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OUTPUT AND PERFORMANCE BASED ROAD MAINTENANCE CONTRACTING – CASE STUDY SERBIA

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Professional paper
The paper describes the main features of contract work for road maintenance and improvement under the Output and Performance-Based Contracting for Roads (OPBC). Experiences in the application of such contracts for the roads are reviewed. Road agencies that have adopted an OPBC approach have achieved cost savings from 10 % to 40 % compared to traditional method-based contracts. During the period 2004 ÷ 2008 Serbia implemented the Output Performance-based Maintenance Contract (OPBC) for routine road maintenance pilot project within Transport Rehabilitation Project financed by World Bank. The main results and conclusions are presented.

Keywords: *contracting, maintenance, performance indicators, roads*

Ugovaranje održavanja cesta temeljeno na rezultatima i načinu rada – analiza slučaja Srbija

Stručni članak
U radu se opisuju glavne karakteristike ugovora o održavanju i popravku cesta prema Output and Performance-Based Contracting for Roads (OPBC). Daje se pregled iskustava u primjeni takvih ugovora. Agencije za održavanje cesta koje su prihvatile OPBC pristup uštedjele su od 10 % do 40 % u cijeni radova u usporedbi s radovima ugovorenim po tradicionalnoj metodi. U razdoblju od 2004. do 2008. u Srbiji je bio primijenjen način ugovaranja prema Output Performance-based Maintenance Contract (OPBC) za pilot projekt u okviru Transport Rehabilitation Project-a financiranog od Svjetske banke. Prikazani su glavni rezultati i zaključci.

Ključne riječi: *ceste, održavanje, pokazatelji rezultata rada, ugovaranje*

1 Introduction

Output and Performance-based Contracting for Roads (OPRC) is designed to increase the efficiency and effectiveness of road asset management and maintenance. It should ensure that the physical condition of the roads under contract is adequate for the need of road users, over the entire period of the contract.

In traditional road maintenance contracts, the Contractor is responsible for the execution of works which are normally defined by the Road Administration or the Employer, and the Contractor is paid on the basis of unit prices for different work items. Actually, the Contractor has the wrong incentive, which is to carry out the maximum amount of works, in order to maximize its turnover and profits.

Output and Performance-based Contracting for Roads (OPRC) differs significantly from method-based contracts that have been traditionally used to maintain roads. The basic difference is that under the Output-and Performance-based Road Contract, most of the payments to be made to the contractor are based on measured "outputs" reflecting the target conditions of the roads under contract, expressed through "Service Levels". These Service Levels are defined in the contract. Another major difference is that the Contractor is fully responsible for the design of the works which are necessary to reach the required Service Levels, and the durability and performance of the roads over a longer period. OPRC within the road sector can be "pure" or "hybrid". The latter combines features of both method- and performance-based contracts. Some services are paid on a unit rate basis, while others are linked to meeting performance indicators [1].

Road agencies that have adopted an OPRC approach have achieved cost savings form 10 % to 40 % compared to traditional method-based contracts [2].

During the period 2004 ÷ 2008 Serbia implemented the Output Performance-based Maintenance Contract (OPBC) for routine road maintenance pilot project in Serbia financed by World Bank. The main results and conclusions are presented.

2 Key objectives and context

Output-and Performance-Based Road Contracts (OPRC) are a further development of the earlier "Performance-based Management and Maintenance of Roads (PMMR)" contracts (2002). They are also suitable for the procurement of works and services under longer-term "Design-Build-Operate-Maintain (DBOM)" contracts for roads.

An important focus of the contract is on Management and Maintenance Services, including physical works on the Roads under contract which are needed to maintain the agreed Service Levels over time, but also all activities related to the management and evaluation of the road network under contract. The contract also allows for the execution of (i) Rehabilitation Works to be carried out in order to bring the Roads up to pre-defined standards; (ii) Improvement Works aiming at adding new characteristics to the Roads in response to new traffic, safety or other considerations; and (iii) Emergency Works comprising activities needed to reinstate the Roads after damage resulting from unforeseen natural phenomena with imponderable consequences.

