>Pavement surfacing repairs</p> <ul style="list-style-type: none"> No significant flushing, bleeding, scabbing, stripping, or raveling of the repaired surface No accidents associated with repair performance reported No sections are more than 10 mm higher than the surrounding pavement surface <p>Reinstatement of pavement markings and existing raised pavement markers/"cats eyes"</p> <ul style="list-style-type: none"> Existing pavement markings are reinstated within 48 hours of the surfacing being completed Existing raised pavement markers are reinstated within 7 days of the surfacing being completed <p>Service covers and utility trenches</p> <ul style="list-style-type: none"> All service covers have finished levels within ± 10 mm of the surrounding pavement surface All utility service trench surfaces are within 20 mm of the surrounding pavement surface 	6 months	20% (30%)
RMPM-2: Unsealed shoulder maintenance	<ul style="list-style-type: none"> No edge rutting or low shoulder greater than 50 mm depth No high shoulder extending above the level of the sealed surface No more than 10 potholes with a diameter greater than 300 mm The maximum diameter of any single pothole not greater than 400 mm No pothole greater than 100 mm in depth Maximum length of either shoulder with visually inadequate drainage cross-fall not more than 100 m 	12 months	10%

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Item	Threshold	Response Time	Deduction Percentage ^a
RMPM-3: Drainage maintenance	<p>Ponding of water on the pavement surface</p> <ul style="list-style-type: none"> No more than 20 m of ponding deeper than 10 mm No ponding for more than 1 hour after rainfall <p>Sumps, manholes, and catch-pits</p> <ul style="list-style-type: none"> No more than 20% of the pipe depth filled with debris <p>Culverts and associated structures</p> <ul style="list-style-type: none"> No areas of paint loss or flaking on existing painted concrete or masonry structures No more than 10% of the diameter filled with debris Vegetation height less than 100 mm within 2 m of inlet or outlet <p>Side drains (covered and uncovered)</p> <ul style="list-style-type: none"> No occurrences of blocked drains (ponding water) No more than 10% of depth obstructed by debris, sand, silt, or other obstructions in urban areas 	6 months	5%
RMPM-4: Routine maintenance of bridges and other structures	<p>Cleaning</p> <ul style="list-style-type: none"> No bridge or other major structure with graffiti <p>Damage</p> <ul style="list-style-type: none"> No structure exhibiting unreported damage that could potentially impact the structural integrity <p>Specific maintenance</p> <ul style="list-style-type: none"> No debris on the deck surface or in expansion joints, piers, abutments, bearings, or any other unreported minor non-structural damage 	12 months	5% (10%)
RMPM-5: Obstructions on the pavement surface and shoulders that are not an immediate safety hazard	<ul style="list-style-type: none"> No items on the sealed surface with any dimension greater than 300 mm (or smaller if posing an obvious safety hazard) No dead animals within the right-of-way No incidences of litter within the right-of-way negatively impacting the performance of any road asset (e.g., blocking drains, covering signs, wrapped around safety barriers) 	1 month	5%
RMPM-6: Incident response and emergency works response	<p>Maximum reaction time (from the time of notification)</p> <ul style="list-style-type: none"> To contact appropriate authorities: 1 hour To secure the site: 4 hours To remove (when authorized to do so) materials, abandoned vehicles, fallen trees and other obstructions etc. to free up traffic flow: 8 hours 	N/A	5%

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Item	Threshold	Response Time	Deduction Percentage ^a
RMPM-7: Vegetation control	<p>Vegetation control</p> <ul style="list-style-type: none"> • Vegetation control shall be carried out in a rectangular area extending 2m beyond the edge of seal and 6m above the edge of seal, including grass on all traffic islands • No vegetation on the sealed surface and no trimmed or slashed vegetation left on any sealed pavement surfaces, shoulders, traffic islands, or drainage channels • Maximum height less than 150mm for vegetation on the shoulder within 1m from the edge of the sealed pavement <p>Sight distance</p> <ul style="list-style-type: none"> • Sight distance at all intersections, railway crossings and single lane bridge approaches when seated in a vehicle shall not be less than that specified by the relevant Mongolian road design standard 	12 months	10% (0%)
RMPM-8: Road signs maintenance	<p>General</p> <ul style="list-style-type: none"> • All new signs will have required level of sign retro-reflectivity (regulatory, warning, information, advisory speed signs, and chevron markers) • No sign that is broken, damaged, discolored, dirty, missing, obscured by vegetation, graffiti, or posters or otherwise not performing as intended • No sign that is not visible at night from a distance of 160 m, with headlights on dipped beam, and/or has a reflectivity of less than 50% of its original reflectivity • No incorrectly aligned signs (5% from the vertical) • No signs which carry incorrect or misleading information (e.g., incorrect place names or distances) <p>Unauthorized signs</p> <ul style="list-style-type: none"> • No unauthorized signs <p>Frangible posts</p> <ul style="list-style-type: none"> • All existing or installed frangible posts must be inspected every 6 months and a summary of the inspected signs reported to the engineer within 7 days of the inspection • All damaged frangible posts are repaired within 48 hours or the next working day during weekends and/or public holidays <p>Sign gantries</p> <ul style="list-style-type: none"> • All sign gantries, including township entry sign structures, are checked every 6 months and are being maintained in fully operable condition • All damaged sign gantries, including township entry signs, are repaired within 48 hours or the next working day during weekends and/or public holidays 	6 months	2.5%

