

THIS IS AN AUTOMATIC TRANSLATION, PLEASE REFER TO SPANISH FOR ORIGINAL VERSION

THE IMPACT OF PUBLIC-PRIVATE PARTNERSHIPS TENDERED UNDER PERFORMANCE STANDARDS

Ángel Trinidad Martínez Arboleya, Ariadna Moncada Palafox, Franco Gómez Rojas
VISE S.A. de C.V. Concessions Management, Guanajuato, Mexico
amartinez@vise.com.mx

SUMMARY

Public-private partnerships (PPP) are "a long-term contract between a private party and a public party to provide a public asset or service in which the private party assumes significant risk and management responsibility and remuneration is linked to performance" [1].

One of the main elements of PPPs is the identification, description, quantification, and allocation of risks between the public and private sector in the different stages of the projects, which generally include: design, development or rehabilitation, financing, operation and maintenance of the assets. The allocation of these risks will define the type of PPP contract and the associated payment mechanism.

In road projects in particular, the allocation of risks to the private sector in the operation and maintenance stage is especially relevant, since it is at this stage that the main social benefits for which the investment project was implemented and developed are obtained, through a reduction in vehicle operating costs and generating savings in travel time for users and goods.

Including the application of performance-related concepts in PPP contracts whose main objective is to modernize, conserve, maintain and operate highway sections in specific compliance with previously established, correctly defined parameters, and associated with an efficient and effective payment mechanism, will make it possible to meet the project's objectives.

This research paper analyzes 3 of these contracts by presenting: i) the description of each of the PPP contracts under performance standards, ii) the control and verification methodologies of each of the PPP contracts, iii) the different associated payment mechanisms, and iv) the main social, economic and technical benefits of the contracts.

The purpose of the work is to promote PPP schemes under performance standards and offer tools to decision-makers in road infrastructure bidding processes, so that the projects efficiently and effectively meet the objectives for which they were developed.

1. BACKGROUND

In Mexico, "The concession experience has gone through different stages with greater and lesser success. Despite the problems with those granted in the early nineties, in what was called the National Highway Program, Mexico has evolved very positively in recent years and is currently one of the most active countries, both in concessions and in other ways of introducing private initiative in the provision of infrastructure" [2] [2].

In 2004, the rules for developing Service Provision Projects (PPS) were published, which were developed to involve private investment in the provision of public services through long-term contracts where certain responsibilities were shared between the public and private sectors; This situation served as a precedent for the National Bank of Public Works and Services (BANOBRAS) to implement the New Model of Highway Operation (NMO) that allowed the participation of the private sector through multi-year Public-Private Partnership contracts in the operation, maintenance and conservation subject to compliance with performance standards, with the Law of Roads, Bridges and Federal Transportation.

Finally, in 2012, after more than 15 years of learned experiences, the Public-Private Partnerships Law (LAPP) was enacted, with which Mexico took an important step to promote and develop infrastructure under a legal framework that, on the one hand, provided security and legal certainty to private parties partnering with the government, and on the other hand, required a high level of project preparation.

Based on the LAPP and the NMO, the Ministry of Communications and Transportation (SCT) promoted PPP contracts for road maintenance under performance standards, which consisted of structuring long-term contracts to facilitate the participation of private companies, favoring construction quality with bonuses for compliance with long-term performance standards, and modifying the vision for infrastructure development in our country as shown in Table 1.

Table 1 - PPP vs. Traditional Scheme for Infrastructure Development

Concept/Scheme	Conservation PPP Scheme	Traditional Scheme
Scope	Design, financing, construction, equipment, maintenance and operation of the asset.	Infrastructure Development
Payments	Payment for Performance Standards subject to deductions	Unit Price or Lump Sum Payments
Term of contracts	Long-term contracts	Short or medium-term contracts
Parameters	Performance Indicators	Specifications and Standards
Risks	Substantial risk transfer to the private sector	Substantial risk retention
Financial effort of the Unit	In the medium and long term	In the short term
Public sector purchases	Services	Assets

Source: 1st International Seminar on Road Maintenance by Salvador Pou Boix.

The particularities of highway PPP projects under performance standards are: i) the infrastructure already exists, ii) the Developer rehabilitates and maintains it, iii) it is a contract in which the Developer provides a service, iv) the right of way is available and the environmental impact assessment is exempted, and v) in the case of projects under the NMO, "operation" services were included since they are implemented on toll roads.

2. DESCRIPTION OF CONTRACTS

The three contracts to be analyzed in this paper were developed by different authorities, and in different time periods and areas of Mexico, which allows us to identify the main differences in their structuring.