An OPRC may cover either only individual assets (e.g., only traffic signs, only bridges) or all road assets within a road corridor.

The level of complexity of an OPRC can range from "simple" to "comprehensive" depending on the number of assets and range of services included. A "simple" OPRC would cover a single service (e.g., only street light

maintenance) and could be awarded for relatively short periods (several months or one year). A "comprehensive" OPRC would typically cover all road assets with the right-of-way and comprise the full range of services needed to manage and maintain the contracted road corridor. Such services would include routine maintenance, periodic maintenance and traffic accident assistance, etc. [2].

The OPRC helps insure that variation orders are minimized and that the contractor is generally paid in equal monthly instalments throughout the contract period. The risk for cost overruns is transferred to the contractor. The contractor is responsible for designing and carrying out the works, services and actions he believes are necessary in order to achieve and maintain the Service Levels stated in the contract. The Service Levels are defined from a road user's perspective and may include factors such as average travel speeds, riding comfort, safety features, etc. If the Service Level is not achieved in any given month, the payment for that month may be reduced or even suspended.

The OPRC can deliver higher customer satisfaction by aligning contractor payments with the needs of the customer/road users. These needs are directly reflected in the performance indicators specified in the contract. Performance specifications set a minimum level of service that is expected from the contractor over the entire contract period.

An OPRC approach can help ensure stable financing for the maintenance program over a longer-term when compared with traditional method-based contracts. An OPRC typically covers a period of several years.

3 Key differences from traditional method based approach

Under the OPRC, the Contractor has a strong financial incentive to be efficient and effective whenever he undertakes work. In order to maximize profits, he must reduce his activities to the smallest possible volume of intelligently designed interventions, which nevertheless ensure that pre-defined indicators of Service Level are achieved and maintained over time. This type of contract makes it necessary for the Contractor to have a good management capacity. In other words, the Contractor is entitled to independently define: (i) what to do, (ii) where to do it, (iii) how to do it, and (iv) when to do it. The role of the Road Administration and of the Employer is to enforce the contract by verifying compliance with the agreed Service Levels and with all applicable legislation and regulations.

Maintaining a road network includes both routine and periodic tasks. Minimum road conditions and Service Levels are defined through output and performance measures, and these are used under the OPRC to define and measure the desired performance of the Contractor.

The performance criteria should ideally cover all aspects of the contract and take account of the fact that different sub-areas within the contract area might require different Service Levels. To avoid ambiguity, all performance measures must be clearly defined and objectively measurable. Together the performance measures define the minimum acceptable Service Level for the particular road. In setting the measures various criteria (both technical and practical) need to be carefully considered, such as (i) traffic volume and composition, (ii) urban vs. rural roads (iii) flat, hilly or mountainous terrain, (iv) subgrade quality and type, (v) quality of available construction materials, (vi) capacity of available contractors, (vii) any environmental constraints, such as protected areas, parks, forest reserves, etc. However, probably the most important criterion is the question of what Service Level can be afforded and economically justified for the road in question. Under the terms of the contract, the Contractor will also be responsible for the continuous monitoring and control of road conditions and Service Levels for all roads or road sections included in the contract.

4 Worldwide results

Road agencies that have adopted an OPRC approach have achieved [2]:

- **Cost savings from 10 % up to 40 %**. Examples are given in Tab. 1. In addition, recent evaluations indicate that the savings in costs accrued from the CREMA are in order of 12 to 18 % compared to the traditional method-based contracts.