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Item	Threshold	Response Time	Deduction Percentage ^a
RMPM-9: Raised pavement markers – “cats eyes”	<ul style="list-style-type: none"> No more than two consecutive dysfunctional or missing raised pavement markers and no more than six in total in any continuous section No more than five raised pavement markers outside the required locations by more than ±25 mm A raised pavement marker shall be deemed to be nonconforming if it is not clearly visible at night, when viewed from the center of the lane from a distance of 160 m with headlights on full beam, or 80 m on dipped beam 	6 months	2.5% (0%)
RMPM-10: Pavement marking	<ul style="list-style-type: none"> No more than 10 m where the pavement markings do not comply with the relevant technical specification No more than 20 m that are not clearly visible during the day or at night, when viewed from the center of the lane from a distance of 160 m with headlights on full beam, or 80 m on dipped beam All areas of high wear or loss identified from monthly audit visual inspections to be remarked within 60 days of identification 	6 months	5%
RMPM-11: Traffic island and roundabout maintenance	<ul style="list-style-type: none"> No more than 1 location where a defined traffic island, roundabout, or similar traffic directing structure is visibly damaged and has not been programmed for repair 	12 months	2.5% (0%)
RMPM-12: Crash barrier maintenance	<ul style="list-style-type: none"> All damaged barriers are secured and do not compromise road user safety risk within 8 hours of observation or notification All damaged barriers are permanently repaired within 15 days from the time of notification All components have been installed in conformance with the manufacturer’s installation instructions, are structurally sound and functional, of uniform appearance, clean of any graffiti, unauthorized markings, signs, posters, etc. 	6 months	5% (0%)
RMPM-13: Handrail and pedestrian barrier maintenance	<ul style="list-style-type: none"> All damaged rails and barriers are secured and do not compromise a road user safety risk within 8 hours of observation or notification All damaged rails and barriers are permanently repaired within 2 weeks from the time of notification All components have been installed in conformance with the manufacturer’s installation instructions, are structurally sound and functional, of uniform appearance, clean of any graffiti, unauthorized markings, signs, posters, etc. 	6 months	2.5% (0%)

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Item	Threshold	Response Time	Deduction Percentage ^a
RMPM-14: Marker post maintenance	<ul style="list-style-type: none"> All marker posts comply with the Ministry of Roads and Transport Development specifications for materials, visibility, and spacing, including the maintenance of all painted surfaces There are no missing marker posts (including marker posts with missing reflectors, or reflectors that cannot adequately be seen because of excessive buildup of dirt) At least 80% of all reflectors are intact Marker posts are clear of any vegetation obscuring the marker above 200 mm from ground level 	12 months	5% (7.5%)
RMPM-15: Winter maintenance	<ul style="list-style-type: none"> Remove snow on the full width of the travelled lanes, through toll booths, in rest areas, weigh scale areas, and other such areas to ensure that accumulations remain below 4 cm on one lane in each direction, and below 8 cm on all other lanes During extended periods of extreme cold, remedy unsafe conditions such as, but not limited to, ice on the travelled lanes and those conditions arising from melt and refreeze situations Complete removal of loose snow and slush from the areas designated above, within 24 hours of the last measurable snowfall At all superelevated curves and other locations where the shoulder edge is higher than the travelled lanes, the contractor must push snow and ice beyond the shoulder edge within 2 days of the end of the last measurable snowfall to prevent snowmelt drainage onto the travelled lanes When guardrails prevent the complete removal of the snow to the shoulder edge, the contractor must deal with any resulting condition that is unsafe or has the potential to be unsafe Undertake all reporting as documented in the winter maintenance plan Remove grit as per the winter maintenance plan at the end of winter Commence application of de-icing chemicals within 2 hours of instruction to proceed and complete within 6 hours of instruction to proceed 	N/A	15% (20%)

cm = centimeter, m = meter, mm = millimeter, N/A = not applicable, RDPM = road durability performance measures

^a The first percentage is the standard percentage. The percentage in brackets is what was actually applied in the performance-based road maintenance contract.

Source: Contract document.

