TA to Connectivity in the Western Balkans

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Preparation of Maintenance Plans 2018-2022 for Road/Rail TEN-T indicative extensions to WB6

FINAL REPORT (draft) – Road MPs

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Contents

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List of Abbreviations

AADT	Annual Average Daily Traffic
ALB/AL	Albania
AMS	Asset Management System
AO	Administrative Order
BiH	Bosnia and Herzegovina
BP	Business Plan
CA	Contracting Authority
CAP	Capital Cost
CNC	Core Network Corridor
CONNECTA	Technical Assistance to Connectivity in the Western Balkans
CONNECTA	The MMD led Consortium implementing CONNECTA
CRM	Connectivity Reform Measures
DG MOVE	Directorate-General for Mobility and Transport
DG NEAR	Directorate-General for Neighborhood and Enlargement Negotiations
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EIB	European Investment Bank
ETCS	European Train Control System
EU	European Union
EUD	EU Delegation
EUR	Euro (currency)
FR	Final Report
GIS	Geographic Information System
GPR	Ground Penetrating Radar
GSM	Global System for Mobile Communications
GSM-R	Global System for Mobile Communications – Railway
HDM-4	Highway Development Management Model
IFI	International Financing Institution
IM	Infrastructure Manager (refers to railways)
IPF	Infrastructure Project Facility
IR	Inception Report
IR	Internal Roughness Index
IRR	Internal Rate of Return
ITS	Intelligent Transport Systems
KE	Key Expert
KoM	Kick-off-Meeting
KOS	Kosovo* (hereinafter referred to as Kosovo)
MED	Mediterranean (corridor)
MKD/MK/MAC	the former Yugoslav Republic of Macedonia
MNE/MON	Montenegro
MMD	Mott MacDonald
M&R	Infrastructure Maintenance and Renewal
MS	Maintenance Standard
NIPAC	National IPA Coordinator
NPV	Net Present Value

NKE	Non-Key Expert
OECD	Organization for Economic Cooperation and Development
OEM	Orient East Mediterranean (corridor)
OHL	Overhead Line
PBM	Performance- Based Maintenance
PBMC	Performance Based Maintenance Contract
PM	Project Manager
RAMS	Road/Rail Asset Management System
RFA	Request for Approval
RIA	Railway Infrastructure Asset
RI-AMS	Railway Infrastructure Asset Management Systems
RMM	Road Maintenance Management
RMMS	Road Maintenance Management System
RMS	Road Management System
RP	Regional Participants
RWIS	Road Weather Information System
S&C	Switches & Crossing
SEETIS	SEETO Information System
SEETO	South East Europe Transport Observatory
SNKE	Senior Non Key Expert
SRB/SER	Serbia
TA	Technical Assistance
TEN-T	Trans-European Network – Transport
TL	Team Leader
ToR	Terms of Reference
VOC	Vehicle Operating Costs
WB	World Bank
WB6	Western Balkans 6 countries

*This designation is without prejudice to positions on status and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

SYNOPSIS

Project (sub-project) Title:	**Preparation of Maintenance Plans 2018-2022 for Road/Rail TEN-T indicative extension to WB6 (CONNECTA-TRA-CRM-REG-02)**
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Summary

The Western Balkans (WB6) Road Core & Comprehensive Network is strategically located with regard to the European transport system. It consists of a number of physical transport corridors that enable the continuity of different parts of the TEN-T Network in the region, providing connections for the Western and Central European countries to SE Europe, the Black Sea and further beyond to Asia. The SEETO Core/Comprehensive Network (regarded as indicative extension of TEN-T in WB6) consists of thirteen Routes and six Corridors totaling about 5,370 km (road network).

Review and Analysis of Current Maintenance Practices and Needs (Roads)

Total needs estimate for the identified portion of the SEETO Core/Comprehensive Network of almost 2,100 km (39.4% of total network) is approximately EUR 260 million. Logically, as a direct result of the longer portion of network in an average state of deterioration (almost 1,800 km), compared to the remaining two categories (21 km and 318 km), approximately EUR 208 million is necessary to keep this part of the network on the safe side, i.e. not to let it deteriorate further. Repair of Corridors requires about EUR 90 million, which is almost 35% of what needs to be spent for approximately 24% of the network. Taking into consideration the importance of these Corridors in the RPs' overall transport system and traffic volumes, the amount of resources needed for their maintenance is reasonable. Out of the identified part of the network that needs maintenance treatment, 11.31 km within the poor category, as well as 284.09 km within the medium category, are roads with a double carriageway providing highway/expressway level of service. This makes 17.1% of the whole double carriageway part of the network.

Table I. Summary of maintenance needs per Route/Corridor of the SEETO Core/Comprehensive Network

Route/ Corridor	Length [km]	Condition: very poor		poor		medium		Total per Route/Corridor	
		length [km]	cost [EUR]	length [km]	cost [EUR]	length [km]	cost [EUR]	length [km]	cost [EUR]
R1	174.10	0.00	0.00	0.00	0.00	122.50	9,555,000.00	122.50	9,555,000.00
R2a	219.67	0.00	0.00	6.79	1,045,660.00	56.05	4,804,436.00	62.84	5,850,096.00
R2b	395.39	20.75	3,216,250.00	88.54	12,708,608.00	69.00	6,039,800.00	178.29	21,964,658.00
R2c	125.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R3	200.52	0.00	0.00	84.31	11,888,904.50	47.31	3,843,937.50	131.62	15,732,842.00
R4	591.70	0.00	0.00	0.00	0.00	129.50	12,919,920.00	129.50	12,919,920.00
R5	210.00	0.00	0.00	0.00	0.00	155.40	15,434,250.00	155.40	15,434,250.00
R6	254.50	0.00	0.00	0.00	0.00	228.70	20,046,000.00	228.70	20,046,000.00
R6b	205.00	0.00	0.00	33.00	3,993,000.00	147.00	24,625,900.00	180.00	28,618,900.00
R7	312.70	0.00	0.00	0.00	0.00	45.70	4,339,010.00	45.70	4,339,010.00
R8	78.00	0.00	0.00	0.00	0.00	71.00	6,506,500.00	71.00	6,506,500.00
R9	354.13	0.00	0.00	24.61	3,814,382.00	126.31	12,503,081.50	150.92	16,317,463.50
R10	139.60	0.00	0.00	0.00	0.00	139.60	12,174,500.00	139.60	12,174,500.00
Vc	351.29	0.00	0.00	80.49	15,476,076.00	61.85	10,392,649.80	142.35	25,868,725.80
VIII	543.65	0.00	0.00	0.00	0.00	30.20	2,944,500.00	30.20	2,944,500.00
X	694.50	0.00	0.00	0.00	0.00	229.90	52,302,900.00	229.90	52,302,900.00
Xb	183.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Xc	111.42	0.00	0.00	0.00	0.00	24.00	2,340,000.00	24.00	2,340,000.00
Xd	170.20	0.00	0.00	0.00	0.00	73.20	7,137,000.00	73.20	7,137,000.00
Total per condition		20.75	3,216,250.00	317.74	48,926,630.50	1,757.22	207,909,384.80	**2,095.71**	**260,052,265.30**

Table II. Summary of maintenance needs per each Western Balkans regional participant

Regional Particip.	Length [km]	Condition: very poor		poor		medium		Total per Regional Participant	
		length [km]	cost [EUR]	length [km]	cost [EUR]	length [km]	cost [EUR]	length [km]	cost [EUR]
ALB†	640.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BIH	1,053.69	20.75	3,216,250.00	258.74	41,158,430.50	287.42	30,702,354.80	566.91	75,077,035.30
MKD	858.35	0.00	0.00	0.00	0.00	334.60	34,386,300.00	334.60	34,386,300.00
KOS	355.3	0.00	0.00	0.00	0.00	231.30	33,027,800.00	231.30	33,027,800.00
MNE	669.40	0.00	0.00	59.00	7,768,200.00	345.10	28,965,820.00	404.10	36,734,020.00
SER	1,737.62	0.00	0.00	0.00	0.00	558.80	80,827,110.00	558.80	80,827,110.00
Total per condition		20.75	3,216,250.00	317.74	48,926,630.50	1,757.22	207,909,384.80	**2,095.71**	**260,052,265.30**

† Data provided by the RP showed only good and very good condition of SEETO network. Also, there is an on-going performance-based maintenance project supported by the World Bank covering SEETO network. Consequently, the needs analysis showed zero values and no further analysis has been undertaken.

Bearing in mind the fact that maintenance needs for structures were not assessed, it can be concluded that the above amount of EUR 260 million may be increased by another 15-20% to reach the final estimate of EUR 300-315 million for coverage of the maintenance backlog over the complete SEETO Core/Comprehensive Network and taking into consideration the whole structure of the road. It must be noted that majority of structures were built some 30+ years ago and generally have not received proper care and maintenance.

For the assessment of routine maintenance needs, a detailed inventory of all road assets and relevant costs is necessary, but complete records on the remaining items of the road structure (right-of-way area, culverts, bridges, tunnels, drainage elements, small engineering structures) and traffic signalization and equipment are not available from the WB6 RPs' road authorities. A very general assessment of routine maintenance needs for the total network of about 5,300 km (calculating an average rate of EUR 7,000 per kilometer of single carriageway road and EUR 14,000 per kilometer of dual carriageway road) would be approximately EUR 50 million per annum (or roughly EUR 9,000 per kilometer of dual-carriageway road and EUR 7,500 per kilometer of single-carriageway road).

However, for successful maintenance management it is crucially important to have the information necessary to realize the goals of the management system and to evaluate possible maintenance alternatives. Data is needed to provide the basis for management decisions and as such should be up to date.

Development of Common Maintenance Guidelines

The purpose of the guidelines is to facilitate performance of road maintenance and management activities within the WB6 road agencies, and to present recommendations for establishing the road maintenance management system. In general, road maintenance management is a narrowly specialized area of expertise connecting the function of road ownership with the function of performing tasks related to maintenance of roads. More precisely, the aim of this document is to:

- emphasize the importance of maintaining the road network and associated facilities;
- ensure that the road agencies use a systematic common approach to decision making within a consistent framework;
- provide a common and consistent basis for assessing the overall maintenance needs;
- ensure that roads are maintained to a consistent standard, and continue to be so following the completion of all planned project works;
- assist in the effective allocation of national and local resources;
- encourage the regular review of policies, standards and the effectiveness of maintenance programs.

Road Maintenance Management (RMM) can be divided into four main functions, i.e. planning, programming, preparation and operations. These guidelines are mainly concerned with planning and programming, which are considered from the perspective of costs and benefits of investing in maintenance, data, treatment selection and prioritization. The remaining functions, preparation and operational issues of day-to-day management of roads and procurement of works, which should be of interest to those working at the detailed levels of road maintenance management, possibly in districts or operational organizations, are not covered within these guidelines.
The guidelines are developed in accordance with the best practices prevailing within the EU and from countries with advanced road management worldwide, and aim towards harmonization and rationalization of maintenance across the WB6

Road Asset management System

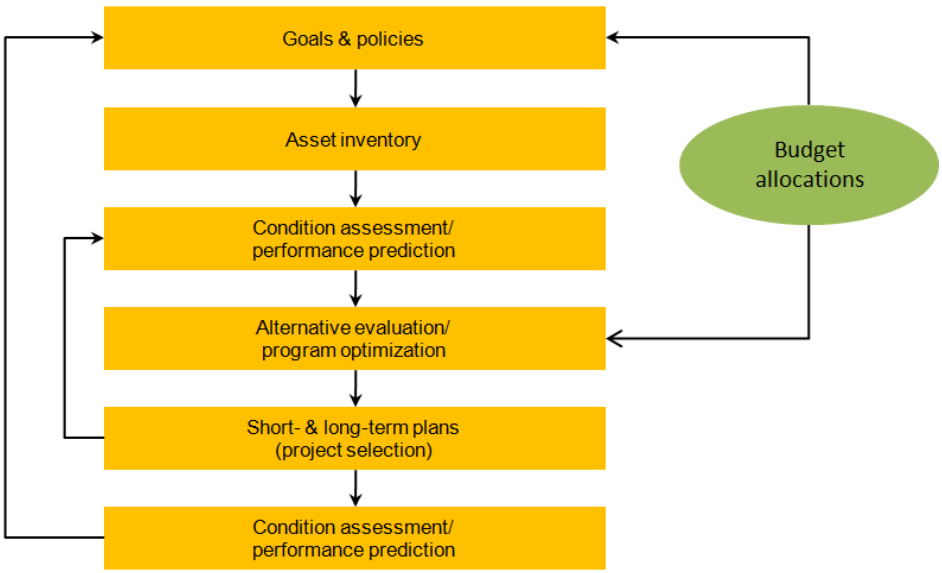
Review of current practice showed that it is mostly similar within WB6, although with certain specificities. The main deficiencies in the region, having direct impact on planning and programming of activities is the availability of up-to-date data and lack of proper RAMS. Few of the regional partners have up-to-date databases (ALB, BIH, SER), while some are in the process of being updated or having the overall system developed (BIH, MKD, SER). Establishment of a fully operative RAMS as a systematic process which combines engineering principles with sound business practice, including implementation of the asset valuation, is one of the most important activities required to improve current practice.

An appropriate definition of “asset management” for the roads sector is the one proposed by the OECD (Organization for Economic Cooperation and Development) in 2001: “A systematic process of maintaining, upgrading and operating assets, combining engineering principles with sound business practice and economic rationale, and providing tools to facilitate a more organized and flexible approach to making the decisions necessary to achieve the public’s expectations”.

One of the key objectives in implementing a RAMS is to provide justification for budget, and to help direct limited funds towards those areas where the return on investment will be greatest.

The RAMS should be viewed as an integral component in the road agencies’ planning, implementation and monitoring processes. The outputs from the RAMS should be used to prepare annual reports as this helps ensure that data are collected regularly and the system is applied.

Figure I. Framework of the AMS

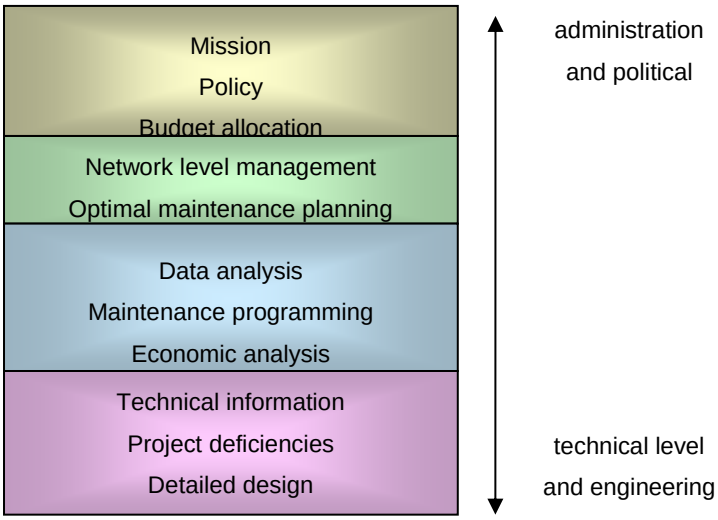


In general, the main processes in asset management comprise:

- establishment of the asset inventory;
- assessment of the asset condition;
- establishment of an LoS to be achieved for each road; this will depend on road type and its level of use;
- preparation of an optimized plan to achieve objectives and maximize the asset value, using the most cost-effective method possible.

Bearing in mind the levels of decision making (Figure II) in the process of RMM, it is clear that the level of information to be presented varies from very rough and general, at the executive-political and organizational level, to very detailed, for the design level. This also complies with the information quality concept, elaborated earlier.

Figure II. Levels of decision making



All systems rely on three fundamental components: processes, people and technology. Of course, appropriate funding is one of the prerequisites. If any of these components are lacking, the system will not be successful. The best technology in the world will ultimately fail if implemented in an environment where there are no people to run it, or where the processes are not in place to utilize it.

In theory, for an RMMS to be successful, the importance of each component would be clear. Executives and managers would be demonstrably committed to the system, both in their relations with external stakeholders and internally in their agency through good management principles. Policies would explicitly state the goals and objectives of the organization with regard to RMM, and procedures would detail exactly how the road management system would be used to achieve these goals.

Successful businesses, like RMM should be prepared to take calculated risks to achieve objectives. Globalization, deregulation, complicated financial instruments and contracts, emerging markets, all contain tremendous potential advantages for companies and carry the danger of huge mistakes or unexpected developments. Businesses must measure these risks, try to minimize them and, if possible, use them to their advantage.

Analysis and Recommendations for Setting up PBMC

Road authorities worldwide face mounting problems with maintaining the serviceability of their road networks. Over the years there has been a gradual progression in road maintenance philosophy. In general terms, it was traditionally carried out directly by the road authority with its own maintenance organization supplementing its own capacity, to a greater or lesser degree, by contracting some works to contracting companies. The contracted element of the works steadily increased with many authorities reaching the point where all maintenance activity is carried out by contractors applying traditional methods of contracting and measurement of works under the authority's supervision.

Within the last 20 years, however, there has been a shift in implementing contracted maintenance through the use of performance-based methods. Under this Performance-Based Maintenance (PBM) methodology, the contract is based on the concept of payment for specified results (resulting in a well-maintained road) based on the contractor meeting specified standards of performance rather than measuring and paying for the quantities of work which he actually does, i.e. based on outputs. This contracting method is generally considered to be more cost effective than the traditional, input-based methods using measurement of units of work undertaken with payment at unit rates. PBM is generally recognized as the best way forward to better, more economical maintenance. It is a logical development in a sequence of evolving maintenance practices which have developed from direct labor to contracted maintenance through admeasurement contracts to PBM.