Table 1 Cost savings of different countries under PBC over the conventional contracts [2]

Country	Cost savings, %
Norway	about 20 ÷ 40
Sweden	about 30
Finland	about 30 ÷ 35 about 50 % lesscost/km
Holland	about 30 ÷ 40
Estonia	20 ÷ 40
England	10 % minimum
Australia	10 ÷ 40
New Zealand	about 20 ÷ 30
USA	10 ÷ 15
Ontario, Canada	about 10
Alberta, Canada	about 20

- **Expenditure certainty**. As the contractor is paid a fixed price, based on a regular schedule the road agency enjoys full control of expenditures without unexpected variation orders.
- **Reduction of the in-house workforce**. For example, in Estonia, where 63 % of the national network is under PBC, the workforce of the national and sub-national road agencies has declined, specifically from 2046 (administration staff - 561, workers - 1485) in 1999 to 692 employees (administration staff - 343, workers - 349) in 2003.
- **Improved conditions of contracted road assets and reduction of roads in poor condition**. Many road agencies have acknowledged that on completion of an OPRC, road assets are generally returned either in an improved condition when the OPRC was awarded. Argentina has reduced the share of roads in poor condition from 25 % to less than 5 % by the end of 1999 due to the PBC approach.

- **Greater road user satisfaction**. Road users appear to become more satisfied with the services delivered and the condition of the roads maintained under OPRCs.
- **Multi-year financing of a maintenance program**.

The growth and expansion of an OPRC approach to other roads in the network is the best indicator of its success. The Department of Transportation (DoT) in Washington, D.C., USA, recognizes OPRC as an effective way to keep assets at or above their current condition. It has therefore decided to apply this approach for management and maintenance of tunnels, street lighting, and other streets in Washington, D.C. Peru has expanded its program of performance-based contracting of micro-enterprises from the rural to the national network. Argentina expanded a performance-based contracting from the national to provincial roads. The Florida DoT increased from the current 19 performance-based contracts to 28 by 2008[2].

5 Pilot OPBMC maintenance project in Serbia

In the period from 2004 to 2008 in Serbia was carried out Pilot Output-Performance Based Maintenance Contract (OPBMC) for routine road maintenance works on about 1200 km of road network in Mačva and Kolubara.

5.1 Basic information about Project

The World Bank Project included implementations of two Pilot Contracts for Output Performance-based Maintenance Contract (OPBMC) for routine road maintenance on about 1200 km of road network in Mačva and Kolubara District for 3 years + additional 2 years (2004 ÷ 2008). The agency responsible for the implementation of the Transport Rehabilitation Project (in the further text TRP) financed by the Credit was the Republic of Serbia Road Directorate, i.e. Public Enterprise "Roads of Serbia" (PERS).

Main characteristics of the Pilot Project are:

- Procurement of routine road maintenance works by international bidding procedures involving interested companies from the private sector;
- Separating of routine maintenance contracting from all other type of works (construction, reconstruction, rehabilitation and periodic maintenance);
- Introducing into practice service quality level, lump sum payments and demerit points for non-compliance with the requested standards, as well as other typical PB Contract characteristics, for the certain types of routine maintenance items;
- Appliance of new winter maintenance service organization, winter maintenance performing and payment model based on RWIS (Road Weather Information System).

