REPUBLIC OF MACEDONIA

PUBLIC ENTERPRISE FOR STATE ROADS

Terms of Reference
and Scope of Consultancy Services

Assistance to the Public Enterprise for State Roads in Carrying Out Preparatory Activities for Introduction of Bridge Management System

January 2019

Terms of Reference
for Consultancy Services

"ASSISTANCE TO PUBLIC ENTERPRISE FOR STATE ROADS IN CARRYING OUT PREPARATORY ACTIVITIES FOR INTRODUCTION OF BRIDGE MANAGEMENT SYSTEM"

1. INTRODUCTION

The World Bank (WB) is supporting the Public Enterprise for State Roads (PESR) in Macedonia in their efforts to establish a Road Asset Management System, part of which will be a Bridge Management System (BMS).

The Public Enterprise is mandated to plan, construct, reconstruct and rehabilitate the National and Regional roads and bridges in the country. Bridges are broadly categorized as follows: (1) Bridges on National Roads (these bridges are on roads primarily connecting to neighboring countries but also to the largest regional centers in the country), and (2) Bridges on Regional Roads (these bridges are on roads connecting two or more municipalities and securing critical in-country connectivity). The current road network in Macedonia comprises a length of 14,159 km, of which 1,112 km are National Roads (consisting of 236.5 km highways and 876 km of non-motorway National Roads) with 467 bridges, 3,721 km are Regional Roads with 640 bridges, and the remaining 9,240 km are Local Roads. National and Regional Roads are under the responsibility of PESR.

The reference system for the Bridge Management System was established in 2007/08, by the Institute of Earthquake Engineering and Engineering Seismology (IZIIS) in Skopje, Rep. Macedonia, under a technical-assistance study. This study generates a database of bridges and identifies information that is needed to assess their level of exposure to the hazards. The existing reference system identified 1107 bridges existing on the entire main and regional road network. This study covered 151 bridges, viaducts and overpasses on route A1 (Border crossing Tabanovce to/from Serbia – Border crossing Bogorodica to/from Greece) with ID number, report of currently situation with photographs. The study produced the following documents tailored to Macedonian conditions: (i) Bridge Database and Systems; and (b) Guide to Bridge Condition Survey and Evaluation.

The BMS which PESR is developing will cover the Bridges on Motorways, Expressways, National and Regional Roads. It will be part of a Road Asset Management System (RAMS) introduced in July 2017 and currently operational, managed by the Sector for road management and safety (also called RAMS team/unit), which falls under the Maintenance Department of PESR. In its current stage of development, the RAMS is used for pavement management, on the basis of an IT system consisting of:

- A road data bank (RDB)
- A road reference system (RRS) in both tabular and graphical (Web GIS) form

- A RAMS Portal used as the single-entry point to all RAMS components (the PESR IT unit is managing user rights)

Data collection and entry has so far been performed using Ground Penetration Radar (GPR) measurements as well as Weigh-In-Motion (WIM) measurements.

RAMS information has been used to provide input for strategic analysis, to support road investment planning, using HDM-4.

The following is a description of the current RAMS components:

Road Data Bank (RDB): It includes a database and application for road data management. The RDB database is designed as an integrated relational and GIS database that stores all road data in a standardized relational database MS SQL server according to the road reference system (road section and chainage) and geometry (coordinates) simultaneously. The RDB application is implemented as a Web solution to enable use of the RDB by as many users as possible but also as a client/server solution with more advanced functionality for advanced users (RAMS team). An important functionality of the RDB is the customized *data handling module* that is used for road data analyses and defining homogenous sections and importing prepared data to HDM-4 software. The data handling module was customized according to the HDM-4 needs. The RDB database was filed with road reference data as well as GPR- and WIM-measured data. All available data were transformed to new RRS, adapted to RDB structure and imported to RDB. Also, GPR data (for almost 4,400 km of state roads) and WIM data (for 20 locations) were inserted to RDB.

- Goal of the GPR measurement was to determine pavement structures (material type and thickness of pavement structure layers). The roads survey was made by *Road Doctor Survey Van*, that includes ground penetrating radar (GPR), video, laser scanner, accelerometer and positioning system (GPS with IMU). Data taken are continuous but were homogenized by 10m sections before delivery for bound, second and unbound layer. Important results of this measurements are also road pictures now integrated in WEB GIS – a total of 69000 images were produced with an image interval of 50m. Also source measurement data were delivered including video of road - data can be viewed with Road Doctor software.
- The WIM measurements were made through bridge WIM systems installed over the full width of roads.