2.1. THE GUADALAJARA-COLIMA HIGHWAY (M&R)

It is a toll highway with a length of 148 km that was concessioned through the Ministry of Communications and Transportation (SCT) to Banco Nacional de Obras y Servicios Públicos (BANOBRAS) for the construction, operation, exploitation, conservation and maintenance of the highway. In 2012, BANOBRAS selected this project as a pilot for the NMO and separately tendered the Maintenance and Rehabilitation (MR) and Operation (O) activities of the toll booths.

2.2. THE QUERÉTARO-SAN LUIS HIGHWAY (APPQRO)

It is a toll-free Federal road, with a length of 167.42 km, which, is part of one of the 10 contracts that, as of 2016, the SCT tendered under Mexico's Public-Private Partnerships Law (LAPP), contemplating in a multi-year contract the activities of conservation, rehabilitation, reconstruction and road services.

2.3. THE ATLACOMULCO-MARAVATÍO HIGHWAY (MRO)

It is a toll highway with a length of 64 km that was concessioned through the SCT to BANOBRAS for the construction, operation, conservation and maintenance of the road section. In 2019, BANOBRAS authorized and tendered in a single package the maintenance, rehabilitation and operation activities. Previously, the highway, along with the Guadalajara-Colima Highway, were piloted for the NMO promoted by BANOBRAS and tendered separately, the Operation Maintenance and Rehabilitation activities.

Two important differences described above are i) 2 of the 3 contracts were bid through BANOBRAS, and 1 directly from the Federal Government through the SCT; This represents a slight difference with respect to the structuring of the contracts and the specifications of the performance standards that we will review later, and ii) the two contracts tendered by BANOBRAS are toll roads, in one of them, the same Developer performs the activities of Maintenance, Rehabilitation and Operation, while in another, such activities were separated between Maintenance and Rehabilitation, and on the other hand the Operation, and the third contract tendered directly by the Federal Government, is a toll free road.

The APPQRO and M&R contracts consider a similar financing structure in which the initial investment amount to carry out the rehabilitation and/or overhaul works of the highways under certain standards established in the contract was with resources contributed by the Developers (15-25%) and by the acquisition of bank loans and/or subordinated debt (75-25%). In the case of MRO, the initial fine-tuning was paid in full by BANOBRAS through a payment called "Pago Unitario por Servicio Prestado (PUSP)", paid at the end of the completion of the fine-tuning activities.

The source of funds for recovering the investment and carrying out the roadway maintenance and preservation work comes from periodic payments by the Contracting Party.

The main objective of the contracts is to provide a public service by offering road users adequate levels of service to ensure continuous, safe and smooth vehicular traffic flow.

Table 2 shows the contracts and their main characteristics.

Table 2 - Main characteristics of the contracts analyzed

Contract	Location	Length (km)	Type of road	Contract start - end year
M&R	Jalisco and Colima	148	A2 and A4	2012-2025
APPQRO	Querétaro, Guanajuato and San Luis Potosi	167.42	A4	2016-2027
MRO	State of Mexico and Michoacán	64	A4	2019-2026

Source: Own elaboration with information from contracts.

3. CONTROL AND VERIFICATION METHODOLOGIES

Establishing a PPP contract under performance standards allows, through a series of economic incentives and penalties, the Developer to offer a quality service that benefits road users and the Contracting Party to regulate, control and evaluate that such service complies with the requirements of the contract.

Among the main control methodologies established in the contracts are the following:

3.1. DIVISION OF SECTIONS AND SEGMENTS

One of the main differences in the three contracts was the strategy implemented by the Contractor in the subdivision of the road sections.

The subdivision of the roads has a direct impact on the achievement of the objectives established in the PPP contracts since it influences the time of the initial rehabilitation, the establishment of performance standards for each of the segments according to the conditions of the road, the payment mechanism, and the application of deductions for non-compliance.

Table 3 - Division of tranches and segments of each contract

Contract	Sections	Segments
M&R	5	16
APPQRO	1	16
MRO	1	1

Source: Own elaboration with information from contracts

The M&R contract was divided first by sections and then by segments. This segmentation was made for three main reasons: i) there were no previous references in the establishment of performance standards and their specifications, ii) due to the wide differences in the physical and geographic characteristics of the road segments, and iii) some road segments were under construction, so the delivery of these segments would be in different periods of time and in installments.

The segmentation of the road section into 2 divisions had different effects: (i) the contract stipulated that payment for the Initial Rehabilitation would begin once each section complied with the contract specifications, this situation encouraged the Developer to implement a rehabilitation strategy that would allow it to receive such payments as soon as possible, so that, in most of the sections, the Rehabilitation stage was concluded earlier than presented

in the proposal, (ii) this situation generated a budgetary pressure since the contract term was defined and the payment based on the fine-tuning of each section, iii) it allowed establishing performance standards according to the geographic conditions of each section, and iv) the contract stipulated that the application of deductions for non-compliance would be per segment and based on a weighting of the sections, which resulted in relatively low amounts to be deducted for non-compliance, which discouraged the Developer from complying on time with certain established standards.