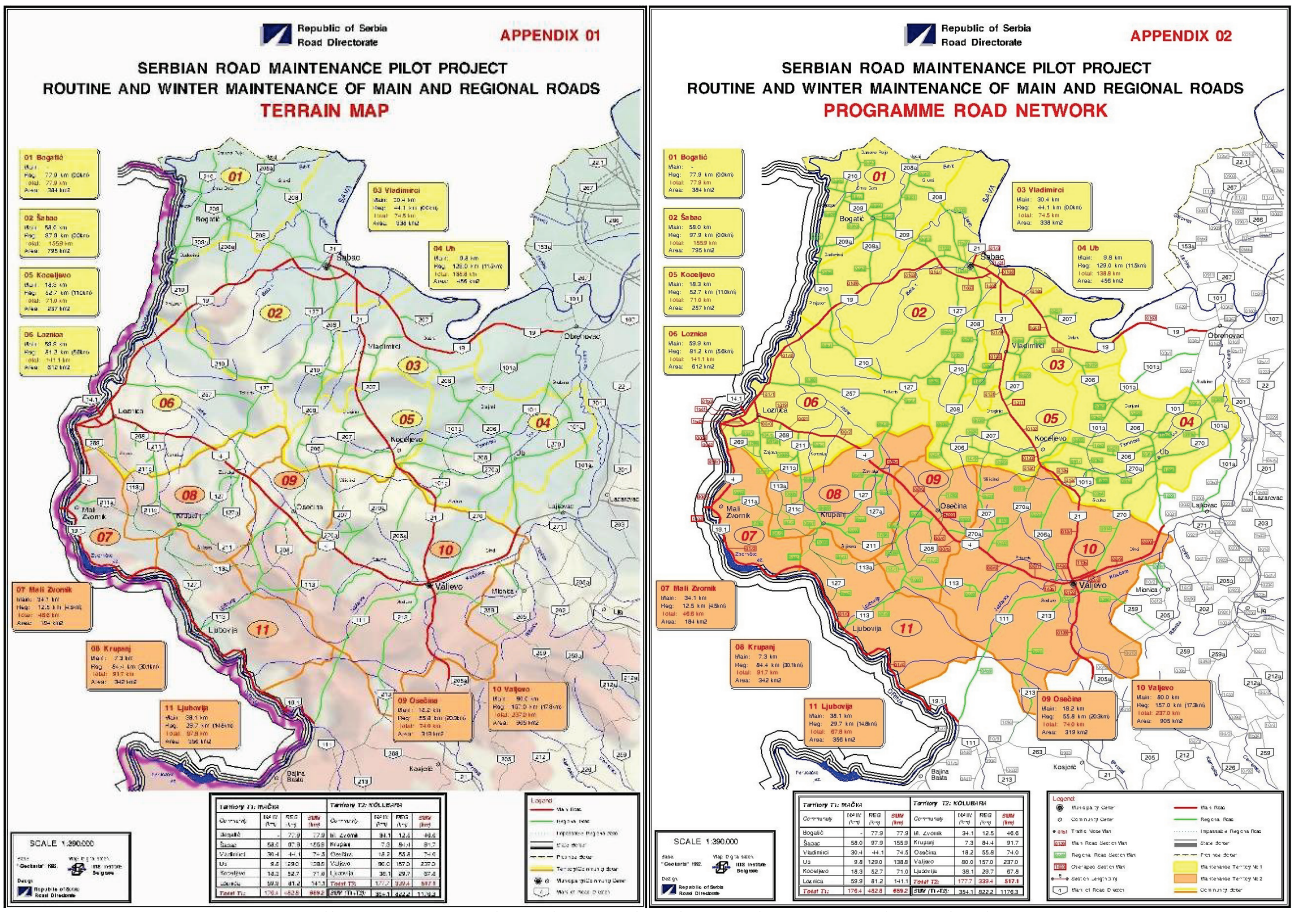

Figure 1 Pilot Contract Areas for performance based contracting (PBC) routine road maintenance

5.2 Preparation and contracting

5.2.1 Selection of Pilot territories

The following criteria have influenced to selection of pilot territories Mačva and Kolubara:

- Length of the road network under the jurisdiction of the Directorate of Roads (PERS) is approximately the same (about 600 km on one area, or 1200 km in both areas).
- Mačva with its geographical position (flat terrain) is a characteristic representative of the road network for regular (summer) road maintenance; while the Kolubara region is a characteristic representative for winter road maintenance works (mountainous terrain).
- Both areas are close allowing evaluation of the project, monitoring of the results and supervision.
- In the previous period, the regular maintenance works are not carried out in a satisfactory way by road maintenance companies.

5.2.2 Road asset data collection

A comprehensive road asset data had to be collected to form adequate road information system and issue the tender documentation.