Metadata were prepared for all transformed data, but also for other data – road reference system data, GIS background maps data, etc.

Road Reference System (RRS): In the GIS application, road data collected in RDB are effectively presented through visualization with appropriate background maps. The GIS application covers also the presentation of results of data analyses made by the RDB data handling module, as well as HDM-4-prepared programs of road works. As there was no existing road reference system (except road definition), a new RRS was established defining road sections and nodes and the methodology for road section definition and digitalization were defined as a first step. Digitalization of road centerlines for state roads took place subsequently, where “Open street” maps was taken as background and road ramps on motorways were also

digitized. For RRS data maintenance, an IT environment inside ESRI ArcGIS Desktop was established and user training for RRS data maintenance was done.

To further improve its management of road assets, PESR is planning to complement the existing RAMS through the addition of a Bridge Management System (BMS) module and to strengthen the RAMS unit through addition of BMS specialist staff. To achieve the above goals, PESR intends to employ a consultancy firm to support the RAMS team in establishing and strengthening the BMS function, detailing a roadmap for BMS and supporting PESR in the preparation and implementation of subsequent specialized assignments / procurement activities. This assignment will be funded by PESR with funds of a WB loan under the Road Upgrading and Development Project (RUDP).

2. OBJECTIVES OF THE SERVICES

The objective of this activity is to provide guidance to PESR in the initial activities related to the introduction of BMS. The Consultant through this consultancy will provide support to PESR in: (i) strengthening the existing PESR Sector for road management and safety to include BMS staff and activities , (ii) detailing a roadmap for introduction of BMS as part of the RAMS, (iii) developing terms of reference for a project-funded consultancy to prepare the Bridge Investment Plan, (iv) developing terms of reference for a project-funded consultancy to prepare the national bridges condition survey and support in the procurement of that consultancy, (v) supporting the procurement of BMS software and hardware (bridge database and evaluation tools) through preparation of bidding documents, (vi) providing technical advice and quality review during the development and acceptance process of the BMS software, and (vii) evaluating the available bridge network data to compute monitoring indicators and statistics and perform a macro evaluation of the network to support planning and programming purposes.

3. SCOPE OF THE SERVICES

Task I – Establishing and strengthening the BMS function in the PESR RAMS Unit

The Consultant shall review existing road and bridge management policies & procedures and assist the PESR Maintenance Department & Sector for road management and safety in their refinement and/or suggestion of any additional ones necessary for implementation of the BMS as part of the RAMS.

The Consultant shall prepare a strategic proposal for the PESR's BMS function, to be submitted to the Management for approval.

Following PESR Management's approval, the Consultant shall prepare a detailed operation plan for the BMS function, including job descriptions, budgets and outcomes. The detailed plan will include also position papers on necessary policy areas and present them to the PESR management for approval. Likely policy areas to be addressed include: investment planning / asset management; financial / budget; reporting; maintenance; human resources; IT.

Task II – Detailing a roadmap for introduction of BMS as part of the RAMS

The consultant shall review the current RAMS status and any structure management elements thereof, while at the same time developing (in cooperation with the Investment Department and RAMS unit) a description of desired functionalities and elements of BMS, including:

- **technical**, such as

data types;

data collection requirements and procedures: Consultant shall develop formal contract management procedures for management of data collection contracts (covering at least survey planning, preparation of ToR, evaluation of ToR, negotiations, and contract management) and will provide training in these procedures; Consultant shall also develop formal data collection procedures (to cover survey planning, scheduling, staffing, liaison, equipment, data definition, network referencing, field collection, measurement techniques, safety, and data management) and provide training in these procedures; finally Consultant shall develop formal data quality assurance procedures for validation of all bridge data to be used by the PESR and shall provide training in these procedures.

referencing – compatible with the existing RAMS (detailed road network referencing procedures will be made available to the Consultant at the start of the services);

reporting

- **asset valuation**: Consultant shall develop an approach and procedure for estimating the asset value and depreciation of the bridge structures, and for incorporating asset value into the BMS and the annual report. This approach should draw upon international best practice but should also be based on the agreed data collection policies and procedures established for the BMS under these services.

- **works program monitoring**: Consultant shall develop procedures for monitoring the implementation of the forward works programs being produced by the BMS, and for feeding back relevant information to the BMS to enable future planning to be more accurate and effective. The feedback must include location, type, and cost of actual works in the field. The Consultant shall also provide training in these procedures.