Regional experience in PBMCs is not extensive. The previous PBMC pilot project in Serbia confirmed its suitability to introduce such an approach related to routine and winter maintenance. Following this, Serbia has recently launched procurement of PBMC for approximately 3,000 km of national roads through its own budget resources. Similarly, Albania has also performed one pilot project covering approximately 270 km

of national roads, and is currently in the process of implementing another four contracts, of five years' duration. Experience of BIH showed lack of interest, very high rates and revealed the opinion that the resources are spent without quantity justification.

The roadmap for starting the PBMC implementation is shown in Table III, with details of the possible strategy for the implementation of the contract, and the steps and timeframe for starting the pilot PBMC (Figure III).

Table III. Progression of PBMC - time line

PBMC type	1st generation pilot PBMC	2nd generation PBMC	Comprehensive PBMC	Comprehensive PBMC + asset management
Duration	3-5 years	5-7 years	5-10 years	15+ years
Pavement maintenance	✓	✓	✓	✓
Drainage maintenance	✓	✓	✓	✓
Maintenance of signalization and equipment	✓	✓	✓	✓
Trees and vegetation control	✓	✓	✓	✓
Road cleaning	✓	✓	✓	✓
Winter maintenance	PB + BoQ	PB + BoQ	✓	✓
Emergency maintenance	BoQ	BoQ	BoQ	BoQ
Minimal rehabilitation	BoQ, if unavoidable	PB or BoQ	✓	✓
Major periodic intervention	-	PB or BoQ	PB or BoQ	PB or BoQ
Major rehabilitation	-	-	PB or BoQ	PB or BoQ

PB - performance-based; BoQ - Bill of Quantity, i.e. admeasurement, input-based

Performance monitoring is key to the success of this type of contracting road maintenance. Operational performance indicators apply to daily serviceability of the road network being maintained and include condition of pavement and road furniture. Manner and frequency of monitoring inspections of PBM activities throughout the duration of PBMC have to be defined (e.g. regular inspections and testing, and joint monthly verifications).

Figure III. Typical timeline for implementation of pilot PBMC

	Year 1				Year 2				Year 3				Year 4			
Activity	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1st generation contracts (3-year pilot PBMC, preferably hybrid and routine maintenance only for 300-500 km)																
Enabling legal and financial conditions to introduce PBMC																
Procure Initial TA																
Develop Maintenance Standards																
Assess local Contracting and Consulting capacity																
Assess Roads Generally																
Preparation of templates for PBM bidding documents for pilot project																
Data collection for preparation of PBM bidding documents for pilot project																
Selection of pilot areas for PBM pilot project for routine maintenance																
Preparation of bidding documents for PBM pilot project for routine maintenance																
Procure Project Management TA																
Training for potential bidders																
Procurement of pilot PBM contracts																
Pre-bid w orkshop																
Contract aw ard for pilot PBM contracts																
Implementation of pilot PBM contracts																

Support to Regional Participants in Preparing Road Maintenance Plans 2019-2023

Analysis performed within the Assessment Report for Road Maintenance Needs in the WB6 identified that about 2,100 km of roads on the Core/Comprehensive network are in need of maintenance in order to fulfil the goal of eliminating sections in poor or very poor condition. According to the data received from RPs, the condition of Albanian roads belonging to the SEETO network is much better compared to the remaining five RPs (only good and very good condition rating), and these were not considered for further analysis.

Table IV. Summary of the recommended maintenance plan for 2019-2023 resulting from revised time distribution and leveling to current RPs' allocations for periodic maintenance

RP	Year	Length [km]	Cost per year [EUR million]	Total RP cost [EUR million]
BIH	2019	140.43	18.42	85.86
	2020	178.47	23.83	
	2021	160.84	23.04	
	2022	87.18	10.74	
	2023	83.41	9.84	
MKD	2019	88.80	6.52	12.76
	2020	73.60	6.24	
KOS	2019	163.30	7.87	25.56
	2020	142.60	8.47	
	2022	92.10	10.22	
MNE	2019	94.20	8.77	28.98
	2020	73.80	7.31	
	2021	33.00	6.41	
	2023	71.20	6.50	
SER	2019	208.10	16.15	45.76
	2020	220.60	17.21	
	2022	115.20	12.40	
			Total [EUR million]	198.92

Table V. Summary of the recommended maintenance plan for 2019-2023 per Route/Corridor

Route/ Corridor No.	Total treated length [km]	Years of intervention
R1	122.80	2019, 2023
R2a	92.88	2019, 2020, 2022, 2023

R2b	175.29	2019, 2020, 2021, 2022, 2023
R3	131.62	2020, 2021, 2022
R4	99.60	2019, 2020, 2023
R5	155.40	2019, 2020
R6	208.80	2019, 2020, 2022
R6b	235.00	2019, 2020, 2021, 2022
R7	46.40	2019, 2020, 2022
R8	71.00	2019, 2020
R9	144.59	2019, 2020, 2021, 2022, 2023
R10	56.80	2019
Vc	167.15	2019, 2020, 2021, 2023
VIII	14.60	2020
X	260.90	2019, 2020, 2022
Xb	24.00	2019
Xc	20.00	2020

In terms of the above presented figures for the recommended plan (Tables IV. and V), it must be noted that BIH would definitely need to apply for additional resources (International Financing Institutions' (IFI) loans/credits or commercial credit lines) because the periodic maintenance expenditures in the past five-year period range between EUR 10 and 12 million. The situation in MKD and MNE is less critical and an additional budget of about EUR 2 million should cover the planned activities. SER should be able to finance the plan by allocating about EUR 20 million/year and KOS about EUR 10 million/year for periodic maintenance in the past period.

In order to overcome the burden of an excessive budget for BIH, MKD and MNE, the following two options were also considered. However, it must be noted that these two options assume that each RP would significantly change its practice in terms of available financing and management of road maintenance activities (both routine and periodic maintenance) and make further efforts towards preserving its road assets. These two options either completely (Table VI) or partially (Table VII) exclude sections in medium condition which significantly changes the output of the maintenance plan.

Table VI. Summary of the reduced maintenance plan for 2019-2023 resulting from the assumption that only sections with IRI higher than 3.5 should be treated

RP	Year	Length [km]	Cost per year [EUR million]	Total RP cost [EUR million]
BIH	2019	140.43	18.42	74.99
	2020	155.92	19.90	
	2021	160.84	23.04	
	2022	47.18	7.72	
	2023	60.87	5.91	
MKD	2019	88.80	4.17	4.17
KOS	2019	88.70	4.51	6.13
	2020	24.10	1.62	
MNE	2019	94.20	8.77	28.98
	2020	73.80	7.31	
	2021	33.00	6.41	
	2023	71.20	6.50	
SER	2019	150.70	11.83	33.64
	2020	135.30	11.09	
	2022	99.00	10.72	
Total [EUR million]				147.91

Table VII. Summary of the reduced maintenance plan for 2019-2023 resulting from the assumption that only sections in poor and very poor condition should be treated

RP	Year	Length [km]	Cost per year [EUR million]	Total RP cost [EUR million]
BIH	2019	44.80	9.39	46.96
	2020	88.47	14.46	
	2021	125.37	19.42	
	2022	20.75	3.69	

MNE	2021	33.00	6.41	6.41
			Total [EUR million]	53.37

By completely excluding sections in medium condition, only BIH and MNE should work on improvement of their respective parts of the SEETO network, while the remaining four RPs (ALB, MKD, KOS and SER) have to at least preserve their assets above the threshold for poor condition.

On the other hand, partial exclusion of sections in medium condition assumed that all RPs would properly take care of all sections having an IRI lower than 3.5 and preserve these from further degradation.

Conclusions and Recommendations - Roads

The following bullet list provides the main conclusions and recommendations of the component for RPs and their respective road authorities:

- There is a need to establish proper practice of road network data collection, not only for portions of SEETO Core/Comprehensive Network, but for all roads under the jurisdiction of each road authority, followed by regular analysis of maintenance activities and studies on a short- and medium-term basis;
- Road authorities should make a strategic decision on how to collect data (in-house or outsourcing) and how to use existing equipment in the ownership of the road authority. This has to run in parallel with completion/establishment of the system and implementation of asset management principles;
- As a results-based activity, road asset management greatly relies on the asset valuation, so the RPs should follow this approach in order to evaluate performance of the road authorities and get an impression of the direction in which the road network is heading;
- Total needs estimate for the identified portion of the SEETO Core/Comprehensive Network of almost 2,100 km (39.4% of total network) is approximately EUR 260 million. This amount may be increased by another 15-20% to come to the final estimate of EUR 300-315 million for coverage of the maintenance backlog over the complete SEETO Core/Comprehensive Network and taking into consideration the whole structure of the road;
- Results of performed analysis during preparation of maintenance plans 2019-2023, for total length of analyzed road network show that: (i) the values of realized IRI and IRI flow through time prove the efficiency of suggested work programs on pavement condition maintenance and repair, (ii) time flow of IRI values is in compliance with required criteria on each road category; (iii) the process is characterized by large investments in the first year and an unfavorable schedule of investments, which is primarily the consequence of the deteriorated condition of RPs' networks, and (iv) there is clear work profitability on BIH, MNE, SER and KOS roads; Net Present Value (NPV) on the MKD roads should be interpreted from the point of large investments required in 2019 and rather low traffic volume along the identified routes;
- Recommended maintenance plan resulted in the overall amount of EUR 198.92 million, with the following distribution:
  - ✓ BIH - EUR 85.86 million for 650.33 km,
  - ✓ MKD - EUR 12.76 million for 162.4 km,
  - ✓ KOS - EUR 25.56 million for 398 km,
  - ✓ MNE - EUR 28.98 million for 272.2 km and
  - ✓ SER – EUR 45.76 million for 543.9km; -
- In order to overcome the burden of the excessive budget for BIH, MKD and MNE, another two options were also considered. These two options assume that each RP would significantly change its practice in terms of available financing and management of road maintenance activities (both routine and periodic maintenance) and make further effort towards preserving its road assets. These two options either completely or partially exclude sections in medium condition which significantly changes the output of the maintenance plan. When dealing only with sections having an IRI higher than 3.5, the distribution is as follows:
  - ✓ BIH - EUR 74.99 million for 565.21 km,
  - ✓ MKD - EUR 4.17 million for 88.8 km,
  - ✓ KOS -
    EUR 6.13 million for 112.8 km,
  - ✓ MNE - EUR 28.98 million for 272.2 km and
  - ✓ SER - EUR 33.64 million for 385 km.

- By completely excluding sections in medium condition, only BIH (EUR 46.96 million for 279.39 km) and MNE (EUR 6.41 million for 33 km) should work on improvement of their respective parts of the SEETO network, while the remaining four RPs (ALB, MKD, KOS and SER) have to at least preserve their assets above the threshold for poor condition;
- Performed analysis should represent a basis for further programming of works on the SEETO Core/Comprehensive Road Network rehabilitation with more detailed information (ideally from current or future established RAMS) by each RP. Intervention levels should be retained at the predicted level, at least in the first five-year period, in order to reach a satisfactory standard for the network with the highest transport work for the overall region;

Maintenance guidelines should be used to facilitate performance of road maintenance and management activities within the WB6 road authorities by:

- emphasizing the importance of maintaining the road network and associated facilities;
- ensuring that the road agencies use a systematic common approach to decision making within a consistent framework;
- providing a common and consistent basis for assessing the overall maintenance needs;
- ensuring that roads are maintained to a consistent standard, and continue to be so following the completion of all planned project works;
- assisting in the effective allocation of national and local resources;
- encouraging regular review of policies, standards and the effectiveness of maintenance programs.

Going further into the implementation of maintenance activities, a comprehensive set of recommendations for PBMC was prepared. The following bullet list briefly provides the major recommendations:

- It is worthwhile to try to introduce the PBMC within WB6 in response to international maintenance practice and good governance;
- None of the RPs is fully prepared for the introduction of PBMC;
- All RPs would require the change of certain legal solutions to allow for multi-year contracting and provision of financial resources;
- It is important to carefully select the network to which the PBMC will be applied, with the SEETO network being a good starting point for consideration as a network of strategic roads and within each RP. It should be borne in mind that the SEETO network is not compact in even one of the RPs and that it is composed of single carriageway two-lane roads and motorways/highways/expressways, so the most likely choice would be the region-based PBMC on that part of the network or maybe only on the continual portion of the motorway/highway/expressway network. Also, it is evident that all RPs have a certain maintenance backlog (to a greater or lesser extent), so it is necessary to make a decision about a possible initial rehabilitation/reconstruction, and only afterwards apply PBMC on a network brought to a certain quality;
- In relation to the type of contract, for all RPs except ALB and SER who already already took this step in the previous period, it is very likely that the approach with the PBMC pilot (even better if being further supported by the IFI) will give the best results and reveal all positive sides and deficiencies that should be removed for further application. Also, the implementation of a hybrid contract, with certain Bill of Quantities items that have increased risk level for the contractors to be contracted on the admeasure basis, would allow an effective and relatively painless adjustment of the Contractors in the case of advanced methodologies;
- Training, both for managers, as well as for local contractors and consultants, is mandatory given the lack of experience, certainly with the engagement of the TA consultant;
- Independently of the PBMC introduction, one of the mandatory steps in improving maintenance practices for all RPs should be the introduction of RWIS in the winter maintenance phase to monitor the weather conditions and timely determine the moment for interventions on the network.

1 Project Purpose and Objectives

1.1 Project purpose

The purpose of the project is to undertake an assessment of institutional and budgetary framework[s] for the road/rail maintenance, to propose best practice solutions with regard to the situation in the Western Balkans and to prepare the maintenance plan for 2018 - 2022 for the indicative extension of the TEN-T Road/Rail Core/Comprehensive Networks in the Western Balkans.

This project provided direct support to the Western Balkans' ministries responsible for transport and infrastructure, road authorities, railway infrastructure managers in planning, programming infrastructure maintenance and SEETO Secretariat in monitoring the implementation of relevant transport measures in the framework of the Connectivity agenda.

1.2 Objectives

The soft measure: "Establishment of functioning maintenance system ensuring no section in poor/very poor condition by 2020" should focus on implementing a sustainable and optimized solution for managing and maintaining infrastructure assets, targeting the indicative extension of TEN-T Road and Rail Core/Comprehensive Networks.

Infrastructure maintenance for roads and rail network should be aimed at the preservation of assets and promotion of sustainability for the future. There is a need for a multi-dimensional approach to be taken in terms of institutional and operational management of the assets. This should include:

(i) Institutionalizing sound asset management practices to enable countries to collect [data on and], manage and analyze conditions across Core/Comprehensive networks, which will then be used to optimize road/rail maintenance strategies;
(ii) Maintenance Contracting Strategy to make use of Performance-based Contracts to introduce a cost-effective form of contracting aimed at preserving the infrastructure assets.

The general objective is the improvement of infrastructure conditions in the indicative extension of the TEN-T Road/Rail Core/Comprehensive Network in the Western Balkans. Infrastructure improvements will lead to increased performance of the transport networks and increased competitiveness of the region.

2 Transport Sector Background

The TEN-T Regulation 1315/2013 forms the current legal basis for the development of the Trans-European Networks (TEN-T)[1]. The European Commission has concluded that the TEN-T network would be best developed through a dual-layer approach, consisting of a Comprehensive Network and a Core Network.

- The Comprehensive Network constitutes the basic layer of the TEN-T. It consists of all existing and planned infrastructure meeting the requirements of the TEN-T Guidelines. The Comprehensive Network is to be in place by 31 December 2050.
- The Core Network is a focused sub-set of the Comprehensive Network, overlaying it, to connect the strategically most important nodes, hubs, and links/routes of the Comprehensive Network.

Therefore, only parts of the Comprehensive Network are selected for the Core Network, which are essentially the components of TEN-T with the highest European added value in terms of addressing cross border missing links, key bottlenecks, and multi-modal nodes. The Core Network is to be in place by 31 December 2030.

In a future EU enlargement, the transport networks of future Member States would be required to be integrated into the EU TEN-T Network at any given time. Coherence between the network development and compliance with EU regulations would undeniably enhance the integration process.

The Western Balkans Comprehensive Network is strategically located with regard to the European Transport system. It constitutes a physical transport corridor that enables the continuity of different parts of the TEN-T Network, providing connections for the Central European Countries to the Black Sea and further beyond to Asia. In June 2015, the transport infrastructure related Ministries of the WB6 and the European Commission (DG NEAR and DG MOVE) indicatively identified the main transport axes that will be connected to the existing TEN-T Core Network Corridors[2]. This was carried out in accordance with the application of the *"Planning methodology for the trans-European transport network (TEN-T)[3])"*, which sets out many of the specific criteria for identifying the network's Core nodes and subsequently, Core links in terms of connecting Core nodes.

The WB6 agreed on the alignment of their core transport networks, which shall be developed in line with EU recommendations. Independent of their anticipated future membership of the EU, these countries are already moving towards improving their transport systems in terms of both infrastructure and operational measures.

Furthermore, in June 2015 during the TEN-T Days in Riga, three of the nine identified Core Network Corridors (CNC) were proposed to be extended for the Western Balkans. The three identified CNCs are:

- the Orient-East Mediterranean (OEM) Corridor which connects central Europe with the maritime interfaces of the North, Baltic, Black and Mediterranean seas;
- the Mediterranean (MED) Corridor which links the Iberian Peninsula with the Hungarian-Ukrainian border,
- the Rhine/Danube Corridor which provides the main east–west link between continental European countries, connecting France and Germany, Austria, the Czech Republic, Slovakia, Hungary, Romania, and Bulgaria all along the Main and Danube rivers to the Black Sea.