5.2.3 Legal and technical aspects

It was necessary to re-define road categories for routine and winter road maintenance in accordance with existing road classification, Public Road Law and Rulebook for road maintenance [4]:

- The categories of roads for routine and winter road maintenance are defined (Tab. 2 and Tab 3)
- The technical specifications for the routine maintenance of roads and bridges are defined
- The desired Service Level (quality of construction) and how to measure and control is defined
- Penalties (demerit points) are defined
- The minimum set of construction machinery for the execution of maintenance works is defined.

The main differences in comparison to previous "classic" contracts:

- Introduction of the works paid by lump-sum
- Maintenance categories are defined
- Application of "demerit points" (Tab. 8)
- Using RWIS in the process of road winter maintenance
- Self-control of the contractor (the introduction of the Internal Control Unit).

Table 2 Defined road maintenance categories for Pilot Project [5]

Road Maintenance Category	AADT (v/d)	Road Rank	Other Roads (not fullfilling criteria under column 2)
A1	≥ 6000	All roads	Motorways, semi-motorways, mainroads
A2	3000 ÷ 5999	Main&Regional roads	Important regional roads
A3	< 3000	Main roads	All other main roads
B1	1000 ÷ 2999	Regional roads	Regional roads with cultural – historical and turistic importance
B2	500 ÷ 999	Regional roads	
B3	< 500	Regional roads	

Table 3 Defined road winter maintenance categories for Pilot Project [5]

AADT (v/d)	Road Winter Maintenance Categories	
	Main roads	Regional roads
≥ 6000	A1	A2
3000 ÷ 5999	A3 or B1	A3 or B1
1000 ÷ 2999	A4 or B1	A4 or B1
500 ÷ 999	B1	B1 or B2
< 500	B1	B2

The introduction of penalties ("Demerit") points:

- If during the execution of the Contract the Contractor reaches 175 demerit points, the Contractor shall forfeit its right to participate in any tender of the Roads Directorate (PERS) in the next 2 years,
- If during the first year of the Contract the Contractor is allocated to more than 100 demerit points, the Investor has the right to terminate the Contract.
- If, during the second year of the Contract, the Contractor is awarded a total of more than 160 demerit points, the Investor has the right to terminate the Contract
- If in the third year of the Contract the Contractor is awarded a total of more than 200 demerit points, the investor has the right to terminate the Contract
- Demerit points are accumulated from the first day of the Contract.

Table 4 Scale and value of "Demerit" points [4]

Number of points		Valued of one point in RSD
From	To	
1	50	20 000
51	75	50 000
76	125	100 000
126	175	120 000
176	200	150 000
	>200	200 000

5.2.3 Economic aspects

To justify economic reliability of routine and winter maintenance works during the contract period economic analyses were performed using HDM-4 model.

5.2.4 Preparation of Tender Documentation

Standard Bidding Documents are prepared by the procedures and guidelines of the World Bank:
- February 2002: The World Bank announced: "Sample Bidding Document for PMMR - Performance-based Management and Maintenance of Road Networks"
- September 2005: Revised edition "Sample Bidding Document, now called OPRC - Output-and Performance-based Road Contract"
- It can be downloaded from the WB Procurement Website http://www.worldbank.org/procure/.

5.2.5 Procurement and Contracting

Procurement of Works:
- World Bank ICB procedures
- Requirements relating to the public announcement of procurement (international and national advertising; prior notice, public invitation, announcement of contract award decision)
- Obligatory use of standard bidding documents prescribed by the Bank
- Requirements relating to deadlines in the procurement (defined minimum and maximum deadlines for certain phase supply)
- Defined method for the evaluation of tenders and contract award.

Procurement of consulting services:
- World Bank QCBS procedures
- Definition of the Terms of Reference (TOR)
- Requirements relating to the announcement of the first phase of procurement
- Forming a shortened list of qualified consultants (short list of consultants)
- Defined way of forming and issuing of tender documents (Request for Proposals - RFP)
- Defined process evaluation of technical proposal, opening and assessment of financial and final offer combined ratings
- Defined framework for contract negotiations and contract award process.