- **organizational and business-related such as human resources**

- **budget/financing** - budget estimate for annual operation of the team responsible for BMS, including all staffing, equipment, data collection (contracted or in-house), field travel, etc. in line with any policies of the PESR

- **use of outputs** to inform: the PESR's statutory annual report; the measurement of Key Performance Indicators / KPI; the establishment of multi-year programs and annual plans; preparation of a financial plan for current and future road maintenance.

The Consultant is also expected to assist in presentations to external stakeholders, including Ministry of Transport and Communications, Ministry of Finance, Ministry of Economy regarding the principles and benefits of the BMS being implemented. The system shall be

provided with a simple data viewing application which will allow for these external stakeholders to view the data.

Work on this task will be provided in three stages:

First - The BMS functional analysis will be submitted (together with Task I's strategy proposal) for PESR management approval.

Second - Following PESR management approval, the consultant shall develop an action plan for the introduction of BMS as part of RAMS (together with Task I's detailed operation plan for the BMS function), including description of training and capacity building for the BMS staff, as well as raising awareness of benefits.

Third – Detailed training materials and training sessions will be delivered. All training and training materials will remain the property of the PESR at the end of the services. The PESR will retain the right to modify the materials and to conduct future training using the materials. Such training may be conducted in-house or by any external training provider appointed by the PESR. Training will be tuned-in as necessary to the actual functionalities of the BMS application when delivered but will not include application-specific training (which will be the task of the BMS application supplier/integrator).

The Consultant shall prepare a training plan, to be approved by the PESR prior to commencement of the training. The training plan should outline the Consultant's approach to training, identify the trainers involved, provide a timetable for training, give brief descriptions of all training modules, list any pre-requisites for each module, identify the intended trainees, describe the training facilities and equipment to be used, give details of any feedback and evaluation process to be employed, and describe any certification to be provided.

The training materials must be in Macedonian language (in case of English-speaking lecturer simultaneous translation shall be provided by the Consultant).

The Consultant shall provide training and training materials in the following procedures as a minimum:

- procedures to be followed to refine the BMS application;
- adaptation of BMS output to planning/programs ready for implementation in the field (the activities from system output to logistically robust programs);
- data collection-planning, management, supervision and coordination;
- data quality assurance-verification and checking of data;
- data collection contract management-in case of contracting out portions of data collection;
- monitoring and feedback procedures;
- management reporting-reporting and presentation to senior management and executives;
- audit training-specific training or awareness shall be provided to the PESR's Internal Audit Department.

Task III – Developing Terms of Reference and preparation of the Bridge Investment Plan

Consultant shall describe the current state regarding PESR bridge investment planning and the purpose and functions of the desired Bridge Investment Plan, compatible with the approved BMS roadmap (action plan) identified in Task II, and include in Terms of Reference, which have to be approved by the PESR.

The goal of the Investment Plan for Bridges shall be to preserve the bridges on road network to insure safety and serviceability, while optimizing all available resources. Specifically, the bridge network condition goals are:

- as a priority on the road network, immediately address the needs of 100% of the structures of critical concern.
- to improve the overall condition of the bridges on the motorway and expressway network so that 50% of the structures on that network are rated good or fair by 2025.
- to improve the overall condition of the other bridges on national and regional road network so that 80% of the structures on that network are rated good or fair by 2030.

Task IV – Developing Terms of Reference for a project-funded consultancy to prepare the national bridges condition survey

Consultant shall describe the current state regarding the national bridge condition survey as well as the desired content of the national bridge condition survey, compatible with the BMS roadmap identified in Task II. The above will be in included in the Terms of Reference and refined cost estimate for preparation of the national bridge condition survey.

The Consultant will also support PERS during all stages of the procurement of the national bridges condition survey.

Task V – Supporting the procurement of BMS software and hardware (bridge database and evaluation tools) through preparation of bidding documents

On the basis of desired BMS functionalities, gap analysis and overall functional analysis and action plan as prepared for Task II, an initial scoping of the BMS including a cost estimate should be produced in cooperation with the Maintenance Department & Sector for road management and safety, for the approval of the PESR Management. This costing should include all hardware and software elements foreseen for the BMS, a life-cycle costing of the BMS including procurement, installation / data migration (plus related intranet design), maintenance / support.

Following PESR Management approval, the Consultant shall prepare the bidding documents for the BMS software and hardware elements, as well as an acceptance testing plan.