[1] Recently amended (Commission Delegated Regulation (EU) 2016/758 of 04.02.2016)

[2] as considered by Article 8 of the Regulation (EU) 1315/2013. The indicative extension of the TEN-T Network to the Western Balkans Region is articulated in EC Regulation 2016/758, which amended the TEN-T Regulation.

[3]Building the Transport Core Network: Core Network Corridors and Connecting Europe Facility {COM (2013) 940 final}

3 The Team of Non-Key Experts (NKE) and Scope of Services

3.1 The Team of Road Non-Key Experts

The Team of Non-Key Experts, established for the scope of this specific project, consists of five (5) Senior Experts, presented in the following table, as per the AO:

Position in ToR		Name	Category
1.	Project Manager	Giorgos Xanthakos (GX)	SNKE
2.	Road Maintenance & PBMC expert	Igor Jokanovic (IJ)	SNKE
3.	Pavements & Structures expert	Bojan Matic (BM)	SNKE
4.	Road Engineer	Dusan Nikolic (DN)	SNKE
5.	Economist-Financial expert	Ioannis Filopoulos (IF)	SNKE

This team was supplemented by four local SNKE which supported (horizontally) all three on-going connectivity reform sub-projects (ITS, Maintenance Plans and Road Safety), as follows:

- Emiljano Zhuleku for Albania and Kosovo
- Jovan Hristoski for the former Yugoslav Republic of Macedonia
- Amna Redzepagic for Bosnia and Herzegovina
- Dusan Savkovic for Serbia and Montenegro.

3.2 Scope of Services

Component 1 of the assignment - TEN-T Road Core/Comprehensive Network to Western Balkans-Maintenance - basically consisted of four broad activities requested by the Terms of Reference (ToR) and outlined in the Table 3.1. The results of each activity are detailed further below.

Table 3.1. Scope of the Component 1- Roads

Activity No.	Scope
1	Review and analysis of the current maintenance practices and needs within the TEN-T Road Core/Comprehensive Network to Western Balkans for the period 2018-2022. Output: Assessment Report for Road Maintenance Needs in WB6
2	Development of common (pavement and structural) maintenance guidelines for the whole region by identifying common ground among existing practices and aiming at harmonization with European Union (EU) best practices, including unified definitions of routine, periodic maintenance, as well as seasonal (winter) maintenance and ad hoc repairs. Output: Guidelines for Pavement and Structural Maintenance for the Whole Region
3	Support to Regional Participants (RP) in preparation of their Maintenance Plans that reflect the specific development characteristics/plans of each RP and in accordance with the regional context, including financial analysis under different budget scenarios resulting from the cost breakdown by road category (Corridor, Route). Output: Road Maintenance Plan for Core/Comprehensive Networks for 2018-2022
4	Analysis and recommendations for setting up Road Asset Management Systems (RAMS) and Performance Based Maintenance Contracts (PBMC) in the WB6 region. Output: Analysis and Recommendations for Setting up Road Asset Management Systems and Performance Based Maintenance Contracts in the Region

It is noted that the outputs for Activities No. 2 and No. 4 have been changed through the Inception Report, upon agreement on restructuring some activities during the kick-off meeting with SEETO (South East Europe Transport Observatory), to better suit the needs of the RPs and to provide specific instruction on establishing common practice and common definitions and set up the maintenance principles. The proposal within the Inception Report was based on different subjects covered within each of the sub-activities and knowing that PBMCs cover only one (mostly contractual) aspect of the complete road business while RAMS serves as a comprehensive approach (and tool) to establish relevant implementation programs. Therefore, the new setting of the outputs for Activities No. 2 and No. 4 was adopted as follows:

- **Activity No. 2 output**: Guidelines for Road Maintenance Management
- **Activity No. 4 output**: Recommendations for Setting up Performance Based Maintenance Contract

During the initial visits and meetings with RPs, **the applicability of the originally conceived maintenance plan (as per ToR) for the period 2018-2022 was discussed to a certain extent**. Namely, in most road authorities at RPs, at the time of initial meetings, the maintenance plans for 2018 had already been prepared or were at an advanced stage of development. This is normal practice and is limited by the appropriate state budget preparation cycle, which is usually adopted by the end of the calendar year. It thus became clear that any plan that contained 2018 in its framework would be inapplicable. In line with such a discussion and the preliminary agreement with RPs, **it was suggested that the plans be prepared for the period 2019-2023**, which would allow for an adequate follow-up for the next budget framework, as well as planning documents within road authorities.

The deliverables and their submission dates are indicated in the Table 3.2 below for each of the components.

Table 3.2. Submitted deliverables - Roads

Report No.	Report title	Draft	Final
1	Inception Report (common for Road/Rail)	07/07/17	02/08/17
2	Assessment Report for Road Maintenance Needs in WB6	11/12/17	25/05/18
3	Guidelines for Road Maintenance Management (including basis of Road Asset Management) in WB6	16/02/18	26/09/18
4	Road Maintenance Plan for Core/Comprehensive Networks for 2019-2023, for different budget scenarios	24/04/18	10/07/18
5	Recommendations for Setting up Performance Based Maintenance Contracts (PBMC)	22/06/18	30/07/18

4 Review and Analysis of Current Maintenance Practices and Needs

The Western Balkans Comprehensive Network is strategically located with regard to the European transport system. It constitutes a physical transport corridor that enables the continuity of different parts of the TEN-T Network, providing connections for the Central European countries to the Black Sea and further beyond to Asia. The SEETO Core/Comprehensive Network consists of thirteen Routes and six Corridors totaling about 5,370 km.

In order to ensure the sustainability of the network, which plays an important role in the socio-economic development of the region, there is need for proper maintenance (routine and periodic), to maintain the service quality to its users, ensure an economic and efficient road transport system [cost], and also preserve the assets, i.e. roads. There is no need to further emphasise the necessity of adequate and timely maintenance for all types of road surfaces to keep the roads at a good level of serviceability, and also to preserve the road assets, which have been developed over a long period of time.

The purpose of this activity was to undertake assessment of current road maintenance practice in each of the RPs, as well as maintenance needs along the SEETO Core and Comprehensive Network for each of the RPs and the network in general.

This is fully in line with the soft measure “Establishment of functioning maintenance system ensuring no section in poor/very poor condition by 2020” defined through the agreement by the Western Balkans Prime Ministers in Vienna (August 2015), and basically provides a starting point for improvement of the network condition and related maintenance systems that should be supporting and sustaining such improvement.

The main challenge in establishing the maintenance needs for the SEETO Core/Comprehensive Network was the data availability and accuracy within RPs. Initial findings showed that most of the road authorities do not perform regular road surveys and available information is very outdated.

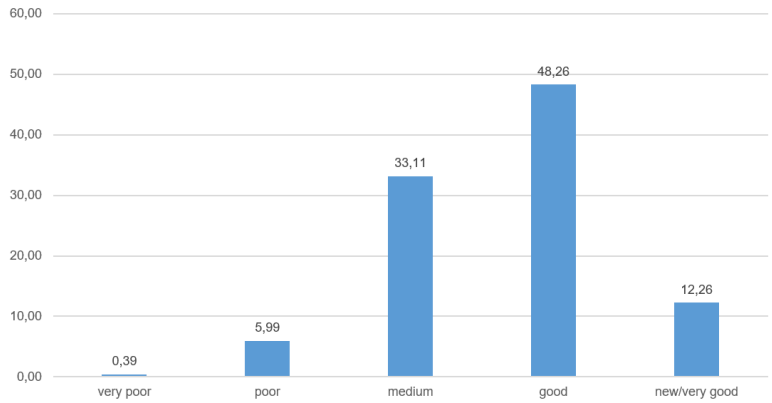
4.1 Description of network by quality parameters

SEETO has overtaken the methodology for quality qualification of pavement surface from the TEN Tec. This methodology defines five quality levels expressed through the International Roughness Index (IRI) parameter (Table 4.1). Overall (Figure 4.1), road sections in good and medium condition prevail (about 72%), while only some 6.4% of the overall SEETO Core/Comprehensive Network can be treated as “non-maintainable roads” (being in poor and very poor condition). The same data shows that, in general, rather high portion of the network is in the good and very good condition (about 60%). This can be attributed to the fact that many of the sections on the Corridors (Vc, VIII and X) are newly built or recently rehabilitated, and still did not suffer an extensive traffic load. Some further details on quality evaluation are presented in Figures 4.2-4.4.

Table 4.1. Pavement surface quality categories

Quality rating	TEN Tec IRI [m/km]	Modified IRI [m/km]
very good	< 1.24	< 1,2
good	1.24 - 2.84	1.2 - 2.8
medium	2.84 - 5.09	2.8 - 5.1
poor	5.09 - 8.94	5.1 - 9
very poor	> 8.94	> 9

Figure 4.1. Overall condition rating for SEETO Core/Comprehensive network



The roads showing the first three categories, i.e. very good, good and medium, are considered as the "maintainable roads". However, knowing that the general road budgets in each of the WB6 RPs are not enough to cover improvement of the condition for sections that are currently qualified as medium (or at least maintaining such conditions at the same level), and taking into consideration traffic growth, it can be expected that most (if not all) sections in the medium condition will suffer a decrease in rating to poor or very poor. Therefore, all such sections were also taken into consideration while assessing maintenance needs.

Figure 4.2. Overview of Routes/Corridors condition

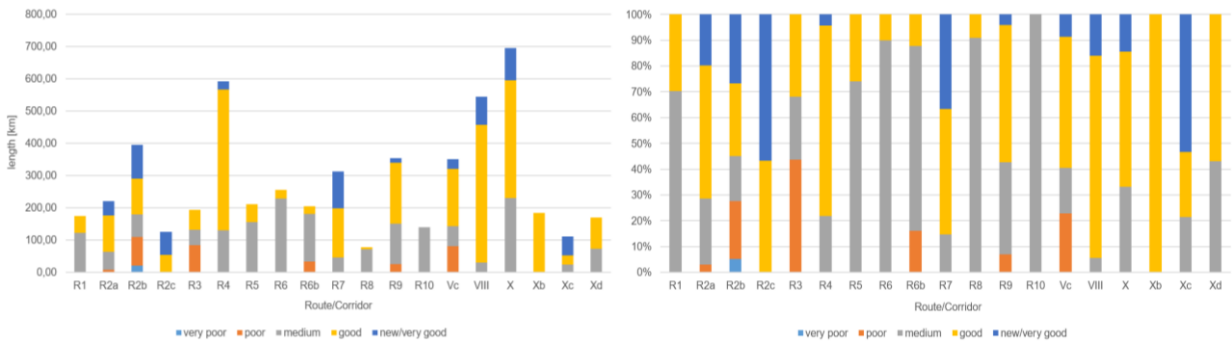


Figure 4.3. Overview of condition rating within each WB6

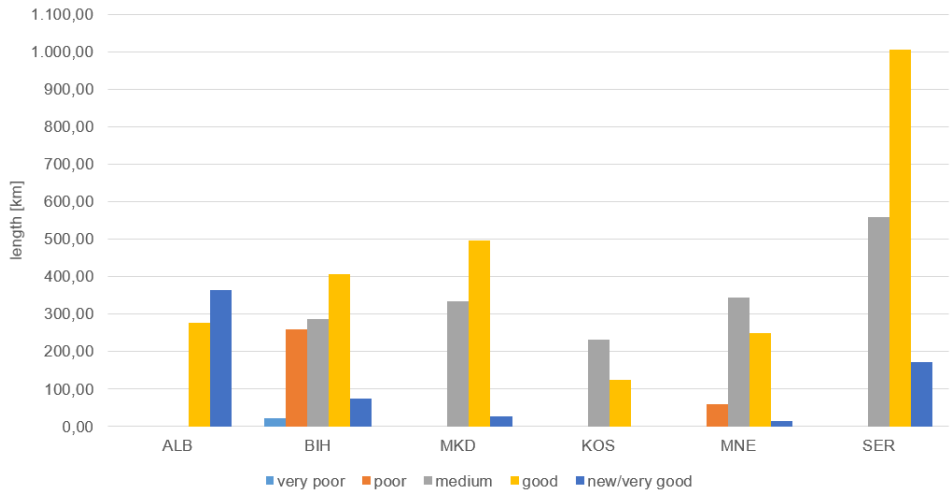
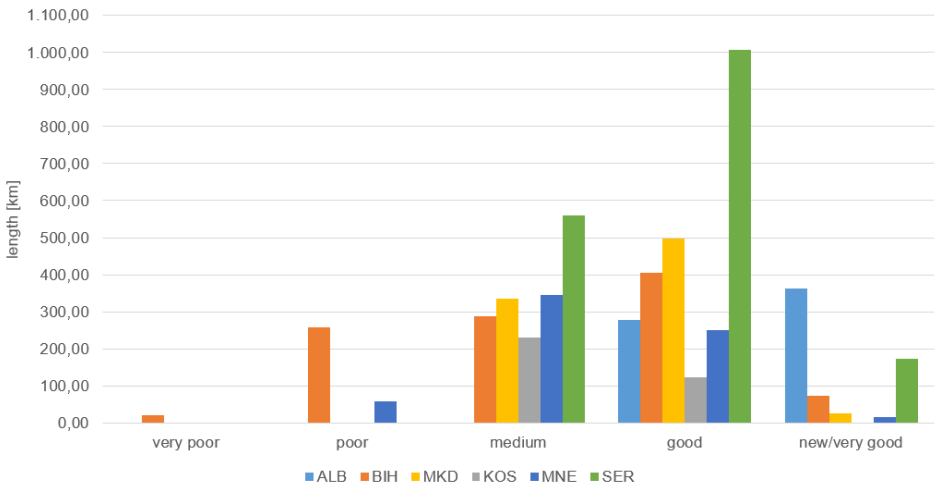


Figure 4.4. Comparison of quality categories between WB6



It is interesting to note (Figures 4.4. and 4.5) that the condition of Albanian roads belonging to the SEETO network is much better compared to the remaining five RPs (only good and very good condition rating). Such condition is the result of major activities on Albanian roads in the recent years (new construction and reconstruction/rehabilitation). Another important element of good practice in Albania is that all SEETO roads are now maintained through performance-based contracts with the support of the World Bank (WB). It is also expected that Serbia will significantly improve condition of its portion of the SEETO network soon: apart from completion of Corridor X, a major road improvement project is ongoing. The only RP whose roads are spread throughout all five categories is BIH, although the very poor portion of the network is recorded for only 20.75 km.

4.2 Assessment of maintenance needs

The total needs estimate for the identified portion of the SEETO Core/Comprehensive Network of almost 2,100 km (39.4% of total network) is approximately EUR 260 million (Tables 4.2. and 4.3). Figures 2.5. to 2.8. show graphical presentation of results. Logically, as a direct result of the longer portion of network in the medium condition (almost 1,800 km), compared to the remaining two categories (21 km and 318 km), approximately EUR 208 million is necessary to keep this part of the network on the safe side, i.e. not to let it deteriorate further. Repair of Corridors requires about EUR 90 million, which is almost 35% of what needs to be spent for approximately 24% of the network. Taking into consideration the importance of these Corridors in the overall RPs' transport system and traffic volumes, this is a reasonable amount of resources needed for their maintenance. Out of the identified part of the network needing maintenance treatment, 11.31 km is within the poor category, 284.09 km within the medium category and [there] are roads with double carriageway providing highway/expressway level of service. This makes up 17.1% of the whole double carriageway part of the network.

Table 4.2. Summary of maintenance needs per Route/Corridor of the SEETO Core/Comprehensive Network

Route/ Corridor	Length [km]	Condition						Total per Route/Corridor	
		very poor		poor		medium			
		length [km]	cost [EUR]	length [km]	cost [EUR]	length [km]	cost [EUR]	length [km]	cost [EUR]
R1	174.10	0.00	0.00	0.00	0.00	122.50	9,555,000.00	122.50	9,555,000.00
R2a	219.67	0.00	0.00	6.79	1,045,660.00	56.05	4,804,436.00	62.84	5,850,096.00
R2b	395.39	20.75	3,216,250.00	88.54	12,708,608.00	69.00	6,039,800.00	178.29	21,964,658.00
R2c	125.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R3	200.52	0.00	0.00	84.31	11,888,904.50	47.31	3,843,937.50	131.62	15,732,842.00
R4	591.70	0.00	0.00	0.00	0.00	129.50	12,919,920.00	129.50	12,919,920.00
R5	210.00	0.00	0.00	0.00	0.00	155.40	15,434,250.00	155.40	15,434,250.00
R6	254.50	0.00	0.00	0.00	0.00	228.70	20,046,000.00	228.70	20,046,000.00
R6b	205.00	0.00	0.00	33.00	3,993,000.00	147.00	24,625,900.00	180.00	28,618,900.00
R7	312.70	0.00	0.00	0.00	0.00	45.70	4,339,010.00	45.70	4,339,010.00
R8	78.00	0.00	0.00	0.00	0.00	71.00	6,506,500.00	71.00	6,506,500.00
R9	354.13	0.00	0.00	24.61	3,814,382.00	126.31	12,503,081.50	150.92	16,317,463.50
R10	139.60	0.00	0.00	0.00	0.00	139.60	12,174,500.00	139.60	12,174,500.00
Vc	351.29	0.00	0.00	80.49	15,476,076.00	61.85	10,392,649.80	142.35	25,868,725.80

VIII	543.65	0.00	0.00	0.00	0.00	30.20	2,944,500.00	30.20	2,944,500.00
X	694.50	0.00	0.00	0.00	0.00	229.90	52,302,900.00	229.90	52,302,900.00
Xb	183.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Xc	111.42	0.00	0.00	0.00	0.00	24.00	2,340,000.00	24.00	2,340,000.00
Xd	170.20	0.00	0.00	0.00	0.00	73.20	7,137,000.00	73.20	7,137,000.00
Total per condition		20.75	3,216,250.00	317.74	48,926,630.50	1,757.22	207,909,384.80	**2,095.71**	**260,052,265.30**

Table 4.3. Summary of maintenance needs per each Western Balkans regional participant

Regional Particip.	Length [km]	Condition: very poor		poor		medium		Total per Regional Participant	
		length [km]	cost [EUR]	length [km]	cost [EUR]	length [km]	cost [EUR]	length [km]	cost [EUR]
ALB†	640.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BIH	1,053.69	20.75	3,216,250.00	258.74	41,158,430.50	287.42	30,702,354.80	566.91	75,077,035.30
MKD	858.35	0.00	0.00	0.00	0.00	334.60	34,386,300.00	334.60	34,386,300.00
KOS	355.3	0.00	0.00	0.00	0.00	231.30	33,027,800.00	231.30	33,027,800.00
MNE	669.40	0.00	0.00	59.00	7,768,200.00	345.10	28,965,820.00	404.10	36,734,020.00
SER	1,737.62	0.00	0.00	0.00	0.00	558.80	80,827,110.00	558.80	80,827,110.00
Total per condition		20.75	3,216,250.00	317.74	48,926,630.50	1,757.22	207,909,384.80	**2,095.71**	**260,052,265.30**

† Data provided by the RP showed only good and very good condition of SEETO network. Also, there is an on-going performance-based maintenance project supported by the World Bank covering SEETO network. Consequently, the needs analysis showed zero values and no further analysis has been undertaken.