The Contract for the work belongs to the so-called: "Hybrid contracts" because it involves basically three models of contracting and payments of work [5]:

1) The Contract based on the unit cost
- The standard model of Contract (Unit Price work item)
- Estimated quantities for each position with a specified unit of measurement
- Contract unit price for each item
- Real quantities are paid

2) The Contract based on the achieved road performance (Lump Sum work item)
- The specified performance standards and criteria of quality of service
- Paying a fixed monthly amount for the required level of service

3) Lease Agreement (resource commitment)
- Limited use
- For a detailed list of resources contracted price list is prepared
- Paying real commitment of resources.

Table 5 Basic information on contracts OPBM [5]

Contract Item	Pilot territory Mačva	Pilot territory Kolubara
Contract ID number	WBC/RMC/2003-01	WBC/RMC/2003-02
ContractName	Serbian road maintenance Pilot Project, Routine and winter maintenance of main and regional roads in the Mačva District	Serbian road maintenance Pilot Project, Routine and winter maintenance of main and regional roads in Kolubara district
Length of road network	660 km	517 km
Contract scope	The Contract includes OPBM on about 660 km of the main and regional road network in the Mačva District for 3 (three) years. The territory under the Contract comprises the following communities: Bogatić, Vladimirci, Šabac, Ub, Koceljeva and Loznica. The Works consist of - Administrative duties, - Routine Road Maintenance, - Routine Bridge Maintenance, and - Winter Road Maintenance.	The Contract includes OPBM on about 517 km of the main and regional road network in the Kolubara District for 3 (three) years. The territory under the Contract comprises the following communities: Mali Zvornik, Krupanj, Osečina, Valjevo and Ljubovija. The Works consist of - Administrative duties, - Routine Road Maintenance, - Routine Bridge Maintenance, and - Winter Road Maintenance.
Contractor	ALPINE MAYREDER BAU GMBH, Austria	PZP BEOGRAD, Serbia
Start date	September 01, 2004	September 01, 2004
Competition date	March 31, 2008	March 31, 2008
Value of the Works	638 564 333,27 RSD (10 821 147,99 US$)	626 869 031,50 RSD (10 972 413,46 US$)

Within the TRP project two contracts were signed for road maintenance under the principle OPBMC (OPBMC – Output Performance Based Maintenance Contracts). Contracts relating to the two pilot territories Mačva and Kolubara in total length of 1177 km and have been implemented in the period from 2004 to 2008.

The Tab. 5 shows the basic data about contracts for road maintenance based on the principle OPBM.

5.3 Implementation of Project

5.3.1 Measurement and payment

The Contractor was paid monthly in accordance with the monthly certificate. Payments were made according to quantities and unit prices in Bill of Quantities of Unit (BOQ), lump sums and additional works. The request for payment was accompanied by appropriate documentation

and inspection report and had to contain proof of the achieved required level of service and quality of the works. There were three bases for payment [3]:

1) Road maintenance is performance - based execution of work (Lump Sum payment)
- Payment is unchangeable and does not depend on the amount committed.
- Paying the annual fee. The total amount can be divided into a number of instalments.
- Verification of a well done job is based on joint inspections carried out once a month at selected kilometre of road.
- If the required Service Level is not achieved, payments are reduced by the penalty provisions of the Contract.

2) Road Maintenance on the basis of unit price (Unit Price payment)
- Payment of works is variable and depends on the amount actually performed.
- Calculation of payments is performed by the unit cost from the Bill of Quantities (BOQ) for the specified unit of measurement in accordance with the quantities actually executed.
- Verification of the quality and quantity of work is performed during the works and immediately after performed work.
- Quantities are reduced for poor quality of performed works that have to be accomplished again.

3) Additional Works (Additional payment)
- For emergency work and in the case of extreme weather conditions during the winter, payment is made in accordance with the agreed price list of resources.
- A separate calculation for each individual event is performed.
- Contractor prepares proposal for payment and payment amount has to be approved by the Project Manager (Consultant).