The APPQRO contract was divided only by 1 section and 16 segments; in the contract it was stipulated: (i) that the payment for the fine-tuning in the Rehabilitation stage would not be made earlier than presented in the proposal even if the requirements were reached ahead of time, this on the one hand discouraged the Developer from complying with the Rehabilitation earlier than required in the contract, and on the other hand, that the Employer did not have a budgetary pressure to increase the value of the contract, and (ii) the performance standards were homologated for the entire road section.

And finally, the MRO contract was split into a single tranche and a single segment.

In the APPQRO and MRO contracts, a lower subdivision of the road assets facilitated the establishment of performance standards, the payment mechanism, and the calculation of the application of deductions, and the penalties for noncompliance have a greater impact the lower the subdivision.

In conclusion, the strategy of dividing the road section has both positive and negative impacts on PPP contracts. It is important to clearly identify the objectives to be achieved, and to implement the appropriate incentives for their proper fulfillment.

3.2. PERFORMANCE STANDARDS

One of the most important elements in ensuring that the utilities provided by the Developer are of quality, and that the objectives of the contract are met, is the selection, grouping, and specification of performance standards.

3.2.1. Selection of Performance Standards and their grouping

The first difference in the contracts analyzed is the grouping and number of performance standards required in each PPP contract.

Table 4 - Performance standards for each contract

M&R		APPQRO	MRO
Standard	Indicator	Performance standard	Performance standard

Crown	Surface deterioration	Surface deterioration	Surface deterioration
	Pavement (fatigue cracking)	Not Applicable	Rigid pavements
	IRI	IRI	IRI
	Depth of rutting	Depth of rutting	Depth of rutting
	Coefficient of friction	Coefficient of friction	Coefficient of friction
	Not measured	Deflections	Not measured
	Not measured	Macrotexture	Not measured
	Cleaning of roadways and shoulders	Roadway Cleaning and Sidewalks	Cleaning of roadways and shoulders
Cuts and embankments	Slopes	Slopes	Slopes
	Landslide removal		
Structures	Structures	Structures	Structures
Drainage, cleaning and repair	Drainage, ancillary works, cleaning and repair works	Drainage Works	Drainage and complementary works
Special pavements and Trustee facilities	Special paving and maintenance of the Trustee's facilities	Not applicable	Not applicable
Signaling and safety devices	Horizontal signage	Horizontal signage	Horizontal signage
	Vertical signage	Vertical signage	Vertical signage
	Defenses and barriers	Defenses and Barriers	Defenses and barriers
Right-of-way functionality	Vegetation control	Right-of-way functionality	Vegetation control
	Cleaning Right of Way		Cleaning Right of Way
	Fence right of way		Fence right of way
Road Safety. Danger Index	Danger Index Improvement (% improvement >25%)	Not Applicable	Emergency Coordination (% improvement >10%) (standard of operation)
Not Applicable	Not Applicable	Road Services	SOS poles (roadside assistance towers and emergency telephones (standard of operation)

Source: Own elaboration with information from PPP contracts.

The first major difference is in the grouping of the activities to be performed in the performance standards. In the M&R contract, the performance standards were grouped into 4 main areas (surface and structural elements, signaling and safety devices, right-of-way functionality, and road safety); within each area, the performance standards to be met were assigned, and each standard was assigned a series of indicators with specific service requirements. Performance standards were established directly in the APPQRO and MRO contracts.

This difference in grouping has a significant impact on the objectives pursued by the Employer through the application of deductions to payment. For example, the "right-of-way functionality" standard in M&R considers 3 indicators for the same standard, in APPQRO it is a single performance standard that encompasses all activities, and in MRO it is 3 independent performance standards.

Another important element to consider are the performance standards to be included in the PPP contract, which will depend on the objectives and resources available to the Contractor, for example, in the APPQRO contract it was decided to prioritize the road conditions by incorporating two additional standards that are not considered in many PPP contracts:

Deflections and Macrotexture, which have a significant impact on the quality of the roadway, however, due to their high specifications, generated that the cost of the contract was higher than others that do not contemplate such standards.

The performance standards established and their grouping will depend on the priority objectives and resources available to the Employer for the benefit of the users.

3.2.2. Performance standards specifications

The second element to consider once the standards and their grouping have been chosen is the performance levels that will be required in each PPP contract.