Bearing in mind the fact that maintenance needs for structures were not assessed, it can be concluded that the above amount of EUR 260 million may be increased by another 15-20% to come to the final estimate of EUR 300-315 million for coverage of the maintenance backlog over the complete SEETO Core/Comprehensive Network and taking into consideration the whole structure of the road. It must be noted that the majority of structures were built some 30+ years ago and did not receive proper care over all the past years.

Figure 4.5. Summary of maintenance needs per Route/Corridor

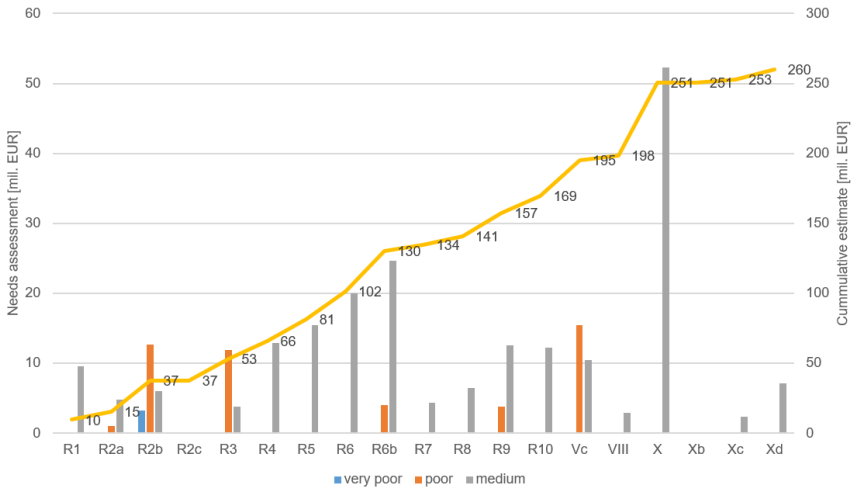


Figure 4.6. Summary of Routes'/Corridors' lengths meriting maintenance treatment

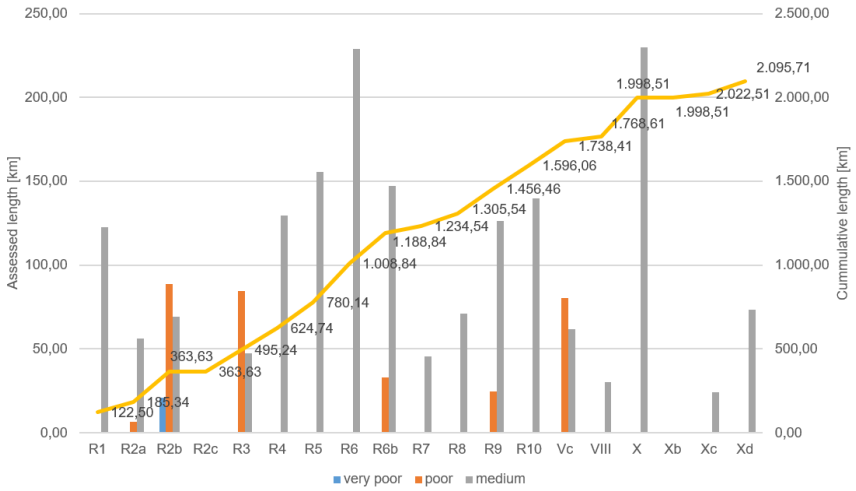


Figure 4.7. Overview of maintenance needs per each WB6

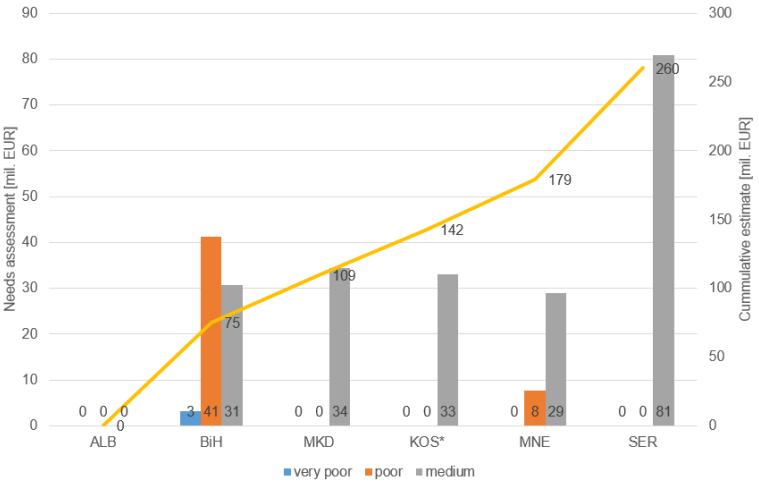
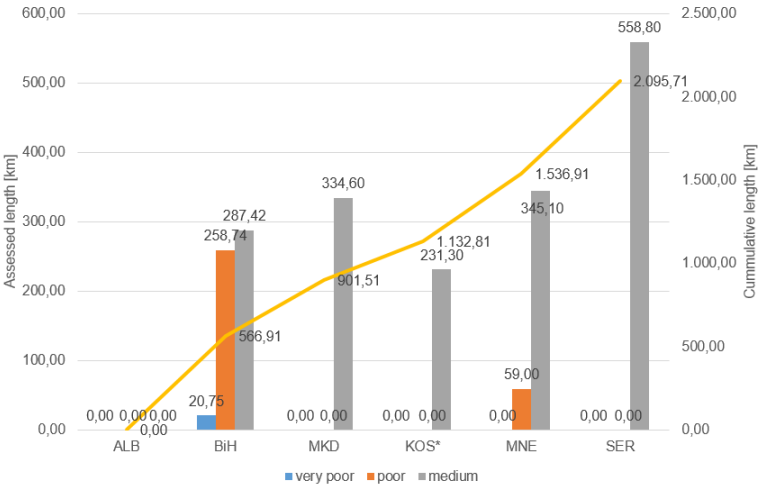


Figure 4.8. Overview of Routes'/Corridors' lengths deserving maintenance treatment per each WB6



For the assessment of routine maintenance needs, a detailed inventory of all road assets and relevant costs is necessary, but complete records on the remaining items of the road structure (right-of-way area, culverts, bridges, tunnels, drainage elements, small engineering structures) and traffic signalization and equipment

are not available within the WB6 RPs' road authorities. A very general assessment of routine maintenance needs for the total network of about 5,300 km (calculating with the average rates of EUR 7,000 per kilometer of single carriageway road and EUR 14,000 per kilometer of a dual carriageway road) would be approximately EUR 50 million per annum (or roughly EUR 9,000 per kilometer of dual-carriageway road and EUR 7,500 per kilometer of single-carriageway road).

This estimate sounds reasonable compared to the current levels of expenditures for routine and winter maintenance among WB6 RPs. It is estimated that such effort in routine maintenance of the SEETO Core/Comprehensive Network would enable deterioration of carriageway at an average rate without the need for extensive rehabilitation or reconstruction works, and at the same time, would provide a satisfactory level of service regarding remaining elements of the road body.

4.3 Systematic approach to data collection for future needs

For successful maintenance management it is crucially important to have the information necessary to achieve the goals of the management system and to evaluate possible maintenance alternatives. Such information forms the basis for rational planning and programming of works. Sound decisions need reliable, relevant, accessible and affordable information so that rational and informed judgments can be made. While it is possible for poor decisions to be made with good information, it is extremely difficult to make good decisions without it.

Data, i.e. inventory, condition, traffic, environmental and cost data, is vital to the success of any management system. Without data, it is not possible to conduct proper analysis and monitoring of the road network. Problems with data are one of the main causes cited in failure of a Road Management System (RMS) or Road Maintenance Management System (RMMS).

Data are needed to provide the basis for management decisions on such aspects as:

- determining optimum road condition and maintenance strategies and expenditures needed to achieve this;
- determining optimum road condition within actual budget constraints;
- assessing current levels of road and structures (bridges, tunnels, etc.) condition;
- determining appropriate levels of investment;
- prioritizing capital improvements and investments in maintenance;
- simulating effects of any improvements on future condition and performance of the road system;
- estimating the cost of improvements;
- controlling on-going expenditure.

As presented above, the main challenge during the needs assessment was to collect the data and fill in the missing information. The analysis is based on data on the conditions collected in different timeframes, some going back as far as a decade ago. Moreover, outdated information on road conditions prevents road authorities from planning and programming appropriate activities at certain periods of time, or as a minimum track network condition and deterioration progress. So, the WB6 road authorities could basically make a double error, i.e. they are trying to make a short or long-term decision on the basis of obsolete data for certain elements of the road structure and the absence of data in others.

Therefore, it is inevitably important to establish (or re-establish in certain cases) proper practice in road network data collection, not only for portions of SEETO Core/Comprehensive Network running through the respective RP, but for all roads under the jurisdiction of certain road authorities.

4.4 Review of current maintenance practice

Through the initial contacts with relevant road authorities and collection of data questionnaires, details on maintenance practice were established which enabled assessment of the current level of achievement. In general, maintenance practice is mostly similar within WB6 RPs, although there are certain specificities resulting from the different status of the road agencies (i.e. level of independence).

Maintenance is incorporated in the transport policies of all WB6 RPs either through a separate policy document on road maintenance or through general transport sector strategy.

On the budgetary side, there is increasing awareness of maintenance and the need to allocate a budget for maintenance. All road authorities receive regular allocations from the state budget through budget lines (tax regime system), while there are also direct incomes like tolling, fee for utilization of right-of-way, exceptional transport, etc. Tolling, as a source of financing road maintenance, does not exist

in Albania (ALB), Kosovo (KOS) and Montenegro (MNE). The budgets allocated for road maintenance have fluctuated in recent years but are more or less stable now. The only noted difference in this trend is for highways in Bosnia and Herzegovina (BIH) where the constant increase is evident due to significant expansion of the network in recent years.

Procurement of maintenance works and services is done under the framework of public procurement laws, except in Serbia (SER) and the former Yugoslav Republic of Macedonia (MKD) where direct contracting still dominates. Maintenance contracts are normally area-based and cover a mix of first and second order national roads, for which SEETO roads make up only a small portion. Most of the maintenance contracts in the WB6 RPs are input-based and multi annual. Multi annual contracts are signed in the form of framework agreements for the relevant period (normally 3-4 years). Only SER, BIH, and ALB have experience in output-based/performance-based contracts and continue implementation although not for the whole network.

In principle, maintenance contractors in all the RPs possess extensive experience in performing routine and winter maintenance - a kind of unique experience, which is also strengthened by an inventory of specialized equipment and maintenance depots along the network. It is generally believed that domestic companies in each RP are completely capable of performing most of the duties with their own resources (staff, equipment, vehicles), while engaging sub-contractors for the remaining, usually specific works (maintenance of electrical facilities, supply of materials (asphalt, concrete, aggregates), capacity upgrade during winter, etc.).

Several road authorities have mostly initiated establishment of the first two generic components of the RAMS (GIS and asset database) while the remaining components are still being dealt without extensive connection to the actual data stored in the database (following the process established a long time ago). A common element in all RPs is non-existent or irregular budget allocation for the update of data and general work on the asset inventory. This results in a lack of updated inventory and data on [road] conditions and prevents proper planning and programming of activities.

In general, possession of survey equipment by the RPs' road authorities is not very common, and the available equipment is not being used in any systematic way, but only when the need arises.

The situation with regard to planning and programming is very similar in all RPs and despite some positive developments, there is no consistent approach to define maintenance costs and develop plans. There are problems with:

- lack of most recent and accurate data on inventories and the condition of all road sections and not just in the SEETO network;
- there are no methodologies for planning and programming;
- lack of good quality business plans;
- none of the regional participants have developed RAMS;
- implementation;
- institutionalization.

Asset valuation, as a part of the overall RAMS, is not performed regularly in any of the RPs, and official methodologies do not exist.

4.5 Conclusions and recommendations

In order to highlight the importance road maintenance in preserving the national assets, it is important to develop proper tools, preferably tangible, so that any analysis and communications on the subject can be effective. Experience worldwide indicates that the operational model needs to be more strongly focused on conservation of the asset base created by progressive investment in a road network, and the language and process of dialogue needs to be changed. It would be more effective, if the conservation of the inherent asset value of the network is expressed in "money terms". The concept is based on the following:

- valuation of the asset of the road network, as carried out for any company's asset;
- lack of maintenance will result in the deterioration of the network by physical attrition due to effects of climate and traffic, which implies a continuous decrease in its asset value; and
- investment in the rehabilitation of heavily deteriorated or unusable routes or the addition of completely new roads, etc. which would be much more than the maintenance cost, if not carried out on time.

As a summary to the analysis and the above statements, the following recommendations should be highlighted:

- repair of very poor and poor sections of the SEETO Core/Comprehensive Network in the short-term and devote due attention to sections in medium condition to prevent further deterioration;
- undertaking timely routine and periodic maintenance activities in order to avoid more costly rehabilitation and/or reconstruction treatments;
- establishment and maintenance of a good dataset (minimum required is asset type, locations, quantity, condition and traffic data);
- regular surveys (at appropriate frequencies, i.e. normally not to exceed 3 years) of the network and data update on inventory and condition;
- establishment of the fully operative RAMS as a systematic process that combines engineering principles with sound business practice, including implementation of the asset valuation.

The next (logical) step, upon completing the assessment of maintenance needs, is the preparation of maintenance plan for the following five-year period on the basis of available data from WB6. However, it must be emphasized that, as a minimum, WB6 road authorities must perform a survey of the SEETO Core/Comprehensive Network within the next year or so. Such activity would allow the authorities to recognize the benefit of systematic and timely data collection in assessment of needs and planning of future activities but would also be a good starting point to expand such surveys to their complete networks.

The following boxes summarize findings and recommendations for each of the RPs.

ALBANIA
▪ SEETO network quality: very good 363.40 km/56.70%, good 277.50 km/43.30%, medium 0.00 km/0.00%, poor 0.00 km/0.00%, very poor 0.00 km/0.00%†
▪ outdated information on condition
▪ estimated periodic maintenance needs: 0.00 km/0.00 mil. EUR (very poor 0.00 km/0.00 mil. EUR, poor 0.00 km/0.00 mil. EUR, medium 0.00 km/0.00 mil. EUR)‡
▪ establish proper practice of road network data collection, not only for portions of SEETO Core/Comprehensive Network, but for all roads under the jurisdiction of the road authority
▪ need to structure budget into categories (routine (and winter) maintenance, periodic maintenance, rehabilitation, structures' maintenance and emergency works)
▪ establish regular maintenance analysis and studies on short- and medium-term basis
▪ need for regular budget allocations for update of data and general work on the asset inventory
▪ make a strategic decision on how to collect data (in-house or outsourcing) and how to use existing equipment in the ownership of the road authority
▪ complete the system and implement asset management principles
▪ perform asset valuation at regular intervals (not to exceed 2 to 3 years)

† Data provided by the RP showed only good and very good condition of SEETO network. Also, there is an on-going performance-based maintenance project supported by the World Bank covering SEETO network. Consequently, the needs analysis showed zero values and no further analysis has been undertaken.