5.3.2 Introduction of RWIS for Winter Maintenance

A total six of Road Weather Information System (RWIS) stations were installed on the pilot territories:

Road Weather Information Systems (RWIS) are used for:
- Prognosis of interventions and
- Calculation of winter maintenance.

Basic data from RWIS:
- Air temperature and humidity
- Dew point temperature
- The type and amount of rainfall/snowfall
- Pavement temperature
- Pavement temperature on bridges
- Wind speed and direction.

Data are presented in tabular and graphical form.

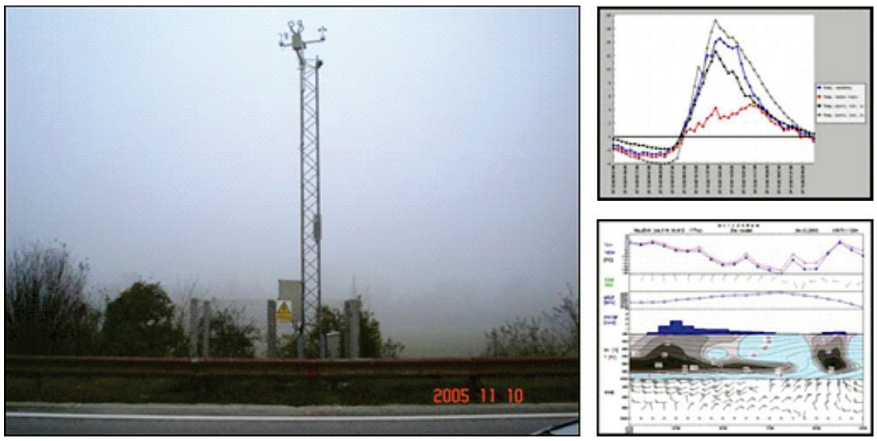

Figure 2RWIS station in the Kolubara areas [4]

5.3.3 Results

In the first year of the Contract almost 77 % of the total numbers of penalty points were awarded to contractors giving the opportunity to Employer to terminate the Contract (100 demerit points). A significant number of penalty points were assigned to contractors due to winter maintenance standards.

In the second and third year of the realization of Contract, the realization was significantly improved.

The percentage of the "demerit" points by regular maintenance work positions are presented in the Tab. 6.

Table 6 Basic information on contracts OPBM [4]

Postion	Name of position	No. of points	%
B.1.	Road side maintenance	4	4,60
B.2.	Drainage system maintenance	50	57,47
B.4.	Cross-section maintenance	11	12,64
B.5.	Pavement maintenance	4	4,60
B.6.	Road marking and equipment maintenance	12	13,79
C.2.	Bridge maintenance	6	6,90
	Total:	87	100

Comparing to the rest of Serbia territories, the Pilot Project territories achieved routine maintenance cost savings in range from 31 % to 55 % (average 46 % for 5 years) (Tab. 7, Figs. 3 and 4).

Table 7 Basic information on contracts OPBMC in Serbia [4, 5]

Territory	Routine maintenance unit costs (RSD / km)					
	2005	2006	2007	2008	2009	Average in the last 5 years
Mačva	235 119,59	350 460,48	339 278,71	487 649,62	594 771,16	401 455,91
Kolubara	254 819,58	335 280,87	409 495,18	292 588,62	359 014,39	330 239,73
Pilot territories	244 969,59	342 870,68	374 386,95	390 119,12	476 892,78	365 847,82
Serbia without pilot territories	472 253,90	754 919,72	718 183,93	731 272,14	691 708,00	673 667,54
difference (RSD/km)	227 284,32	412 049,05	343 796,99	341 153,02	214 815,23	307 819,72
Savings / %	48	55	48	47	31	46