The Consultant should specify Commercial Off-The-Shelf (COTS) BMS software. The system should be capable of operational interaction with the existing RAMS elements, in particular the road reference system (RRS).

The bidding documents should be prepared using the World Bank's standard ICB format (SBD, Procurement of Works, The World Bank, March 2012) consisting of:

PART 1 – Bidding Procedures (Section I- Instructions to Bidders; Section II- Bid Data Sheet / BDS; Section III- Evaluation and Qualification Criteria; Section IV- Bidding Forms; Section V- Eligible Countries; Section VI- Bank Policy / Corrupt and Fraudulent Practices).

PART 2 – Supply Requirements (Section VII- Schedule of Requirements, including Technical Specifications).

PART 3 – Contract (Section VIII- General Conditions of Contract; Section IX- Special Conditions of Contract; Section X- Contract Forms).

Bidding documents shall be prepared for two separate procurement activities as follows:

(a) Software
(b) Hardware

The Qualification Criteria and Technical Specifications should cover as a minimum the following areas:

- Regional experience
- Country presence
- Support and maintenance
- References
- Licensing / Number of concurrent users
- Language
- Operating system
- Customization
- Field data collection devices
- Integration with GIS / road network referencing system
- Web enabling
- Terminology
- Network coding rules and conventions
- Bridge data - incl. location (road section, chainage), type of structure (bridge, viaduct, dimensions), structural elements (type, material, dimensions), importance (road/section importance, risk, by-pass possibility), functional index (socio-economic importance), etc.
- Bridge inspection data - general inspections, engineering inspections, emergency inspections, list of possible defects and works, list of defects found by element, specifying gravity and extend, elements condition (substructure, superstructure, furniture, approach, etc.)
- Bridge scoring system
- Cost estimates
- Planning and programming of activities
- Monitoring
- Asset value
- Data export
- User-defined items, data process functionality and
- Historical data

- Data-level security
- Function-level security
- Staging area for data loading
- Application programming interface
- Flexible reporting
- Multimedia storage and display

The Consultant will support RAMS Unit in evaluation of Bids and preparation of Evaluation Report.

Task VI – Provide technical advice and quality review during development and acceptance process of BMS

The Consultant shall prepare a design for an BMS site on the PESR's Intranet, to include relevant information to end users on the BMS. This design shall be in accordance with the PESR's existing Intranet policies and design templates. The Consultant shall ensure that all documentation, reports etc. are submitted to the PESR in a format that is suitable for the PESR's Intranet.

The Consultant shall prepare an acceptance test plan for the BMS. Upon approval by the PESR, this acceptance test plan will form the basis for acceptance testing of the system.

The application software will only be accepted once it is installed and fully operational in the PESR's office. Application documentation must be provided as part of the application acceptance process.

The application will only be considered complete upon formal acceptance by the PESR of the implemented application, consistent with the terms of the contract. The Consultant will address any issues iteratively, until all acceptance tests are completed satisfactorily.

The Consultant shall review the PESR's existing bridge data and assess its quality. Review of the data is for the purposes of loading that data into the BMS if proven to be of satisfactory relevance and quality. The Consultant shall load all data into the BMS and shall submit a data loading report describing all checks performed on that data, summary of the data, and findings, including any reasons why data could not or should not be loaded.

Task VII – Evaluating available bridge network data to compute monitoring indicators and statistics and perform a macro evaluation of the network to support planning and programming purposes

This task includes provision of specialist support to PESR and its RAMS Unit in analysing available data and performing an initial macro evaluation, prior to establishing the Bridge Investment Plan.

It will include a plan for the RAMS Unit's additional training and capacity building, to the extent not covered under Task II, for performing macro evaluation prior to establishing the Bridge Investment Plan.

4. PROJECT TIMETABLE and STAFFING REQUIREMENTS

4.1. INDICATIVE KEY TIMELINES

Activity	Start procurement	Start activity	Finish activity
Current activity (assistance TA)	**Dec 2018**	**Apr 2019**	**Nov 2020**
Task I (BMS function)		Apr 2019	Aug 2019
Task II (BMS roadmap & training plan)		Apr 2019	Oct 2019
Task III (Bridge Investment Plan)		Sep 2019	Nov 2020
Task IV (ToR for Condition Survey)			Oct 2019
Task V (BMS HW/SW Bid Docs)			Dec 2019**
Task VI (BMS acceptance support)		May 2020	Nov 2020
Task VII (Macro evaluation)			Aug 2019
Linked activities			
Bridge Condition Survey	**Aug 2019**	**Oct 2019**	**Oct 2020**
BMS HW and SW Procurement	**Sep 2019**	**May 2020**	**Nov 2020**