BOSNIA AND HERZEGOVINA
▪ SEETO network quality: very good 73.70 km/7.04%, good 405.78 km/38.78%, medium 287.42 km/27.47%, poor 258.74 km/24.73%, very poor 20.75 km/1.98%
▪ outdated information on condition
▪ estimated periodic maintenance needs: 566.91 km/75.077 mil. EUR (very poor 20.75 km/3.216 mil. EUR, poor 258.74 km/41.158 mil. EUR, medium 287.42 km/30.702 mil. EUR)
▪ re-establish proper practice of road network data collection, not only for portions of SEETO Core/Comprehensive Network, but for all roads under the jurisdiction of the road authorities
▪ update/upgrade current database and GIS systems
▪ establish regular maintenance analysis and studies on short- and medium-term basis
▪ need for regular budget allocations for update of data and general work on the asset inventory
▪ make a strategic decision on how to collect data (in-house or outsourcing) and how to use existing equipment in the ownership of the road authorities
▪ complete the system and implement asset management principles
▪ perform asset valuation at regular intervals (not to exceed 2 to 3 years)

THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA

- SEETO network quality: very good 26.60 km/3.10%, good 497.15 km/57.92%, medium 334.60 km/38.98%, poor 0.00/0.00%, very poor 0.00 km/0.00%
- information on condition exists through the Star rating system, which is not fully in accordance with condition rating of pavement through IRI
- estimated periodic maintenance needs: 334.60 km/34.386 mil. EUR (very poor 0.00 km/0.00 mil. EUR, poor 0.00 km/0.00 mil. EUR, medium 334.60 km/34.386 mil. EUR)
- establish proper practice of road network data collection, not only for portions of SEETO Core/Comprehensive Network, but for all roads under the jurisdiction of the road authority
- need to structure budget into categories (routine (and winter) maintenance, periodic maintenance, rehabilitation, structures' maintenance and emergency works)
- contract maintenance on fully competitive basis
- establish database and GIS systems†
- establish regular maintenance analysis and studies on short- and medium-term basis
- need for regular budget allocations for update of data and general work on the asset inventory
- make a strategic decision on how to collect data (in-house or outsourcing) and how to use existing equipment in the ownership of the road authority
- establish the basics of the system and implement asset management principles†
- perform asset valuation at regular intervals (not to exceed 2 to 3 years)

† During the course of the assignment, and after completing the review of current maintenance and management practice, there have been some developments in view of the systematic approach to asset management. Namely, the separate project resulted in establishment of the RAMS with the following components: database, spatial database of road reference system, web GIS, RAMS portal, surveys with ground penetrating radar, and weighing of commercial vehicles in motion at 20 locations. Moreover, a RAMS unit was established through the new working post systematization act, and the whole structure is in operation since July 2018.

KOSOVO

- SEETO network quality: very good 0.00 km/0.00%, good 124.00 km/34.90%, medium 287.42 km/65.10%, poor 0.00/0.00%, very poor 0.00 km/0.00%
- no information on inventory and condition (information taken over from SEETIS records)
- estimated periodic maintenance needs: 231.30 km/33.028 mil. EUR (very poor 0.00 km/0.00 mil. EUR, poor 0.00 km/0.00 mil. EUR, medium 231.30 km/33.028 mil. EUR)
- establish proper practice of road network data collection, not only for portions of SEETO Core/Comprehensive Network, but for all roads under the jurisdiction of the road authority
- establish database and GIS systems
- establish regular maintenance analysis and studies on short- and medium-term basis
- need for regular budget allocations for update of data and general work on the asset inventory
- make a strategic decision on how to collect data (in-house or outsourcing)
- establish the basics of the system and implement asset management principles
- perform asset valuation at regular intervals (not to exceed 2 to 3 years)

MONTENEGRO

- SEETO network quality: very good 15.00 km/2.24%, good 250.30 km/37.39%, medium 345.10 km/51.55%, poor 59.00/8.81%, very poor 0.00 km/0.00%
- outdated information on condition
- estimated periodic maintenance needs: 404.10 km/36.734 mil. EUR (very poor 0.00 km/0.00 mil. EUR, poor 59.00 km/7.768 mil. EUR, medium 345.10 km/28.966 mil. EUR)
- establish proper practice of road network data collection, not only for portions of SEETO Core/Comprehensive Network, but for all roads under the jurisdiction of the road authority
- need to structure budget into categories (routine (and winter) maintenance, periodic maintenance, rehabilitation, structures' maintenance and emergency works)
- establish database and GIS systems
- establish regular maintenance analysis and studies on short- and medium-term basis
- need for regular budget allocations for update of data and general work on the asset inventory
- make a strategic decision on how to collect data (in-house or outsourcing)
- establish the basics of the system and implement asset management principles
- perform asset valuation at regular intervals (not to exceed 2 to 3 years)

SERBIA
▪ SEETO network quality: very good 172.12 km/9.91%, good 1,006.70/57.94%, medium 558.80 km/32.16%, poor 0.00 km/0.00%, very poor 0.00 km/0.00% ▪ outdated information on condition ▪ estimated periodic maintenance needs: 558.80 km/80.827 mil. EUR (very poor 0.00 km/0.00 mil. EUR, poor 0.00 km/0.00 mil. EUR, medium 558.80 km/80.827 mil. EUR) ▪ re-establish proper practice of road network data collection, not only for portions of SEETO Core/Comprehensive Network, but for all roads under the jurisdiction of the road authority ▪ contract maintenance on fully competitive basis ▪ update/upgrade current database and GIS systems ▪ establish regular maintenance analysis and studies on short- and medium-term basis ▪ need for regular budget allocations for update of data and general work on the asset inventory ▪ make a strategic decision on how to collect data (in-house or outsourcing) and how to use existing equipment in the ownership of the road authority ▪ complete the system and implement asset management principles ▪ perform asset valuation at regular intervals (not to exceed 2 to 3 years)

5 Development of Common Maintenance Guidelines

The purpose of the guidelines is to facilitate performance of road maintenance and management activities within the WB6 road agencies, and to present recommendations for establishing the road maintenance management system. In general, road maintenance management is a narrowly specialized area of expertise connecting the function of road ownership with the function of performing tasks related to maintenance of roads. More precisely, the aim of this document is to:

- emphasize the importance of maintaining the road network and associated facilities;
- ensure that the road agencies use a systematic common approach to decision making within a consistent framework;
- provide a common and consistent basis for assessing the overall maintenance needs;
- ensure that roads are maintained to a consistent standard, and continue to be so following the completion of all planned project works;
- assist in the effective allocation of national and local resources;
- encourage the regular review of policies, standards and the effectiveness of maintenance programs.

Road Maintenance Management (RMM) can be divided into four main functions, i.e. planning, programming, preparation and operations. These guidelines are mainly concerned with planning and programming, which are considered from the perspective of costs and benefits of investing in maintenance, data, treatment selection and prioritization. The remaining functions, preparation and operational issues of day-to-day management of roads and procurement of works, which should be of interest to those working at the detailed levels of road maintenance management, possibly in districts or operational organizations, are not covered within these guidelines.

The guidelines are developed in accordance with the best practices prevailing within the EU and among the countries with advanced road management worldwide and aim towards harmonization and rationalization of maintenance across the WB6.

5.1 Guidelines structure and outline

The guidelines are structured with the following parts (details provided outline the scope and main messages).

5.1.1 General notes

The main purpose of the first chapter is to explain the importance of road maintenance activities.

For a long time, especially during the period of road construction throughout the whole world, road maintenance was considered as a “routine” and “non-attractive” activity. Whereas design and construction are dominated by engineering issues, maintenance is essentially a management problem. Taking care of built roads was considered a “poor cousin”, and repetitive routine repairs and interventions together with the rare implementation of protection measures, were not attractive to engineers as they did not provide the prestige gained through design and construction of attractive structures.

In the last 35 to 40 years, road maintenance became the predominant activity of numerous engineers and technicians and is a first priority topic of the most important road institutes and research organizations. Although the need for maintenance is widely recognized nowadays, it is still not getting adequately done. Many countries spend just 20-50% of what they should on maintenance of their road network. Postponing road maintenance results in high direct and indirect costs. If road defects are repaired promptly, the cost is usually modest.

Experience shows that application of RMS on the entire road network provides the possibility to establish long-term consequences of the adopted financing policy. Furthermore, it enables an overview of the financial resources necessary for maintenance that will guarantee the required standards in the road network. This will provide such homogeneity of the network that its condition will not “fall” below the level estimated to be the permissible limit.

What is apparent from the various studies is that road agencies that are successful in their implementations have built strong foundations in all the fundamental components over a number of years. First and foremost, they have developed an “asset management mind set”, i.e. they explicitly and conscientiously implement policies that are geared towards managing their road infrastructure as an asset whose value must be maintained and improved. Their executives and management promote asset management principles in

order to ensure that funding and budget are allocated to appropriate areas. They are explicitly committed to the RMS, in the sense that it is built into their processes and procedures. They ensure that sufficient budget is available for data collection, for upgrades and maintenance of the systems, and for staff training and progression.

5.1.2 Road maintenance management

This chapter elaborates on the general principles of maintenance management.

Maintenance management is essentially a systematic mean of efficiently planning, programming, budgeting, scheduling, controlling, data collection and monitoring of maintenance works. In simple terms, maintenance management aims to get the right resources (people, materials and equipment), to the right place on the road network, to carry out the right maintenance or renewal work, at the right time. In many ways, maintenance management presents a greater challenge to the road engineer than works execution.

In conjunction with road planning, appraisal and design processes, management must optimize the overall performance of the road network over time. RMM aims to identify the need for maintenance works which are necessary to achieve or maintain required standards. RMM attempts to optimize the overall performance of the road network over time. At a practical level, it aims to ensure that the correct activities are performed on the network at the right time, and to the desired quality. The process comprises a series of management functions and covers two somewhat different areas of maintenance - routine and periodic. These are carried out by different staff within the road agency and relate to both short- and long-term decisions, and concern both the whole network and individual sections.

An effective maintenance strategy requires a framework within which the road agency will be able to develop standards and policies suitable to local conditions. The main objectives are considered to be:

- use of a systematic approach to decision making within a consistent framework;
- provision of a common basis for assessing the overall maintenance needs, resources and implications;
- reduction in the present inconsistencies in road maintenance standards and progressive elimination of backlogs;
- assisting in the more effective allocation of national and local resources;
- encouraging the regular review of policies, standards and the effectiveness of maintenance programs.

5.1.3 Road network and traffic data

The third chapter describes the basis of road classification and the establishment of a road reference system and data necessary for system support.

One of the most important assets in modern management organization is data. Data is collected and stored in databases and are used to monitor the performance of the assets as well as different management systems. The value of data depends on how well data gives information that leads to better decision-making and better knowledge. If the value of data is not identified, the data collection is meaningless.

Data describing the performance of road assets are not static. Every vehicle places wear on a road and over time the road requires some form of maintenance to improve the road condition. In order to get sufficient information to monitor the road network performance and to declare where, when and how maintenance should be carried out, data must be collected regularly in a consistent and optimal way with an assured quality.

Information is needed on items such as network details, traffic and axle loads, costs, road conditions, etc., which in turn require the existence of relevant data on which the information can be based. The need to assess physical condition, safety, Level of Service (LoS) and efficiency of operation of road systems is widely recognized. In addition to knowing the characteristics of the existing system, it is becoming increasingly important to be able to predict the effects that proposed policies are likely to have in the future. Such predictive capabilities enable the decision maker to test alternative courses of action to determine which policies and strategies will be the most effective in accomplishing the desired goals with the resources available.

Data are needed to provide the basis for management decisions on such aspects as:

- determining optimum road condition and maintenance strategies and expenditures needed to achieve this;
- determining optimum road condition within actual budget constraints;

- assessing current levels of road and bridge condition;
- determining appropriate levels of investment;
- prioritizing capital improvements and investments in maintenance;
- simulating effects of any improvements on future condition and performance of the road system;
- estimating the cost of improvements;
- controlling on-going expenditures.

Management information of this nature provides the quantitative basis of dialogue between road agencies and ministries of finance during the fund allocation process. It can also provide the basis of a dialogue with elected representatives, road users, farmers and others, and for monitoring departmental performance and meeting of policy objectives. Management information also needs to be understandable to all levels of staff within the road administration itself. The information should be presented in forms that are appropriate for the various audience requirements.

5.1.4 Data collection

Establishment of types of road condition surveys and frequency of their performance is the subject of the fourth chapter in the guidelines.

Each data item requires time, effort and money to collect, store, retrieve and use. The first rule of data collection is that data should never be collected because “it would be nice to have the data”, or because “it might be useful someday”. Every data item collected and stored must have a direct influence on the output that is required from the system, which should already have been determined. Other data items which may be considered as desirable, interesting or, possibly, useful in the future, should be omitted in favor of those that are essential, relevant and of immediate use, unless a very good cost-benefit case can be made for their collection.

The road network has to be inspected on a pre-set programmed basis for the purpose of identifying the need for routine tasks to be carried out as well as to program periodic activities. The requirements shall apply equally to all categories of roads. Where a particular interval is specified between inspections, this shall be adhered to as closely as possible.

All personnel shall be sufficiently responsible and competent for the task and receive suitable training to be fully conversant with the inspection procedures and safety requirements of the road agency. The data collection equipment and information technology hardware and software should be fit for purpose, actively used, properly maintained and covered by some sort of maintenance agreement and replacement strategy.

One of the following methods or combination thereof should be used for data collection:

- Review of archive or project documentation: Information from the detailed designs, as-built designs and construction books for the new construction, improvement or maintenance should be available at the road agency;
- Visual survey: This means that the person collecting the data or condition indicators has a device which may register the coordinate or chainage of a characteristic occurrence or the beginning/end of that occurrence. With this data it is possible to unambiguously define position in space;
- Semi-automated method: The method which means that the vehicle used for measuring the particular occurrences is equipped with odometer and GPS (Global Positioning System) receiver, as well as with special device interface combining automatic and visual measuring;
- Automatic method: This method is based on the state-of-the-art devices (odometer, gyroscope, GPS receiver, laser, accelerometers, ultrasonic sensors, high definition digital video, etc.) installed in the sophisticated systems (for instance ARAN, ROMDAS, Dynatest or similar), including strong hardware and software support and which are able to automatically and continually generate data from surveys. Most frequently, surveying data generated in this way may be directly exported into the database, after checking their validity.

Failure of the RMMS due to data collection is not seen as a failure of the data collection itself, rather a failure to properly institutionalize data collection. Specifically:

- there are often no explicit data collection policies;
- budgets are not made available for data collection;
- staff are not properly assigned to this task, trained or monitored;
- there are no quality assurance procedures;
- there is no auditing;

- there is no replacement strategy for specialist equipment or vehicles.

All these areas need to be specifically addressed in implementation of a management system.

5.1.5 Road maintenance planning and programming

This chapter deals with defining the approach to establishing maintenance standards and to programming maintenance activities.

The key to good performance of maintenance works and activities is their planning and programming. In order to provide the best possible utilization of available financial resources and to guarantee required LoS to road users at a minimum price, it is necessary to execute a series of coordinated activities, which, are presented in a unique way through the management systems.

There follows a general series of activities within these systems, usually known as management steps:

- Inventory, used as a basic reference of planning;
- Surveys and estimate, within which technical condition of road is being evaluated;
- Maintenance needs, easily determined by comparison of survey results with relevant indicator values i.e. pre-determined levels of intervention. These levels are usually called intervention criteria. These criteria should indicate the point when a certain maintenance alternative has to be undertaken and represent the basic element of each management system. When the assessed condition falls outside the acceptable standard, a certain type of maintenance is required to rectify the condition. Selection of values for each of these criteria is very important because it directly influences the country's economy and is a direct function of the goal to be attained. These values are neither technical ideals nor a result of possible financial policy. The acceptable condition is normally based on economic and safety evaluations and criteria and will vary for different road categories;
- Maintenance works prices, as well as total value of intervention are a necessary element to define total financial resources;
- Investment priorities must be established if the total available financial resources are insufficient for execution of all necessary and identified maintenance works. These priorities shall establish which works have to be done immediately and which can be left for later performance;
- Works execution, with selection of appropriate repair technique for each identified damage or defect;
- Monitoring serves as a means of evaluation for performed maintenance works, as well as for the planning of future works.

5.1.6 Road asset management system

Overview and recommendations on how to approach systematic asset management is covered in the RAMS chapter.

An appropriate definition of "asset management" for the roads sector is the one proposed by the OECD (Organization for Economic Cooperation and Development) in 2001: "A systematic process of maintaining, upgrading and operating assets, combining engineering principles with sound business practice and economic rationale, and providing tools to facilitate a more organized and flexible approach to making the decisions necessary to achieve the public's expectations".

One of the key objectives in implementing a RAMS is to provide justification for budget, and to help direct limited funds towards those areas where the return on investment will be greatest. The system should provide organized and systematic procedures covering aspects like:

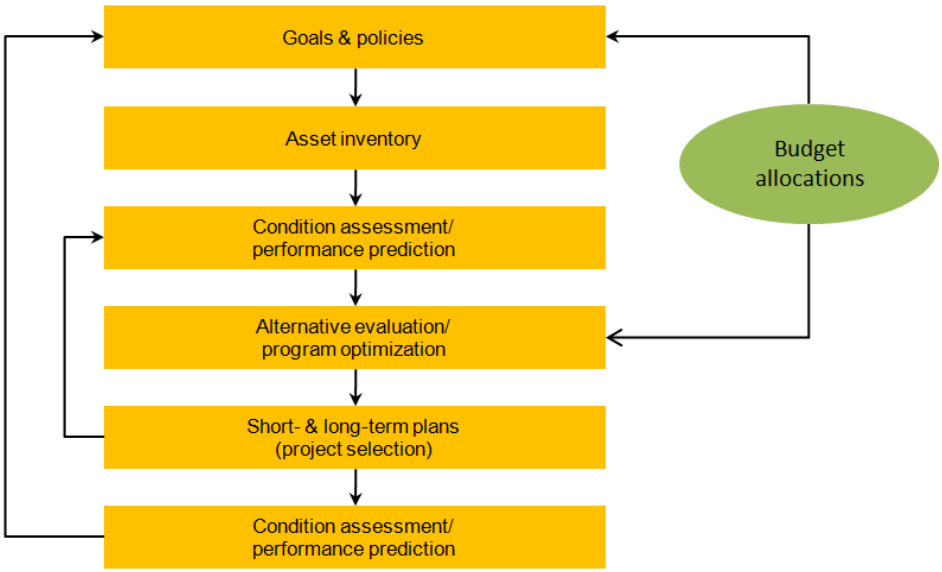
- inventory of assets, i.e. the road network, other infrastructure and other fixed assets and resources;
- valuation of the assets and reporting the value in monetary terms, i.e. capitalization and depreciation;
- RMS for use, maintenance and development of assets;
- implementing accounting by integrating road management and accounting; and
- systems and procedures for utilization of asset management information,

all set up within the overall Asset Management System (AMS) framework (Figure 5.1). System complexity substantially depends on the types of assets that are being managed and the available budgets or resources.