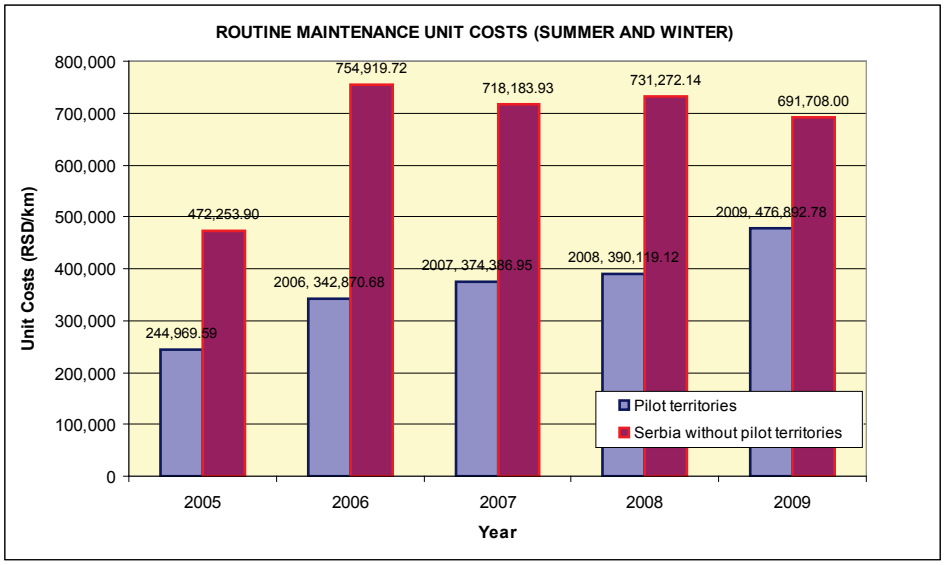

Figure 3 Comparative reviews of unit costs of routine maintenance [5]

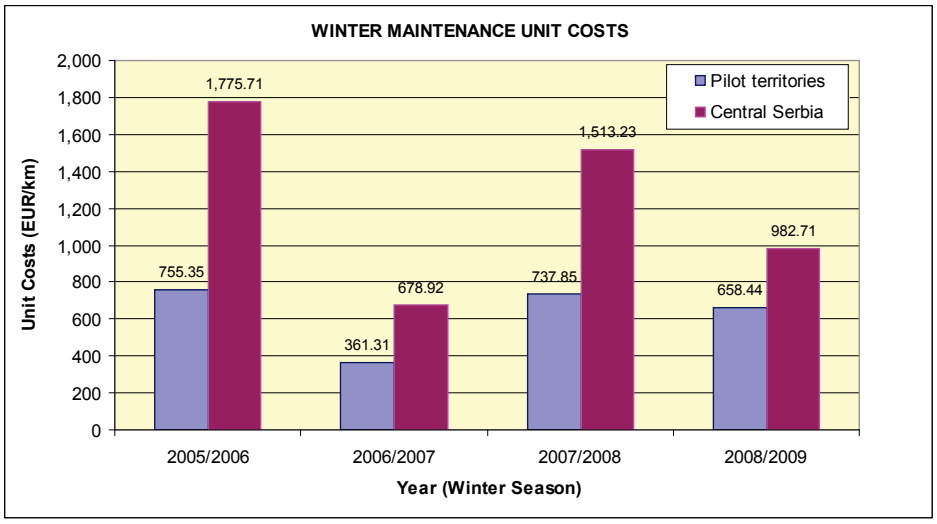

Figure 4 Comparative reviews of unit costs of winter maintenance [5]

6 Conclusion

After initial problems in adapting to new concept of road maintenance in the first year of the implementation, the Pilot project is completed successfully. Engagement of Consultants on Pilot project, especially through continuing education contractors, as well as the establishment of procedures and records, has significantly contributed to its successful completion. Consumption of material for pavement maintenance is significantly reduced and the savings achieved total costs over the first year of implementation of the contract, particularly with respect to the parameters for the rest of the road network in the Republic of Serbia. The most significant savings are made in the winter maintenance.

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