Table 5 - Performance standard specifications by PPP contract

Indicator	M&R	APPQRO	MRO
Surface deterioration	No potholes Crack-Not specified Cracking $\leq 5\%$ a. lane Detachment $< 5\%$ No. of cracks < 1 per 100m	No potholes Crack $< 3\text{mm}$ wide Cracking $< 5\%$ a. rail Detachment $< 5\%$ No. of cracks -Not specified	No potholes Crack -Not specified Cracking $< 10\%$ w/ 100m Spalling $< 10\%$ No. of cracks -Not specified
Structural fatigue	$> 1\%$ per segment per year	Not measured	
IRI	≤ 2.5		
Prof. roderas	$< 10\text{mm}$	$\leq 12\text{mm}$	$\leq 8\text{mm}$
Coefficient of friction	≥ 0.45	$0.4 < U \leq 0.9$	
Deflections	Not measured	≤ 500	Not measured
Macrotexture	Not measured	$> 0.75\text{MM}$	Not measured
Cleaning of roadway and shoulders	Clean and free of obstacles		
Slopes	Slopes in cuts and embankments: no cracking and in good condition		
	Not measured		+ Hydroseeding (80%)
Landslide removal	No obstructions in crown and drainage works due to landslides		
Structures	Bridge Administration System (SIAP) [3,4 or 5)	Mexico Bridge System (SIPUMEX) [0,1 o 2].	Bridge Administration System (SIAP) [3,4 or 5)
Drainage works	Clean, unclogged and unobstructed culverts, ditches, washes, curbs and waterways		
Special pavements	Cracks $< 3\text{mm}$ Detachments $< 75\text{mm}$	Not applicable	Cracking $< 3\text{mm}$
Horizontal signage	100% present, visible and adhered		
	Retroflexion paint: White > 200 mcd/lx/m ² Yellow > 150 mcd/lx/m ² Vibroline 4-lane stretches	Retroflexion paint: White > 200 mcd/lx/m ² Yellow > 150 mcd/lx/m ² Vibroline 4-lane stretches	Retroflexion paint: White > 150 mcd/lx/m ² Yellow > 150 mcd/lx/m ² Red > 24 mcd/lx/m ²
Vertical signage	100% present, clean, well positioned, structurally sound		
	Retroflexion: 580 $>$ White $>$ 342 435 $>$ Yellow $>$ 257 Orange $>$ 104 Green $>$ 38 Blue $>$ 17	Retroflexion: 580 $>$ White $>$ 342 435 $>$ Yellow $>$ 257 Orange $>$ 104 Green $>$ 38 Blue $>$ 17	Retroflexion: White $>$ 342 Yellow $>$ 257 Orange $>$ 123 Green $>$ 34 Blue $>$ 15 Red $>$ 68
Defenses and barriers	100% present, well positioned, and undamaged (SCT regulations). Incl. anti-glare screens		

Vegetation control	10m from curb edge to right-of-way fence Height <20cm	From edge of curb to right-of-way fence Height <20 cm	From edge of curb to right-of-way fence Height <20 cm Reused waste
Right-of-way cleaning	Clean and unobstructed		
Right-of-Way Fencing	Concrete posts and cattle netting 100% present and undamaged.		
Improved Danger Index	YES	Not measured	Standard operation
Road services	Not measured	2 Daily tours Attention to incidents and emergencies (max. 45 minutes)	Standard operation

Source: Own elaboration with information from PPP contracts.

One of the main elements that will determine whether the PPP contract meets the objectives efficiently and effectively is the specification of performance standards.

In each performance standard, the scope and response time are determined, and based on these, a cost will be assigned. It is important to be clear about the objective pursued with the PPP contract, for example, in the case of the M&R contract, in the "Surface Deteriorations" performance standard, 2 elements were determined that apply deductions to the payment: i) number of cracks and ii) cracking. The number of cracks may be perceived by users as visually in poor condition without necessarily being true; including this restriction will increase the value demanded by the Developer without significantly affecting the main objective of the contract, which is to generate social benefits through the reduction of vehicle operating costs (VOC), or including standards such as "Deflections" and/or "Macrotecture" will have a positive impact on road conditions and therefore, on social benefits, but will increase its cost very significantly.

The specifications of the performance standards must also be affordable and well aligned for the Developer, for example, in the M&R contract, the "Improvement in the Danger Index" standard was defined, which seeks to encourage a decrease in the number of accidents on the road, however, its definition was not so effective since, by improving the road conditions, the demand and traffic speeds increased, thus increasing the number of accidents on the road, which was detrimental to the Developer.

Finally, an interesting element that can be considered in the performance standards is the attention and care for the environment as in the case of the MRO contract, in which, in the slopes standard, "hydroseeding" was included to control soil loss.

Therefore, the more demanding the specifications in the performance standards, the higher the cost of the PPP contract, so it is important to be clear about the scope, time and cost of each PPP contract and that these are affordable for the Developer to align with the specifications required in the performance standards.

3.3. EXTERNAL OVERSIGHT AND REPORTING ACTIVITIES

A control measure established in the 3 PPP contracts is the definition of the figure of the "Supervising Manager" (SM) in the case of APPQRO, and the "Supervising Administrative Agent" (SAA) in the M&R and MRO contracts, which are figures that represent the Contracting Party and are in charge of requesting and validating the reports supporting the activities carried out and to be carried out by the Developer. R and MRO contracts, which

are figures that represent the Contracting Party and are in charge of requesting and validating the reports that support the activities performed and to be performed by the Developer, and validating that the contract specifications are being fully complied with, or if applicable, applying the corresponding deductions to the payment received by the Developer.