The RAMS should be viewed as an integral component in the road agencies' planning, implementation and monitoring processes. The outputs from the RAMS should be used to prepare annual reports as this helps ensure that data are collected regularly and the system is applied.

The introduction of a RAMS itself does not guarantee that it will be used, or that it will be successful. The road agencies must also follow basic asset management principles. Furthermore, the involvement of executives and managers prior to and during the implementation of the system is necessary to ensure institutionalized commitment to sustaining a RAMS.

Figure 5.1. Framework of the AMS



In general, the main processes in asset management comprise:

- establishment of the asset inventory;
- assessment of the asset condition;
- establishment of a LoS to be achieved for each road; this will depend on road type and its level of use;
- preparation of an optimized plan to achieve objectives and maximize the asset value, using the most cost-effective method possible.

Each road agency shall implement appropriate RAMS. However, generic components of an RAMS may be summarized as follows:

- GIS — This is a system that will hold and present all types of spatial data related to road infrastructure assets. It may enable visualization of the asset and analysis of data and presentation in a format usually with background mapping;
- Asset database — The asset database is a register of assets. At its most advanced level it may be a single integrated database. Equally, it may comprise separate asset registers for each asset group, e.g. pavements and structures will have separate databases. It may hold inventory and condition data for each asset type, and should be developed with proper coordination from other systems;
- Maintenance management — A maintenance management system will record routine maintenance defects from safety inspections or reported by the public, and their repair;
- Invoicing and payments — Linking to the maintenance management system will ensure invoices and payments are made and are auditable;
- Decision support systems — These will link to the asset database and support predictive modelling to determine future condition of an asset. They will be used to develop lifecycle planning and develop works programs and support prioritization;
- Asset valuation — An asset valuation system based on information provided in the asset database including inventory and condition to record the way how the assets are managed and evaluate success within the road agency.

The outputs of and RAMS should be used to convince decision makers of the drawbacks of insufficient funding for maintenance. Underfunding maintenance results in a depreciation of the value of the road asset,

and a loss of significant proportion of the original capital investment. This erosion of the road asset value is often not understood by governments, road users and general public.

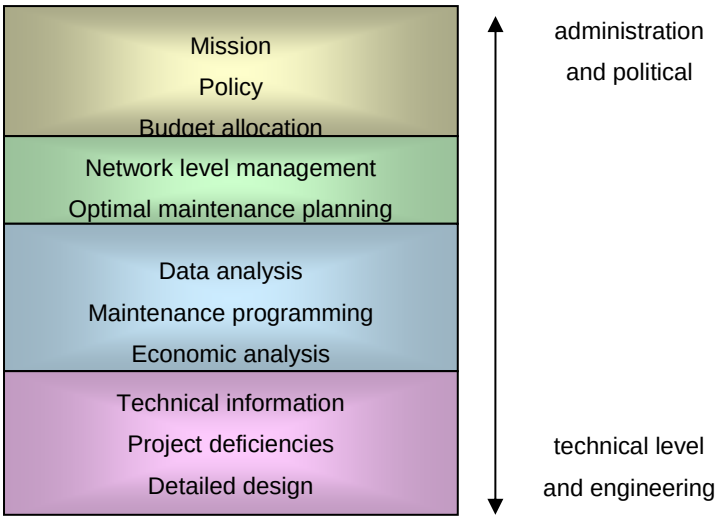
5.1.7 Operationalization

The last chapter of the guidelines describes participants and levels in the decision-making process and institutionalization of the system.

RMM is a big business nowadays. Proper institutionalization, including creation of human capacity, provides a solid ground for a successful RMM. Each road agency has to analyze its own weaknesses and strengths, potential partnering with the adjacent agencies or internationally, or even with the private sector, and decide how to proceed.

Keeping in mind the levels of decision making (Figure 5.2) in the process of RMM, it is clear that the level of information to be presented varies from very rough and general, at the executive-political and organizational level, to very detailed at the design level. This also complies with the information quality concept, elaborated earlier.

Figure 5.2. Levels of decision making



Maintenance is a management-intensive activity that requires an effective institutional set-up.

All systems rely on three fundamental components: processes, people and technology. Of course, appropriate funding is one of the prerequisites. If any of these components are lacking, the system will not be successful. The best technology in the world will ultimately fail if implemented in an environment where there are no people to run it, or where the processes are not in place to utilize it.

In theory, for an RMMS to be successful, the importance of each component would be clear. Executives and managers would be demonstrably committed to the system, both in their relations with external stakeholders and internally in their agency through good management principles. Policies would explicitly state the goals and objectives of the organization with regard to RMM, and procedures would detail exactly how the road management system would be used to achieve these goals.

The agencies which have most successfully implemented an RMMS or RMS have made it an integral element of their business process. The RMMS is used to establish needs, set priorities, and regularly monitor and report on the road network condition.

One of the clearest indications that an RMMS is being successfully used in an agency is the presence in its Annual Report/Business Plan of key indicators and analyses that are produced directly from the RMMS.

Most agencies have a statutory requirement to prepare an annual report. Those which have adopted a formal “business plan” approach have been the most successful at implementing their RMMS. This plan sets out the existing performance and also forecasts future investments. Elements related to maintenance management, both in the annual report and the business plan, typically include:

- Key performance indicators: Indicators by which the agency assesses its performance, for example, the average condition of the network, number of km of pavements maintained, road surface roughness, number of bridges with constraints, etc. Regular data collection provides the basis for many of the indicators;
- Five-year goals: The goals reflect the overall objectives of the agency and should be consistent with their long-term strategic plan. Also, future challenges (for example, lack of resources, price escalations and market forces, drop in quality, etc.) should be outlined in this part. This is usually prepared by the planning and programming module of the RMMS;
- Annual asset management plan: The annual asset management plan describes the specific activities that are required to achieve the agency's goals, including detailed annual work programs. This will include asset management plans for pavements and structures as well as identifying areas where new roads and/or capacity improvements are required;
- Financial plan: The financial plan will describe the current and future sources of financing road maintenance (road maintenance fund, government funding, international donor assistance, etc.) and disbursement schedules.

Successful businesses, like RMM should be, take calculated risks to achieve objectives. Globalization, deregulation, complicated financial instruments and contracts, emerging markets, all contain tremendous potential advantages for companies and carry the danger of huge mistakes or unexpected developments. Businesses must measure these risks, try to minimize them and, if possible, use them to their advantage.

6 Support to Regional Participants in Preparing Maintenance Plans 2019-2023

Analysis performed within the Assessment Report for Road Maintenance Needs in the WB6 identified that about 2,100 km of roads on the Core/Comprehensive network are in need of maintenance in order to fulfil the goal of eliminating sections in poor or very poor condition. According to the data received from RPs, the condition of Albanian roads belonging to the SEETO network is much better compared to the remaining five RPs (only good and very good condition rating), and these were not considered in further analysis.

Data collected for the purpose of maintenance needs assessment has provided the possibility to generally estimate the level of financial resources necessary to improve the condition of the SEETO network within RPs. The analysis has been deepened by the strategic analysis of the networks in relation to:

- section type (2-lane or 4-lane road);
- section number and length;
- traffic volumes on the network (Annual Average Daily Traffic (AADT));
- average values of paramount, important pavement surface condition indicators IRI,

and definition of relevant network matrices.

Works on periodic maintenance are predicted on the basis of existing pavement condition and traffic volume, as well as changes in the pavement condition over time. Options for comparison consist of basic alternatives (patching potholes and crack sealing) each year throughout the analysis period, i.e. routine road maintenance works and suggested maintenance works during the analysis period, i.e.:

- patching potholes;
- crack sealing;
- mill and reinforcement with asphalt concrete;
- new asphalt concrete layer;
- pavement reconstruction.

Unit rates for individual works included in standards, i.e. in the analysis, are obtained after detailed analysis of cost data for works items submitted by the RPs, and relevant market conditions in the region. Apart from the above listed works, each road has to receive certain treatment in terms of arranging the roadside area. They are usually referred to as miscellaneous operations and are implemented annually.

6.1 Maintenance standards and alternatives

Two basic options were considered in this analysis:

- do minimum;
- do something.

“Do minimum“ is a basic alternative and is used as such in comparison process. Generally, it does not predict investment in pavement maintenance (“do nothing”). During the analysis period it is realistic to expect pavement deterioration on each section, but at different speeds, according to existing conditions, pavement characteristics, as well as size and structure of future traffic volume. It is more realistic to predict minimal investments in pavement maintenance during the analyzed period for the purpose of slowing down its deterioration (“do something”), than to presume that there will be no investments in routine maintenance, which would lead to considerable network condition deterioration (“do nothing”). The basic alternative in this analysis is marked as A0 and it presumes costs and effects of routine maintenance during the analysis period.

The “Do something” alternative consists of set of maintenance standards, which are adequate for individual representative sections, with the purpose of maintaining and improving their existing condition throughout the analyzed period. By implementing a roughness optimization method for the “do something” alternative, the quality parameters (represented through IRI) of the network will be unified over the defined planning period, i.e. through to 2023. The following maintenance alternatives were considered in the analysis:

- A1: mill and replace 4 cm;
- A2: mill and replace 5 cm;
- A3: mill and replace 6 cm;
- A4: new asphalt layers 10 cm;
- A5: new asphalt layers 12 cm;

- A6: reconstruction.

Research into an optimal solution, which would reach the set strategic goal, has been done using a HDM-4 (Highway Development and Management) model for each RP separately. Beside the above selected types of works and maintenance standards, including respective unit rates, other parameters were used in the analysis as well, such as: unit vehicle costs (collected from each RP or through market analysis), calibration factors (taken from the most recent calibration exercise performed for SER), etc. The analysis period is 2019-2023, and the discount rate is 8%.

6.2 Model outcomes and maintenance plan

Complete network of 2-lane and 4-lane roads in very poor, poor and medium condition within each of the RPs was analyzed without budget restrictions during the whole analysis period from 2019 to 2023. Works were directed toward minimizing the average roughness.

Results of the analysis for the total length of analyzed road network show that:

- the values of realized IRI and IRI flow over time prove the efficiency of suggested work programs on pavement condition, maintenance and repair;
- time flow of IRI values is in compliance with required criteria on each road category;
- the process is characterized by large investments in the first year and unfavorable time schedule of investments, which is primarily the consequence of deteriorated condition of RPs' networks;
- there is clear work profitability on BIH, MNE, SER and KOS roads; Net Present Value (NPV) on the MKD roads should be interpreted from the point of large investments required in 2019 and rather low traffic volume along the identified routes.

Through the road network strategy analysis, optimal maintenance strategy was determined for each "theoretical" section on the network, depending on the condition of surface and traffic volume, comparing possible activities and obtained results after performed activities. Without budget limitations, optimal quality was determined for each type of network segment, which implies optimal quality by minimizing overall maintenance and user costs.

Unfavorable time distribution of investments per year can be solved by prolonging carrying out of necessary works from the first year to a 3 to 4 year period. This solution also gives additional advantage because road authorities, as well as RPs' road construction companies, would have the possibility to carry out work programs in the suggested time period within their capacities. Resulting network condition indicators would not suffer significant changes due to prolonging the investment period.

Figures 6.1-6.5 present the relation between necessary investments according to the scenario "minimum average roughness" and "revised plan". Revision is done by improving time distribution and leveling to current RPs' allocations for periodic maintenance. Sections with high NPV/CAP ratio are at the top of the list, which implies they are the first priority. These are actually sections with poor or very poor pavement condition and high traffic intensity. Detailed analysis, at the project level, will probably show that for some of these sections it would be necessary to perform more intensive interventions than overlay/reinforcement. At the end of the list there are sections with low NPV/CAP ratio, where delay of works would not have a huge influence on overall network condition.

Figure 6.1. Original/revised ΔIRI investment costs for BIH

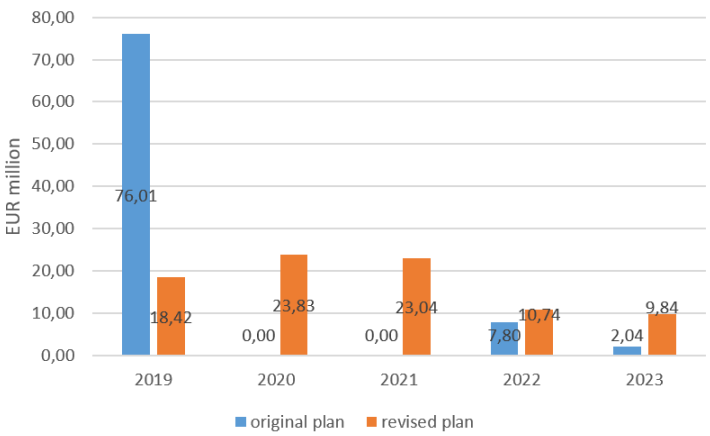


Figure 6.2. Original/revised ΔIRI investment costs for MKD

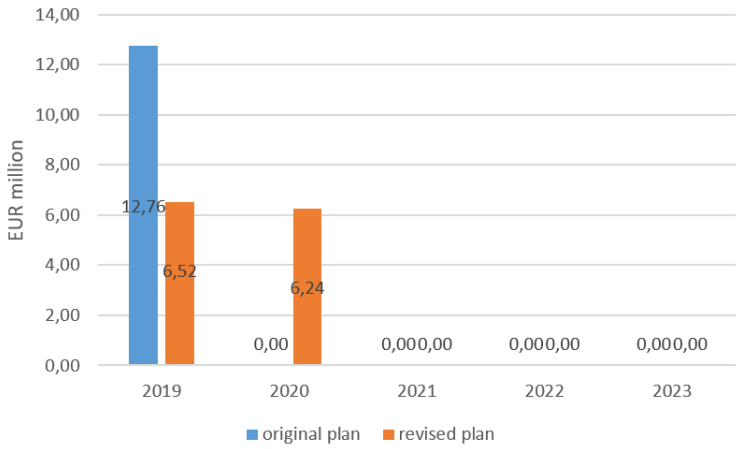


Figure 6.3. Original/revised ΔIRI investment costs for KOS

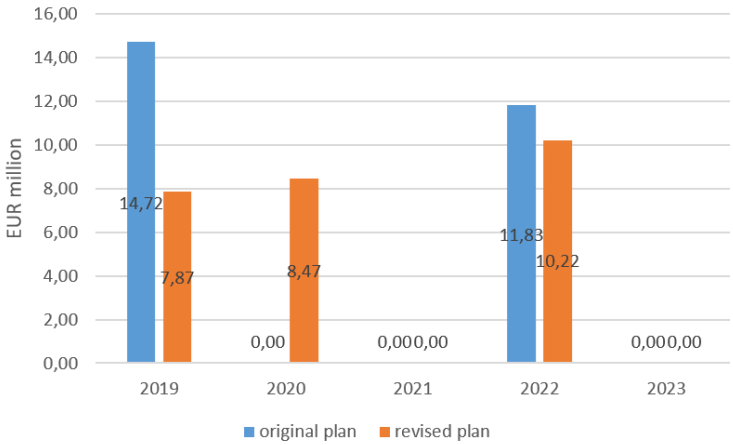


Figure 6.4. Original/revised ΔIRI investment costs for MNE

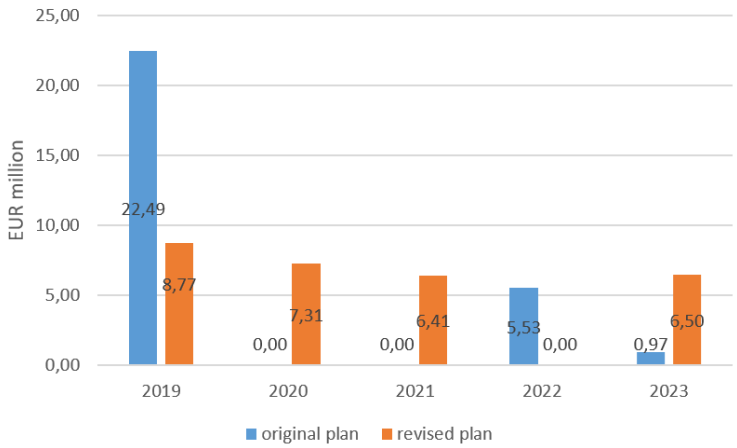


Figure 6.5. Original/revised ΔIRI investment costs for SER

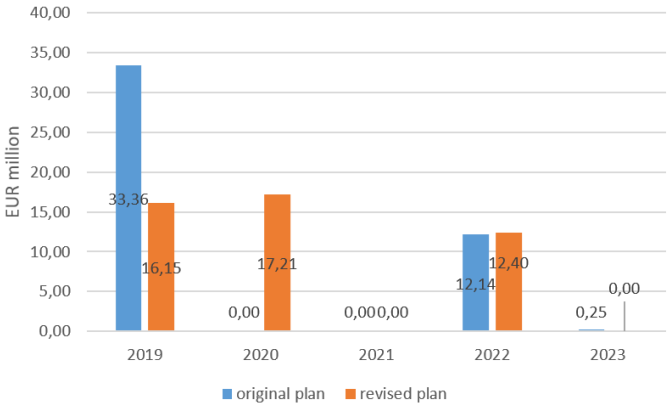


Table 6.1. Summary of the recommended maintenance plan for 2019-2023 resulting from revised time distribution and leveling to current RPs' allocations for periodic maintenance