APPENDIX 9: Performance Standards for Tajikistan

Item	Threshold	Response Time	Units	Deduction Percentage
1. Road usability				
1.1 Road shall be open to traffic at all times with maximum interruption of:	24 hours	2 days	day	1%
2. Road comfort				
2.1 Average safe operating speed from beginning to end of the road section	60 km/hour (1 minute per km)	28 days	min	1%
2.2 Potholes on road surface >10 cm in any dimension	No potholes > 0.5 m ² Fewer than five small potholes in any 1 km segment	7 days	km	5%
2.2a Maximum size of any pothole in the paved road surface	0.5 m ²	7 days	km	2%
2.3 Potholes on shoulder >15 cm in any dimension	Fewer than 15 potholes in any 1 km segment	14 days	km	2%
2.4 Vegetation on road formation, including shoulders, medians, and traffic islands	No vegetation >0.5 m height in any 1 km segment	14 days	km	5%
2.5 Vehicles, soil, rocks, and other debris compromising road user safety	No materials less than 0.5 m from the edge of the road in any 1 km segment	8 hours	km	5%
2.6 Vehicles, soil, stones, and other debris not compromising road user safety	No materials on the shoulder, roadside, or drainage structures	28 days	km	1%
2.7 Road signs present, clean, visible, and undamaged	No tolerance	14 days	sign	1%
2.8 Pavement markings	All markings must be visible from a distance of 100 m in any 1 km segment	28 days	km	2%
2.9 Existing guardrails	No missing and/or damaged section in any 1 km segment	28 days	km	2%
2.10 Guideposts and barriers	Present, clean, visible, and undamaged in any 1 km segment	28 days	km	1%
2.11 After snowfall normal traffic, movement shall be restored	Snow or ice thickness cover on the roadway less than 15 cm	8 hours	km	10%
2.12 After the restoration of traffic:	Apply grit/salt mix to the roadway	4 hours	km	10%

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Table continued

Item	Threshold	Response Time	Units	Deduction Percentage
2.13 After clearing roadway and daytime temperatures above freezing	Remove ice and snow from roadside, shoulders, and drainage facilities	14 days	km	7%
3. Road Durability				
3.1 Unsealed cracks greater than 3 mm wide	Less than 20 m in any 1 km segment	28 days	km	10%
3.2 Raveling or surface delamination on road surface	Less than 10 m ² in any 1 km segment	28 days	km	10%
3.3 Height difference of shoulders in relation to pavement	Less than 7.5 cm drop in any 20m length in any 1 km segment	28 days	km	5%
3.4 Culverts and inlet/outlet channels at each end for 3 meters	Less than 20% obstruction in any culvert	28 days	culvert	1%
3.5 Bridge deck drainage system	Drains and scuppers shall allow unobstructed drainage at each bridge	28 days	bridge	10%
3.6 Watercourse under bridges	Clear debris up to 100 m upstream from each bridge	28 days	bridge	10%
3.7 Bridge super and substructure damage not covered under routine maintenance	Damage or erosion not covered under routine maintenance documented for each bridge	7 days	bridge	5%
3.8 Standing water on the road surface	Less than 20 m ² water with a depth of more than 5.0 cm, 3 hours after rainfall in any 1 km segment	14 days	km	2%
3.9 Standing water on paved and unpaved shoulders	Less than 40 m ² water with a depth of more than 10 cm, 3 hours after rainfall in any 1 km segment	28 days	km	2%
3.10 Lined and unlined drains adjacent to the road	Less than 50% silted up or impeding free water in any 1 km segment	28 days	km	1%
3.11 Erosion or damage in or adjacent to drainage structures or cut or fill slopes	No structural damage or eroded sections exceeding 1 m ³ that impede or divert free flow	28 days	km	4%

cm = centimeter, km = kilometer, m = meter, m² = square meter, m³ = cubic meter, mm = millimeter.

Source: Contract document.

Performance-Based Road Maintenance Contracts in the CAREC Region

This publication looks at performance-based road maintenance contracts, distinguishing between performance-based maintenance contracts, service level agreements, and output- and performance-based road contracts. It reviews 24 different contracts implemented in six members of the Central Asia Regional Economic Cooperation (CAREC) program: Azerbaijan, the People’s Republic of China, Georgia, the Kyrgyz Republic, Mongolia, and Tajikistan. It outlines the contract scope, performance standards, inspections, response times and reaction times, the payments and deductions, and the procurement and contract costs. The publication highlights lessons from the different experiences and provides recommendations for future performance-based road maintenance contracts in these and other countries.

About the Central Asia Regional Economic Cooperation Program

The Central Asia Regional Economic Cooperation (CAREC) Program is a partnership of 11 member countries and development partners working together to promote development through cooperation, leading to accelerated economic growth and poverty reduction. It is guided by the overarching vision of “Good Neighbors, Good Partners, and Good Prospects.” CAREC countries include Afghanistan, Azerbaijan, the People’s Republic of China, Georgia, Kazakhstan, the Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan.

About the Asian Development Bank

ADB is committed to achieving a prosperous, inclusive, resilient, and sustainable Asia and the Pacific, while sustaining its efforts to eradicate extreme poverty. Established in 1966, it is owned by 68 members —49 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.



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ASIAN DEVELOPMENT BANK

6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
www.adb.org