In the case of AAS, it was assigned additional planning and bidding process functions, thus collaborating in the specification of the performance standards that were established in the PPP contract.

3.4. SELF-MONITORING UNIT

In the 3 PPP contracts it was defined that the Developer is obliged to establish within its own organizational structure, a self-monitoring unit with qualified personnel, whose task is to verify, on an ongoing basis, the degree of compliance with the required performance standard indicators.

The Self-control Unit, in conjunction with the AAS or GS, performs inspection functions, control tests, corrective actions, validates follow-up plans, budgets, reports, supervises routine and periodic maintenance work, and validates and approves the monthly payments of the consideration for each performance standard.

3.5. ROAD MANAGEMENT SYSTEM

One element that has become relevant in PPP contracts under performance standards is the obligation for the Developer to have a Road Management System (RMS).

The system aims to ensure the optimal use of the resources available for the administration of the highways so that the infrastructure is in adequate condition, and to carry out timely actions in the stretches that require intervention.

Table 6 - Scope of the PPP Contract Road Management System

Scope of the QMS Module Contract	M&R	APPQRO	MRO
GIS interface (Georeferenced Information System)	X		
Inventory of road assets	X	X	X
Inventory Condition Management and Inspection	X	X	X
Auscultation Charts (Pavement Evaluation)	X	X	
Pavement Management and Preservation (Evolution, Behavior and Pavement Interventions Models)	X	X	
Conservation Management	X	X	X
Queries of the information contained in the Database	X		X
Electronic logbook			X
Operation Management			X
Reports	X		X
Mobile application to review incidents and update inventories.	X		X
Quality and continuous improvement			X
ITS and Communications System			X
Deductions for noncompliance			0.12 % (each day in arrears)

Source: Own elaboration with information from PPP contracts.

Requiring a QMS in PPP contracts will help to have roads in better conditions, to have the complete experience of all the activities that have been carried out on the road asset, to carry out better diagnostics, and to implement actions in a timely manner.

3.6. OTHER CONTROLS

Other controls established in the PPP contracts to ensure compliance with the objectives include:

Table 7 - Other controls established in PPP contracts

Controls established in the contract	M&R	APPQRO	MRO
Camp	X	X	X
Quality control of materials	X	X	X
Equipment calibration	X	X	X
Key personnel	-	X	-
Non-compliance with inspection frequency	X	X	X
Site protection signage	X	X	X
Annual measurement of the structural capacity of the pavement.	-	X	-
Environment	-	-	X
Annual maintenance program for services	X	X	X
Quality Management Plan	X	X	X
Remaining life (years)	2	3	5

Source: Own elaboration with information from PPP contracts.

Among the main differences in other controls established in the PPP contracts we consider: (i) in APPQRO there is a restriction regarding "Key Personnel" in which the Developer must give prior written notice to the Contracting Party of any modification to its key personnel or it would be subject to an economic penalty, (ii) the incorporation of Attention and Care for the Environment in the MRO contract, and iii) a control established in the contracts that guarantees that the work performed during the conservation and maintenance stage is the "Remaining Life of the Pavement" which specifies how long the pavement structure of the road asset should last once the road asset is returned.

4. PAYMENT MECHANISMS

A fundamental element to achieve compliance with the objectives of PPP contracts under performance standards is the "Payment Mechanism" established, since it drives the Developer's behavior through incentives and penalties for compliance with contract specifications.