RP	Year	Length [km]	Cost per year [EUR million]	Total RP cost [EUR million]
BIH	2019	140.43	18.42	85.86
	2020	178.47	23.83	
	2021	160.84	23.04	
	2022	87.18	10.74	
	2023	83.41	9.84	
MKD	2019	88.80	6.52	12.76
	2020	73.60	6.24	
KOS	2019	163.30	7.87	25.56
	2020	142.60	8.47	
	2022	92.10	10.22	
MNE	2019	94.20	8.77	28.98
	2020	73.80	7.31	
	2021	33.00	6.41	
	2023	71.20	6.50	
SER	2019	208.10	16.15	45.76
	2020	220.60	17.21	
	2022	115.20	12.40	
Total [EUR million]				198.92

Table 6.2. Summary of the recommended maintenance plan for 2019-2023 per Route/Corridor

Route/ Corridor No.	Total treated length [km]	Years of intervention
R1	122.80	2019, 2023
R2a	92.88	2019, 2020, 2022, 2023
R2b	175.29	2019, 2020, 2021, 2022, 2023
R3	131.62	2020, 2021, 2022
R4	99.60	2019, 2020, 2023
R5	155.40	2019, 2020
R6	208.80	2019, 2020, 2022
R6b	235.00	2019, 2020, 2021, 2022
R7	46.40	2019, 2020, 2022
R8	71.00	2019, 2020
R9	144.59	2019, 2020, 2021, 2022, 2023
R10	56.80	2019
Vc	167.15	2019, 2020, 2021, 2023
VIII	14.60	2020
X	260.90	2019, 2020, 2022
Xb	24.00	2019
Xc	20.00	2020

In terms of the above presented figures for the recommended plan (Tables 6.1. and 6.2) it must be noted that BIH would definitely need to apply for additional resources (International Financing Institutions' (IFI) loans/credits or commercial credit lines) because the periodic maintenance expenditures in the past five-year period range between EUR 10 and 12 million. The situation is less critical for MKD and MNE who should be able to cover the planned activities with an additional budgetary input of about EUR 2 millio while SER need to allocate about EUR 20 million/year and KOS about EUR 10 million/year for periodic maintenance in the past period.

In order to overcome the burden of the excessive budget for BIH, MKD and MNE, the following two options were also considered. However, it must be noted that these two options assume that each RP would significantly change its practice in terms of available financing and management of road maintenance activities (both routine and periodic maintenance) and make further efforts to preserve its road assets. These two options either completely (Table 6.3) or partially (Table 6.4) exclude sections in medium condition which significantly changes the output of the maintenance plan.

Table 6.3. Summary of the reduced maintenance plan for 2019-2023 resulting from the assumption that only sections with IRI higher than 3.5 should be treated

RP	Year	Length [km]	Cost per year [EUR million]	Total RP cost [EUR million]
BIH	2019	140.43	18.42	74.99
	2020	155.92	19.90	
	2021	160.84	23.04	
	2022	47.18	7.72	
	2023	60.87	5.91	
MKD	2019	88.80	4.17	4.17
KOS	2019	88.70	4.51	6.13
	2020	24.10	1.62	
MNE	2019	94.20	8.77	28.98
	2020	73.80	7.31	
	2021	33.00	6.41	
	2023	71.20	6.50	
SER	2019	150.70	11.83	33.64
	2020	135.30	11.09	
	2022	99.00	10.72	
Total [EUR million]				147.91

Table 6.4. Summary of the reduced maintenance plan for 2019-2023 resulting from the assumption that only sections in poor and very poor condition should be treated

RP	Year	Length [km]	Cost per year [EUR million]	Total RP cost [EUR million]
BIH	2019	44.80	9.39	46.96
	2020	88.47	14.46	
	2021	125.37	19.42	
	2022	20.75	3.69	
MNE	2021	33.00	6.41	6.41
Total [EUR million]				53.37

By completely excluding sections in medium condition, only BIH and MNE should work on improvement of their respective parts of the SEETO network, while the remaining four RPs (ALB, MKD, KOS and SER) must, as a minimum, preserve their assets above the threshold for poor condition.

On the other hand, partial exclusion of sections in medium condition assumed that all RPs would properly take care of all sections having IRI lower than 3.5 and preserve these from further degradation. Figures 6.6-6.10 present the comparison between the original plan, revised plan and two reduced plan options.

Figure 6.6. Comparison between costs or original, revised and reduced plans for BIH

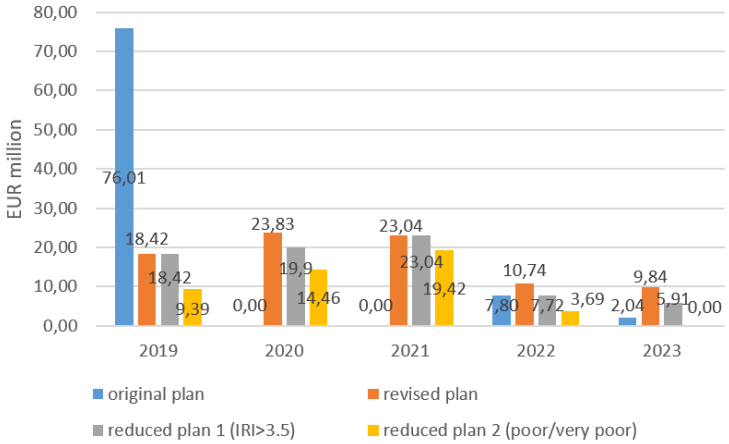


Figure 6.7. Comparison between costs or original, revised and reduced plans for MKD

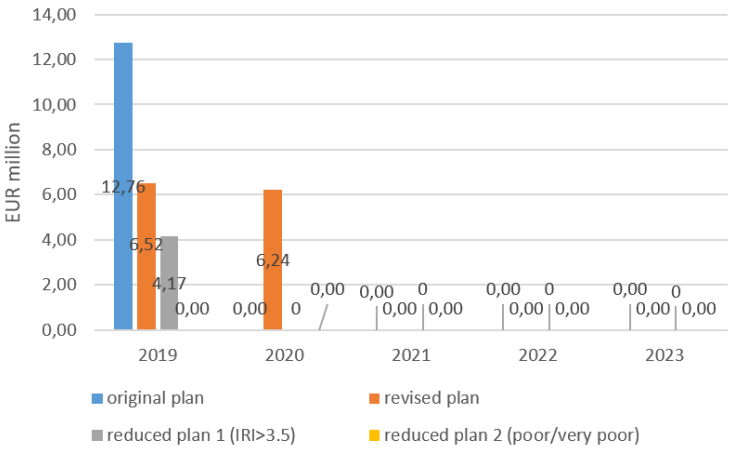


Figure 6.8. Comparison between costs or original, revised and reduced plans for KOS

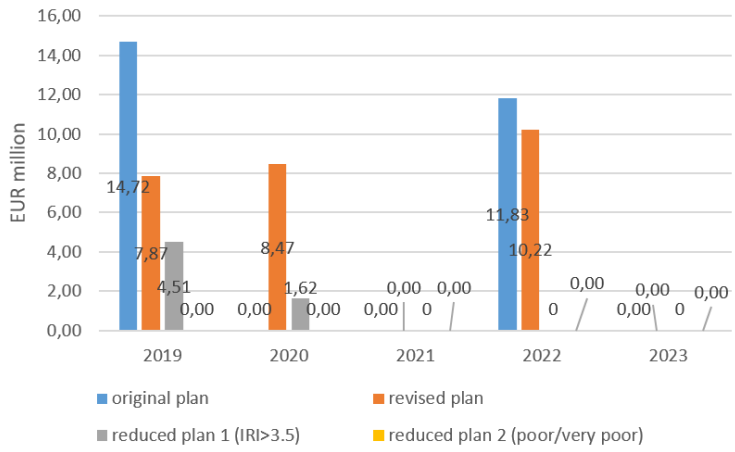


Figure 6.9. Comparison between costs or original, revised and reduced plans for MNE

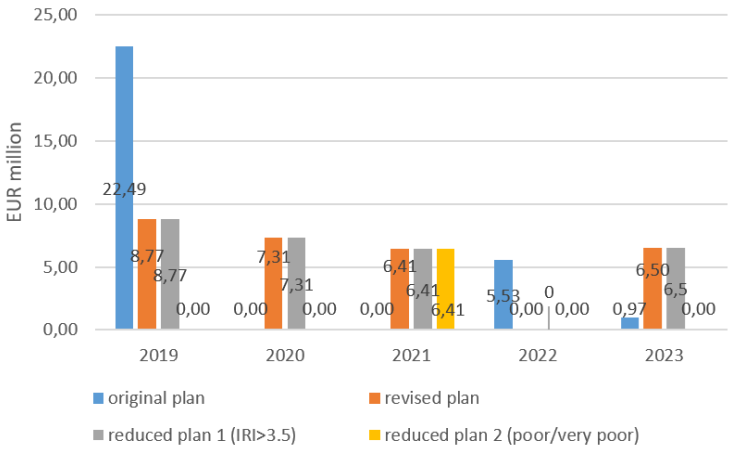
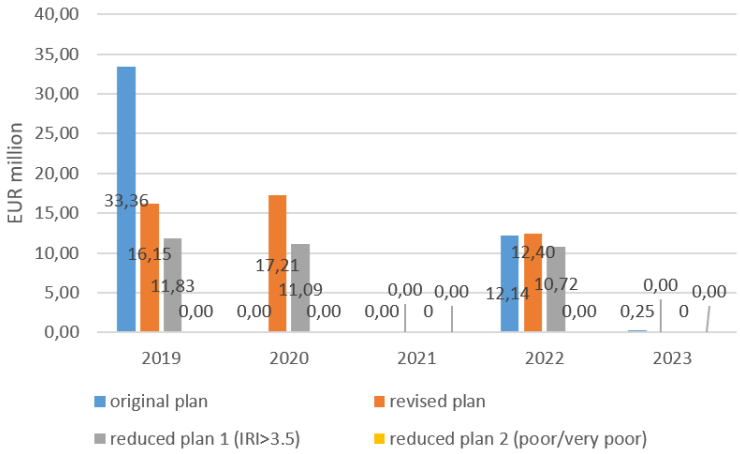


Figure 6.10. Comparison between costs or original, revised and reduced plans for SER



It is noted that the analysis performed was based on available information either received from RPs or extracted from SEETIS (SEETO Information System). A number of expert estimates and assumptions had to be made to fill in the information gaps. As such, the five-year maintenance plans and respective budgeting provide only a good estimate of requirements but cannot be considered by any means as representing accurately the specific maintenance needs.

Hence this analysis should represent a basis for further programming of works on the SEETO Core/Comprehensive Road Network rehabilitation with more detailed information (ideally from current or future established RAMS) by each RP. Intervention levels should be retained at the predicted level, at least in the first five-year period, in order to reach a satisfactory standard for the network with the highest transport work for the overall region.

Timely preparation of detailed designs and following HDM-4 project analysis, with considerably wider range of possible work alternatives (adapted to local conditions and materials), could also provide additional savings in the estimated budget.

The exception to this is a portion of the network in ALB which has recently received extensive periodic maintenance treatment, while a number of links were also newly constructed. Furthermore, the whole SEETO network in ALB is being maintained through performance-based maintenance contracts (four contracts supported by the World Bank (WB)) with a duration of four years (until December 21, 2021) or through a 30-year concession contract. In that sense, ALB is in a good position to at least preserve its major road network in a decent condition. The major condition for this is the continuous and full commitment of the government and road agency to continue maintenance operations as established beyond 2021.

7 Analysis and Recommendations for Setting up Performance-Based Maintenance Contracts

Road authorities worldwide face mounting problems with maintaining the serviceability of their road networks. Over the years there has been a gradual progression in road maintenance philosophy. In general terms, it was traditionally carried out directly by the road authority with its own maintenance organization supplementing its own capacity, to a greater or lesser degree, by contracting some works to contracting companies. The contracted element of the works steadily increased with many authorities reaching the point where all maintenance activity is carried out by contractors applying traditional methods of contracting and measurement of works under the authority's supervision.

Within the last 20 years, however, there has been a shift in implementing contracted maintenance through the use of performance-based methods. Under this Performance-Based Maintenance (PBM) methodology, the contract is based on the concept of payment for specified results (resulting in a well-maintained road) based on the contractor meeting specified standards of performance rather than measuring and paying for the quantities of work which he actually does, i.e. based on outputs. This contracting method is generally considered to be more cost effective than the traditional, input-based methods using measurement of units of work undertaken with payment at unit rates. PBM is generally recognized as the best way forward to better, more economical maintenance. It is a logical development in a sequence of evolving maintenance practices which have developed from direct labor to contracted maintenance through admeasurement contracts to PBM.

In most developed countries, performance- or output-based contracting of road maintenance operations has been effective, where appropriate conditions and institutional settings have been in place. It requires careful preparation in order to create a contract that is balanced, provides an adequate incentive for private sector participation, and is feasible.

Besides the changing philosophy of maintaining their roads, road sectors in most developing countries are at a big crossroads right now. While large investments have been made over the past decades by governments and international lending institutions, the road networks have not been adequately maintained, road safety records are significantly worse compared to developed countries, and road sector financing remains unsustainable. Extensive road maintenance projects (mainly rehabilitation and reconstruction) were implemented in the last 15-20 years in most of the developing countries. However, there has been no significant change in road maintenance practices, mostly because of inadequate, unstable and non-continuous financing, lack of managerial and strategic capacity, and very strong orientation to new investments originating from highly vigorous local political will. Insufficient or uncertain budgetary allocations to road maintenance have resulted in road deterioration that has significantly increased production and transport costs.

IFIs have played a significant role in introducing PBMCs into developing nations as part of loan assistance packages. In the past two decades, a number of attempts were made to introduce PBMCs, performance standards, and outsourcing systems, to promote technical innovations and to enhance basic administrative, procurement and financial management capacity as part of efforts to restructure road maintenance in number of countries to run more efficiently.

Experience of IFIs, donor programs and countries is widely available and some case examples are described in this report. The WB has been particularly proactive in promoting PBM. However, although WB supported PBM projects have generally been described as successful, particularly in the pilot stage, sustainability is an issue, specifically in regard to the inability of road authorities and relevant ministries to secure multi-annual stable financing afterwards.

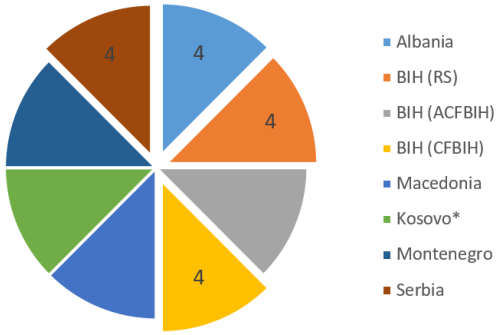
7.1 Current status in WB6

Regional experience in Performance-Based Maintenance Contracts (PBMC) is not extensive (Figure 7.1). The previous PBMC pilot project in Serbia for about 1,100 km, supported by the WB loan, has confirmed an adequacy to introduce such approach related to routine and winter maintenance. Following this, Serbia has recently launched procurement of PBMC for approximately 3,000 km of national roads through its own budget resources.

Similarly, Albania has also performed one WB supported pilot project covering approximately 270 km of national roads, and is currently in the process of implementing another four contracts, of five years' duration, including 1,332 km of the primary and secondary roads. This new contract covers the entire SEETO network

passing through Albania. Unlike in Serbia, these four contracts are again being funded through a WB loan. For the rest of the national road network, Albania is using a hybrid PBMC in a more budget constraint scenario.

Figure 7.1. Duration [years] of PBMC experience in WB6



CFBIH implemented PBMC as a trial contract at Livanjski kanton in the first contract signed in 2007, while current implementation runs through the contract for the period 2014-2018. Initially, network condition was surveyed and the decision taken to implement routine and winter maintenance with the aim of maintaining the condition of the road without additional investment. The approximate contract value was EUR 2.5 million and savings in winter maintenance at the contractor's side due to mild winters were around EUR 0.25 to 0.35 million. The prevailing opinion at the CFBIH is that this type of contract is not necessary, especially due to the fact there is the impression that the resources are spent without quantity justification (such an opinion is frequently quoted worldwide as a major obstacle to introducing PBMC). For some of the items the outcomes are on the positive side and there should be the option to contract some kind of mixed contract (input- and output-based). Experience of the JP Putevi RS (PRS) through PBMC for winter maintenance is interesting to note. They have recorded low interest of contractors resulting in lack of competition and very high rates.

Also, one of the major obstacles for most of the WB6, as expressed through the questionnaire, is the fact that the networks are not ready for PBMC implementation (not in a maintainable condition) and would require significant investment in the initial contract period that may consume most of the planned resources. This statement is not related to SEETO Core/Comprehensive Network only, but in general for the state roads networks.

In order to facilitate more efficient management of public assets and better use of funds allocated for road maintenance through PBMC, recommendations for setting up PBMC were developed.