Table 8 - Payment mechanisms and deductions by PPP contract

Concepts	M&R	APPQRO	MRO
----------	-----	--------	-----

Payments	<p>Pay Per Availability (PPD): Initial Rehabilitation Payment.</p> <p>Monthly Unit Prices (MUP): payment for compliance with performance standards, applying deductions in case of non-compliance.</p> <p>Unit Prices for Completed Work (PUOT): additional work not considered in the contract</p>	<p>Fixed Monthly Unit Price for Rehabilitation (PUMr): Payment for Initial Rehabilitation and is comprised of financing plus risk capital.</p> <p>Fixed Monthly Unit Price Maintenance (PUMm): Reimbursement of the IRR of the risk capital plus the standard maintenance amounts.</p>	<p>Monthly Unit Price (MUP): payment for services meeting performance standards. Divided into 2:</p> <ul style="list-style-type: none"> - Maintenance and Rehabilitation (MR): For periodic, routine maintenance and reconstruction. - Operation (O): Operation services. <p>Unit Price Service Provided (PUSP): initial improvement works that are paid upon completion of the work.</p>
Formula for deductions in payment	$\%Cumpl = \left[1 - \left(\frac{\sum(Bi+ai)}{Stot} \right) \right] * 100$	$PMi = \sum PMiSjEeR \sum PMiSjEem * FCij$	$ITPUM "MR" c/d = ITPUM MR - \sum DTVCx$
Special features	Deduction for: degree of affection (defined), days, and segment weighting.	Deduction for 3 scenarios (2%-5%): threshold allowed, not solved in time, and for additional corrective time, and if applicable, area or length affected.	Deduction for 3 scenarios (0.25%-10%): initial, corrective and reiterative deduction, and by length and/or times of occurrence.
	Segment weighting and defined degree of impairment	Includes Compliance Factor (1.05)	Method for calculating the impact.
Advantages	Segment payment allowed early termination of IR	Compliance factor as an incentive or excessive punishment	Deduction established for each standard, and allocation methods.
	Segmentation allows the establishment of standards according to the characteristics of the section.	Deduction focused on correction times.	Inclusion of "Reiterative" deduction percentage.
Cons	Predefined weightings that may be subjective	Segmentation decreases the amount to be deducted.	Does not include compliance factor incentive
	Segmentation of standards decreases the amount to be deducted.	There is no deduction for repeat offenses.	Does not include penalty for elapsed days.
Historical % Deductions with respect to Payment	0.23%	0.20%	0.13%

Source: Own elaboration with information from PPP contracts.

In the 3 contracts we have identified and presented in Table 8 the advantages and disadvantages in the payment mechanisms, as well as the impact on the deductions of each contract.

The payment mechanism is an element in PPP contracts that either incentivizes or disincentivizes the Developer to fulfill the requirements of the contract efficiently and effectively.

We consider it essential to propose a simple payment mechanism, with clearly established deductions, and to identify variables that incentivize the Developer to comply with the specifications of the PPP contracts.

5. ECONOMIC AND SOCIAL IMPACTS

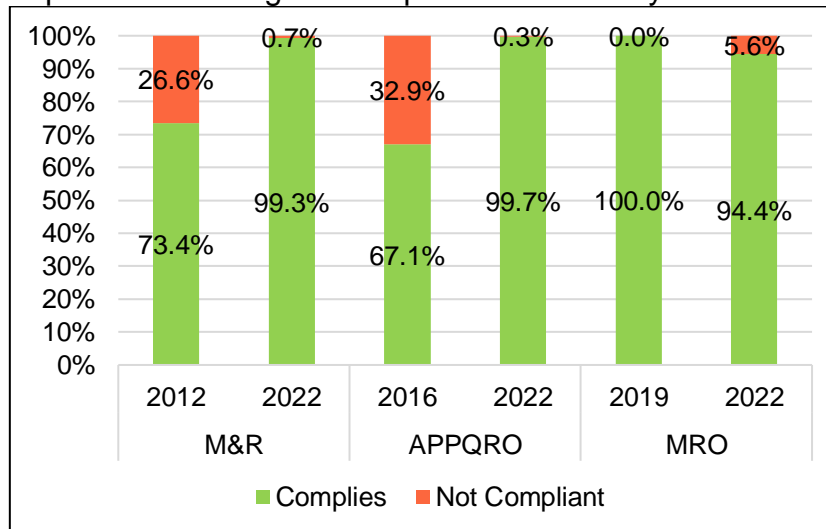
The particular characteristics of each PPP contract had different technical, economic and social impacts. This section will compare the situation before the bidding of the PPP contract against the current situation for each contract with their respective specifications in the performance standards.

5.1. INTERNATIONAL ROUGHNESS INDEX (IRI)

Graph 1 evaluates the percentage of compliance with the IRI performance standard specifications for the 3 PPP contracts.

In the M&R contract before the bidding process, 26% of the roadway did not comply with the contract specifications, currently 0.7% of the total roadway is not compliant, in APPQRO it was 32.9% and currently it is 0.3%, and in MRO it went from 0% to 5.6%, this due to the fact that it is a contract under second generation performance standards, however, the percentage of non-compliance is less than 6% and the Developer is currently implementing Periodic Maintenance actions to raise the compliance percentage.