7.2 Recommendations for WB6

The purpose of the recommendations is to facilitate implementation of PBMCs within the WB6 RPs through:

- description of the basic characteristics of PBMCs;
- analysis of international practical experience in implementation of PBMCs;
- identification of problems and challenges faced by the management institutions (ministries and road authorities) in the preparation and implementation of these agreements in the transition countries;
- setting relevant conditions and steps for launching and monitoring the successful PBMCs in WB6.

The considerations presented in the report provide sufficient information on roads' PBMCs, as well as the steps that should be taken when deciding on the approach, or during the preparation and implementation of the same. In any case, the most important fact for any RP is to determine whether the road network is in a condition that can be maintained according to PBMC principles, and whether the existing legal framework enables the implementation of this type of contractual relationship.

Based on the diverse international experience and lessons learned, experiences in the application of PBMC in the region, as well as in transitional economies and the current situation in the region regarding the condition of the road network and general maintenance practices, it is possible to recommend the following:

- It is worthwhile trying to introduce the PBMC within WB6 in response to international maintenance practice and good governance in meeting the expectations of political and civil structures, and most importantly by road users themselves who expect adequate (and visible) quality of roads for the funds

allocated through vehicle registration, taxes on fuel, excise taxes, etc. Moreover, the relevant governmental structures will witness the actual results against the budget allocations they make for road maintenance;

- In general, none of the RPs are fully prepared for the introduction of PBMC. Even ALB and SER, which have the appropriate practical experience, have certain limitations on the application of full PBMCs, primarily in terms of legal and financial constraints;
- Regarding the legal bases, practically all RPs would require the change of certain legal solutions to allow for multi-year contracting and provision of financial resources in the management of budgets that operate on the basis of annual plans and allocations from the general budget;
- One particular question is whether the road authorities in the RPs are ready for the introduction of PBMC in organizational and capacity terms. The answer is simple. If they are able to manage the current network maintenance contracts, then this question should not be posed - the organization is not questionable, rather its capacity is, especially in relation to modern principles of road asset management. However, the capacity of the authority will, in time, and especially during the preparation of the contract with the support of a Technical Assistance (TA) consultant, be brought up to the required level;
- It is important to select the network to which the PBMC will be applied carefully, with the SEETO network being a good starting point for consideration as a network of strategic roads and within each RP. It should be borne in mind that even with one of the RPs, the SEETO network is not compact and that it is composed of single carriageway two-lane roads and motorways/highways/expressways, so the most likely choice would be the region-based PBMC on [that?] part of the network or maybe only on the continual portion of the motorway/highway/expressway network. Also, it is evident that all RPs have a certain maintenance backlog (to a greater or lesser extent), so it is necessary to make a decision about a possible initial rehabilitation/reconstruction, and only afterwards apply PBMC on a network brought to a certain quality;
- In relation to the type of contract, for all RPs, except for ALB and SER that have already passed this step in the previous period, it is very likely that the approach with the PBMC pilot (even better if being further supported by the IFI) will give the best results and reveal all positive sides and deficiencies that should be removed for further application. Also, the implementation of a hybrid contract, with certain Bill of Quantities items that have increased risk level for the contractors to be contracted on the admeasure basis, would allow an effective and relatively painless adjustment of [those] contractors [who have their doubts?] in the case of advanced methodologies;
- The introduction of Maintenance Standards (MS) will represent a major change for all RPs (except ALB and SER), since they mainly operate without specifically prepared standards or technical specifications for maintenance activities. Even if PBMC does not develop in its basic form, the road authorities must have in their possession defined technical conditions for regular maintenance;
- Training, both for managers, as well as for local contractors and consultants, is mandatory given the lack of experience and definitely with the engagement of the TA consultant;
- Passing through certain phases is the best way to introduce a full PBMC which, in addition to routine network maintenance, will include periodic maintenance activities;
- Independently of the PBMC introduction, one of the mandatory steps in improving maintenance practices for all RPs should be the introduction of Road Weather Information System (RWIS) in the winter maintenance phase to monitor the weather conditions and determine the moment for interventions on the network in a timely manner.

7.3 Typical stages of PBM program

Without wanting to prejudice any approach or solution within any of the RPs' road authorities, the steps and needs for making certain decisions presented under Section "3 Introducing Performance-Based Maintenance Contracts", as well as the monitoring of the implementation of the contract itself (Section "4 Instruction on Performance Monitoring"), allow a gradual approch to the concept and scope of this type of contract.

In Section 3, specific attention has been paid to the following elements:

- the roles and commitment of policy makers and the road authority;
- technical assistance to support preparation and implementation of the PBMC;
- duration of contract and strategy of implementation;
- definition of the scope of contract;
- establishment of MSs and performance indicators;
- selection of the contract type, incentives and penalties;

- selection of the procurement method and preparation of tender documents;
- importance of the analysis of local contracting industry and necessary preconditions;
- establishment of appropriate physical capacity of the road authority (maintenance depots);
- recommendations on the typical stages of PBM program;
- instructions for PBM piloting and recommendations for the way forward after the pilot stage.

The roadmap for starting the PBMC implementation is shown in Table 7.1, with details of the possible strategy for the implementation of the contract, and the steps and timeframe for starting the pilot PBMC (Figure 7.1).

Table 7.1. Progression of PBMC - time line

PBMC type	1st generation pilot PBMC	2nd generation PBMC	Comprehensive PBMC	Comprehensive PBMC + asset management
Duration	3-5 years	5-7 years	5-10 years	15+ years
Pavement maintenance	✓	✓	✓	✓
Drainage maintenance	✓	✓	✓	✓
Maintenance of signalization and equipment	✓	✓	✓	✓
Trees and vegetation control	✓	✓	✓	✓
Road cleaning	✓	✓	✓	✓
Winter maintenance	PB + BoQ	PB + BoQ	✓	✓
Emergency maintenance	BoQ	BoQ	BoQ	BoQ
Minimal rehabilitation	BoQ, if unavoidable	PB or BoQ	✓	✓
Major periodic intervention	-	PB or BoQ	PB or BoQ	PB or BoQ
Major rehabilitation	-	-	PB or BoQ	PB or BoQ

PB - performance-based; BoQ - Bill of Quantity, i.e. admeasurement, input-based

Any further analysis of the recommendations for individual RPs would represent a deep, vertical analysis of the circumstances per individual partner, both the management framework and road maintenance practices, road network condition and the regulatory basis. This analysis significantly exceeds the framework of current services, so RPs are recommended to engage a TA consultant for more detailed analysis, defining the scope and terms of the contract.

7.4 Monitoring and success measurement

Performance monitoring is key to the success of this type of contracting road maintenance. The methodology should be clearly and accurately spelled out in the contract to prevent any misunderstanding from the contractor's side and avoid potential disputes. Operational performance indicators apply to daily serviceability of the road network being maintained and include condition of pavement and road furniture. Manner and frequency of monitoring inspections of PBM activities throughout the duration of PBMC have to be defined (e.g. regular inspections and testing, and joint monthly verifications). The PBMC requires a high level of self-monitoring and quality control from the contractor. The essence of the contract is that the contractor has undertaken to maintain the project roads to a set standard of maintenance. It is for the contractor to ensure that his work complies in all respects with the specifications.

Figure 7.1. Typical timeline for implementation of pilot PBMC

	Year 1				Year 2				Year 3				Year 4			
Activity	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1st generation contracts (3-year pilot PBMC, preferably hybrid and routine maintenance only for 300-500 km)																
Enabling legal and financial conditions to introduce PBMC																
Procure Initial TA																
Develop Maintenance Standards																
Assess local Contracting and Consulting capacity																
Assess Roads Generally																
Preparation of templates for PBM bidding documents for pilot project																
Data collection for preparation of PBM bidding documents for pilot project																
Selection of pilot areas for PBM pilot project for routine maintenance																
Preparation of bidding documents for PBM pilot project for routine maintenance																
Procure Project Management TA																
Training for potential bidders																
Procurement of pilot PBM contracts																
Pre-bid w orkshop																
Contract aw ard for pilot PBM contracts																
Implementation of pilot PBM contracts																

The modern type of maintenance activities (like PBM) includes a new approach to winter road maintenance in order to enable successful planning and operation of winter maintenance activities. Contractor's interventions are based on the data received from the RWIS which provides the contractor with information on current and expected weather and road condition in a timely manner.

The purpose of an RWIS is to predict likely weather events by observing trends in environmental measurements (temperature, wind velocity, humidity, etc.) with the purpose of proactively scheduling maintenance interventions (such as precautionary spreading, de-icing, snow cleaning, etc.) and properly make decisions. The intention is twofold:

- to improve the speed and quality of response to weather events thus reducing the impact on traffic safety and minimizing disruption to road users, and
- to enable historic recording of environmental conditions across the network so decisions can be audited and reviewed at a later date. It is then possible to ensure the road weather response plan is delivering value for money.

Maintenance projects significantly differ from capital projects and the productivity of maintenance work is usually not directly measured. It may be possible to measure the performance of maintenance contractors through a performance measurement approach (time and response measurements, and asset condition), but not the actual productivity. To the contrary of productivity, basic benchmarking for various types of maintenance operations may include tracking of the following indicators:

- Routine maintenance
  - average routine maintenance costs per km of road within the PBM area and their comparison with average routine maintenance costs in other territories where routine maintenance is carried out in standard/traditional way
  - consumption of material (such as stone chips and salt for winter maintenance) per km of road within the PBM area and their comparison with consumption in other territories where routine maintenance is carried out in standard/traditional way
  - operational and monitoring indicators specified in PBM specifications (e.g. response time, condition parameters, etc.)
  - road roughness (IRI) for improvements; lower IRI value leading to reduced Vehicle Operating Costs (VOC) (where applicable)
  - number of traffic accidents
  - public opinion surveys;
- Periodic maintenance
  - average periodic maintenance costs and their comparison with periodic maintenance costs for contracts where periodic maintenance is carried out in standard way
  - operational and monitoring indicators specified in PBM specifications (e.g. response time, preparatory works, etc.)

- road roughness (IRI) for improvements; lower IRI value leading to reduced VOC, analysis before/after
- number of traffic accidents
- public opinion surveys.

8 Conclusions and Recommendations

Component 1 of the assignment - TEN-T **Road** Core/Comprehensive Network to Western Balkans-Maintenance - basically consisted of four broad activities requested by the ToR with the aim of improving the maintenance management capacity of the RPs' road authorities and providing guidance in the road maintenance planning and programming of activities.

Activities performed within this component resulted from the in-depth analysis of the current status of road maintenance management activities and condition of the roads comprising Core/Comprehensive Network within the WB6. The following bullet list provides the main conclusions and recommendations of the component for RPs and their respective road authorities:

- Information on the network inventory and condition is very outdated in all RPs. There is a need to establish proper practice of road network data collection, not only for portions of the SEETO Core/Comprehensive Network, but for all roads under the jurisdiction of each road authority, followed by regular analysis of maintenance activities and studies on a short- and medium-term basis;
- Road authorities in the WB6 greatly suffer from irregular budget allocations which has an impact on the overall condition of the road network, and other management duties - one of these being updating of data and general work on the asset inventory. Road authorities should make a strategic decision on how to collect data (in-house or outsourcing) and how to use existing equipment in the ownership of the road authority. This must run in parallel with completion/establishment of the system and implementation of asset management principles;
- One of the important elements of the asset management system is asset valuation at regular intervals (not exceeding 2-3 years). However, such an exercise has been done in BIH and SER (a long time ago). As a results-based activity, road asset management greatly relies on asset valuation so the RPs should follow this approach in order to evaluate performance of the road authorities and get an impression of the direction the road network is heading;
- The needs assessment exercise, based on the available data, showed that road sections in good and medium condition prevail (about 72%), while only some 6.4% of the overall SEETO Core/Comprehensive Network can be treated as "non-maintainable roads" (being in poor and very poor condition). The data also showed that, in general, a rather high portion of the network is in a good or very good condition (about 60%). Maintenance needs of the network were established on the basis of available data and market rates. Total needs estimate for the identified portion of the SEETO Core/Comprehensive Network of almost 2,100 km (39.4% of total network) reaches approximately EUR 260 million. This amount may be increased for another 15-20% to come to the final estimate of EUR 300-315 million for coverage of the maintenance backlog over the complete SEETO Core/Comprehensive Network and taking into consideration the whole structure of the road;
- Results of performed analysis during preparation of maintenance plans 2019-2023, for the total length of the analyzed road network show that: (i) the values of realized IRI and IRI flow through time prove the efficiency of suggested work programs on pavement condition maintenance and repair, (ii) time flow of IRI values is in compliance with required criteria on each road category; (iii) the process is characterized by large investments in the first year and unfavorable time schedule of investments, which is primarily the consequence of the deteriorated condition of RPs' networks, and (iv) there is clear work profitability on BIH, MNE, SER and KOS roads; Net Present Value (NPV) on the MKD roads should be interpreted from the point of large investments required in 2019 and rather low traffic volume along the identified routes;
- The recommended maintenance plan resulted in the overall amount of EUR 198.92 million, with the following distribution:
  - ✓ BIH - EUR 85.86 million for 650.33 km,
  - ✓ MKD - EUR 12.76 million for 162.4 km,
  - ✓ KOS - EUR 25.56 million for 398 km,
  - ✓ MNE - EUR 28.98 million for 272.2 km, and
  - ✓ SER - EUR 45.76 million for 543.9 km;
- In order to overcome the burden of the excessive budget for BIH, MKD and MNE, another two options were also considered. These two options assume that each RP would significantly change its practice in terms of available financing and management of road maintenance activities (both routine and periodic maintenance), and make further efforts to preserve its road assets. These two options either completely or partially exclude sections in medium condition which significantly changes the output of

the maintenance plan. When dealing only with sections having IRI higher than 3.5, the distribution is as follows:

- ✓ BIH - EUR 74.99 million for 565.21 km,
- ✓ MKD - EUR 4.17 million for 88.8 km,
- ✓ KOS - EUR 6.13 million for 112.8 km,
- ✓ MNE - EUR 28.98 million for 272.2 km, and
- ✓ SER - EUR 33.64 million for 385 km.

By completely excluding sections in medium condition, only BIH (EUR 46.96 million for 279.39 km) and MNE (EUR 6.41 million for 33 km) should work on improvement of their respective parts of the SEETO network, while the remaining four RPs (ALB, MKD, KOS and SER) have to at least preserve their assets above the threshold for poor condition;

- Performed analysis should represent a basis for further programming of works on the SEETO Core/Comprehensive Road Network rehabilitation with more detailed information (ideally from current or future established RAMS) by each RP. Intervention levels should be retained at the predicted level, at least in the first five-year period, in order to reach a satisfactory standard for the network with the highest transport work for the overall region;

Apart from the two basic tasks of this component (needs assessment and maintenance plan), two additional outputs were prepared to facilitate the introduction of contemporary practice in road maintenance management activities.

Maintenance guidelines should be used to facilitate performance of road maintenance and management activities within the WB6 road authorities by:

- emphasizing the importance of maintaining the road network and associated facilities;
- ensuring that the road agencies use a systematic common approach to decision making within a consistent framework;
- providing a common and consistent basis for assessing the overall maintenance needs;
- ensuring that roads are maintained to a consistent standard, and continue to be so following the completion of all planned project works;
- assisting in the effective allocation of national and local resources;
- encouraging the regular review of policies, standards and the effectiveness of maintenance programs.

Going further into the implementation of maintenance activities, a comprehensive set of recommendations for PBMC was prepared. The following bullet list briefly provides the major recommendations:

- It is worthwhile to try to introduce the PBMC within WB6 in response to international maintenance practice and good governance;
- None of the RPs is fully prepared for the introduction of PBMC;
- All RPs would require the change of certain legal solutions to allow for multi-year contracting and provision of financial resources;
- It is important to carefully select the network to which the PBMC will be applied, with the SEETO network being a good starting point for consideration as a network of strategic roads and within each RP. It should be borne in mind that, the SEETO network is not compact in even one of the RPs and that it is composed of single carriageway two-lane roads and motorways/highways/expressways, so the most likely choice would be the region-based PBMC on the part of the network or maybe only on the continual portion of the motorway/highway/expressway network. Also, it is evident that all RPs have a certain maintenance backlog (to a greater or lesser extent), so it is necessary to make a decision about possible initial rehabilitation/reconstruction, and only afterwards apply PBMC on a network brought to a certain quality;
- In relation to the type of contract, for all RPs, except for ALB and SER that have already passed this step in the previous period, it is very likely that the approach with the PBMC pilot (even better if being further supported by the IFI) will give the best results and reveal all positive sides and deficiencies that should be removed for further application. Also, the implementation of a hybrid contract, with certain Bill of Quantities items that have increased the risk level for the contractors to be contracted on the admeasure basis, would allow an effective and relatively painless adjustment of Contractors in the case of advanced methodologies;
- Training, both for managers, as well as for local contractors and consultants, is mandatory given the lack of experience and definitely with the engagement of the TA consultant;

- Independently of the PBMC introduction, one of the mandatory steps in improving maintenance practices for all RPs should be the introduction of RWIS in the winter maintenance phase to monitor the weather conditions and determine the moment for interventions on the network in a timely manner.

APPENDIX A: Assessment Report for Road MPs

(Individual separate volume – Submitted as Interim Report 2)

APPENDIX B: Guidelines for Road Maintenance Management

(Individual separate volume – Submitted as Interim Report 3)

APPENDIX C: Road Maintenance Plans 2019-2023

(Individual separate volume – Submitted as Interim Report 4)

APPENDIX D: Recommendations for Setting up PBMC

(Individual separate volume – Submitted as Interim Report 5)