Graph 1 - Percentage of compliance with IRI by PPP contract

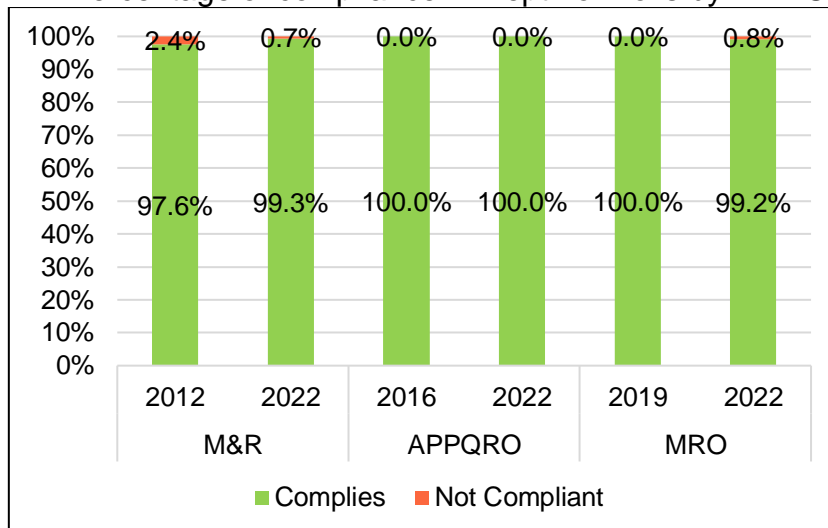


Source: Own elaboration with information from PPP contracts.

5.2. DEPTH OF RUTTING

From Graph 2 it can be seen that in the 3 contracts the performance standard for rut depth required in each contract was and is almost fully met, with the M&R contract showing the greatest improvement, going from 2.4% non-compliance to 0.7%.

Graph 2 - Percentage of compliance in Depth of Bolls by PPP Contract

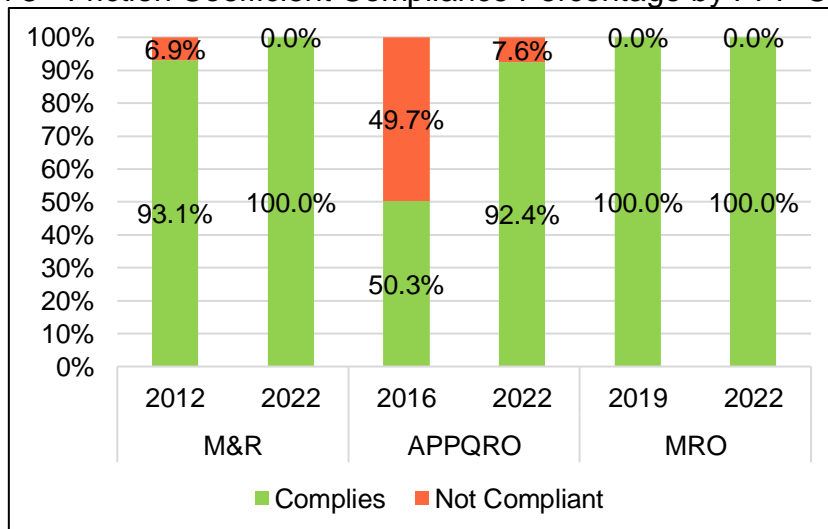


Source: Own elaboration with information from PPP contracts.

5.3. COEFFICIENT OF FRICTION

Graph 3 shows compliance with the Coefficient of Friction performance standard. The M&R contract went from 6.9% non-compliance to 0.0%, APPQRO went from 49.7% non-compliance to 7.6%, and MRO remained at 100% compliance.

Graph 3 - Friction Coefficient Compliance Percentage by PPP Contract



Source: Own elaboration with information from PPP contracts.

5.4. SOCIAL BENEFITS

Improved road conditions with respect to IRI, rut depth and coefficient of friction directly benefit all road users by increasing traffic speeds, reducing vehicle operating costs and increasing traffic safety.

Currently, the M&R contract has more than 5.7 million annual users; the APPQRO contract has more than 11.2 million users, of which almost 50% are freight vehicles; and the MRO contract has more than 4.6 million users.

Table 9 - Annual Average Daily Traffic (ADTD) by PPP Contract

TDPA	M&R	APPQRO	MRO
A	9,438	14,175	8,325
B	729	1,225	472
C	5,563	15,216	3,971
Total	15,730	30,616	12,768
Annual	5,741,450	11,174,840	4,660,320

Source: Own elaboration with data from PPP contracts.

Therefore, comparing the situation before the PPP contracts with the current situation, the improvements in road conditions, under certain assumptions^{*}, generate annual social benefits of more than 321.2 million pesos in the M&R contract, and 848.6 million pesos in APPQRO. In the case of MRO, this calculation could not be made because they are currently performing Periodic Maintenance works, so the performance standards of the situation before the APP contract are better than the current situation.

If we compare the social benefits with the payments made by the Employer for services rendered, we find annual savings of 104.9 million pesos for the M&R contract and 161.7 million pesos for the APPQRO contract, as shown in Table 10.

Table 10 - Annual social benefits per PPP Contract

Concept	M&R	APPQRO
Annual social benefit	321.21	848.61
Annual payment to the Developer	216.36	686.91
Difference	104.85	161.70

Source: Own elaboration with data from PPP contracts.

5.5. ECONOMIC BENEFITS

Finally, one argument against structuring projects under performance standards has been their high cost.

In a preliminary analysis, the costs per kilometer and per vehicle of the PPP contracts were calculated considering the annual payment made by the Contracting Party to the Developer as the cost, and compared against the cost obtained from 46 toll roads currently in charge of the public sector in the National Infrastructure Fund (FONADIN) using the annual income per toll as the cost.

Therefore, this indicator shows the amount spent per vehicle and per kilometer in PPP contracts, and it is assumed that the revenues collected by the public sector from toll collection would be spent on road maintenance and upkeep.

Table 11 - Costs per kilometer and per vehicle (pesos)

^{*} The document published by the IMT "Base operating costs of representative vehicles for interurban transportation 2021" was used.

An average IRI before the PPP contract of 3 was considered for the entire road section and an average IRI of 2 for the entire road section at present.

For vehicle operating costs with an IRI of 3, speeds and costs were averaged between an IRI of 2 and an IRI of 4.

The social value of time of used the data published by the IMT in 2022 for the value of time per hour at the national level for work-related travel.

In the case of buses, a transport of 10 users per bus was considered.

Concept	M&R	APPQRO	MRO	Average 46 roads	Lower cost highway
Cost per kilometer per vehicle	0.25	0.37	0.47	5.09	0.56

Source: Own elaboration with information from contracts and FONADIN.

The table above shows that the cost per kilometer per vehicle of the PPP contracts is much lower than the average obtained for the 46 toll roads reviewed, including the road with the lowest cost.

This situation opens the opportunity to consider the implementation of projects under performance standards since the Contractor can generate economic savings and maintain and preserve roads with high performance standards, directly benefiting society in general.

6. CONCLUSIONS

The success in the implementation of PPP projects under performance standards will depend on a correct and deep analysis of the main variables that affect the scope, time and cost of the projects that affect the fulfillment of the objectives pursued with the contracts.

The segmentation of the tranches allows establishing performance standards according to the particular characteristics of each tranche, however, it may complicate the specifications of the standards, the payment mechanism, and the application of deductions.

The grouping of performance standards will depend on the objectives and resources available to the Employer.

The more demanding the specifications of the performance standards, the higher the cost of the PPP contract, so it is important to be clear on the scope, time and cost of each contract and to verify that the standards are affordable for the developer.

The Self-Monitoring Unit and the Supervising Administrative Agent or Supervising Manager are control strategies for the Employer and the Developer that allow them to supervise, generate reports, duly follow up on the specifications of the performance standards and validate and authorize the corresponding payments and deductions.

The payment mechanism is an element in PPP contracts that either incentivizes or disincentivizes the Developer to fulfill the requirements of the contract efficiently and effectively.

The correct structuring of PPP contracts under performance standards has great social benefits by reducing vehicle operating costs, reducing travel time, and increasing road safety for users.

The implementation of projects under performance standards can generate economic savings to the Employer, and maintain and preserve roads with high performance standards benefiting society.

REFERENCES

1. PPP Knowledge Lab, Reference Guide, IP-0002-Worldbank-E.pdf
2. PIAPPEM, 2010, Mexican Experience in Public-Private Partnerships for the Development of Infrastructure and the Provision of Public Services. Sponsored by the Multilateral Investment Fund of the Inter-American Development Bank, IP-0001-PIAPPEM-S.pdf

3. Instituto Mexicano del Transporte, 2015, Concesiones carreteras en México, una aproximación a su productividad económica como medida de desempeño, IP-0497-Instituto Mexicano del Transporte-S.pdf.
4. Instituto Mexicano del Transporte, 2022, Estimation of the value of time of occupants of vehicles circulating on the road network, IP-0195-Instituto Mexicano del Transporte-S.pdf.
5. Instituto Mexicano del Transporte, 2021, Base operating costs of representative intercity transport vehicles, IP-0653-Instituto Mexicano del Transporte-S.pdf.
6. International, Bridge, Tunnel and Turnpike Association, 2016, New Highway Operating Model, IP-0001-International Bridge, Tunnel and Turnpike Association-S.pdf.
7. Study Center for the Preparation and Socioeconomic Evaluation of Projects, 2018, General Guide for the Submission of Cost-Benefit Assessments of Investment Programs and Projects, IP-0001-Study Center for the Preparation and Socioeconomic Evaluation of Projects-S.pdf.
8. Banco Nacional de Obras y Servicios Públicos, 2012, Service contract for the operation of the Guadalajara-Colima highway section IP-0001-BANOBRAS-S.pdf.
9. Banco Nacional de Obras y Servicios Públicos, 2019, Contrato de prestación de servicios consistentes en el mantenimiento, rehabilitación y operación del tramo carretero Atlacomulco-Maravatío, IP-0001-BANOBRAS-S.pdf.
10. Secretaría de Comunicaciones y Transportes, 2016, Contrato Plurianual de prestación de servicios para la conservación del tramo carretero Querétaro-San Luis Potosí, IP-0001-SCT-S.pdf.