*Support during procurement is included in the relevant linked activity

4.2. COMPANY AND STAFFING REQUIREMENTS

The study will be conducted by a consultant company or an association in the form of a joint venture or sub-consultancy in accordance with the provisions of para 1.15 (Association between Consultants) in the applicable Consultant Guidelines. The following qualifications are required:

- Minimum 10 (ten) years proven experience in preparing and managing projects related to road and bridge management in countries of similar size and similar conditions as the Republic of Macedonia and/or countries in the EU;
- Proven experience in projects assisting road authorities in improving their RAMS practices. At least 2 similar projects in the last 10 years.;

• Proven experience in members countries of EU with experience in BMS implementation.

The consultant is free to propose the composition of its team, but it is expected that the key staff as identified below would be the key team members.

For staffing requirements, the Consultant shall maintain the following team of key experts for the duration of the services:

- Asset Management Specialist-Civil Engineer as a team leader, with minimum of 15 (fifteen) years of overall experience, of which at least 10 (ten) with asset management systems, data collection and definition of business principles; experience in the region is an advantage but not compulsory.
- Senior Bridge Specialist- Civil Engineer with minimum 10 (ten) years of overall experience, of which at least 5 (five) with bridge inspections, planning and programming of activities in maintenance and repairs of bridges; experience in the region is an advantage but not compulsory;
- Bridge Specialist- Civil Engineer with minimum 5 (five) years of experience in bridge design; experience in inspections, planning and programming of activities in maintenance and repairs of bridges is an advantage but not compulsory; experience in the region is an advantage but not compulsory;
- BMS Analyst-Civil Engineer or IT Specialist with minimum 10 (ten) years of experience with all aspects of network referencing, data processing and analysis, data quality assurance. Since most of the COTS systems require configuration only, a civil engineer is preferred who has some knowledge of IT and databases; experience in the region is an advantage but not compulsory;
- GIS Analyst-Minimum 5 years of experience with GIS;
- Training Specialist-Civil Engineer or IT specialist with minimum 5 years of experience in implementation and training on BMS. This position may be combined with another specialist in the team that also has the required qualification.

5. ASSISTANCE to be PROVIDED by the PESR

The PESR will ensure that the Consultant has access to all relevant information and data in the PESR that is deemed necessary to the performance of the services. This includes executive orders, department orders, and department memorandums as they apply to the processes. This also includes all bridges inventory and condition information available to the PESR.

An individual shall be nominated within the RAMS Unit to directly support the Consultant for the duration of the services and will be available throughout the project as needs permit, subject to another workload.

The PESR will make available 2 (two) application support staff throughout the customization and implementation of the application for the purposes of knowledge transfer of the application.

6. IMPLEMENTATION SCHEDULE

The duration of the assignment shall be 20 months but shall not involve continuous services over this period. It is envisaged that up to 12 person-months of input (of the Team Leader) would be required in the assignment period.

7. LOGISTICS

The Consultant shall provide a furnished office accommodation. PESR shall assist in obtaining visas and work permits for the Consultant. The Consultant shall be responsible for providing internet and printing facility connections, residential accommodation, international travel, personal computers, intra-city transportation and telephone communication.

8. DELIVERABLES

The following reports shall be submitted in hardcopy and electronic formats. The reports are to be provided in English and Macedonian, 3 (three) copies each. All reports shall be submitted as drafts, with a 2 (two) weeks review period, followed by additional 2 (two) weeks for finalization, including reflection of the PESR's comments

8.1. PROGRESS REPORTS

Inception Report, including detailed project plan	end of month 1 (one)
Quarterly Progress Reports	
Final Report	end of month 20 (twenty)

8.2. DOCUMENTS/REPORTS AND PAYMENTS

	Deliverable	**Relevant tasks**	**Timeline**	**Payments**
1	Strategy proposal for BMS function and BMS functional analysis	I & II	D1 - end of month 2 (two)	25% of contract price after submission by Consultant of Inception Report and deliverables D1 and

	D1=Review of existing road and bridge management policy and strategic proposal to PESR D2=Detail Operational Plan for the BMS function		D2 – end of month 4 (four)	D2 acceptable to the Client
2	Detailed operation plan for BMS function and action plan for BMS introduction D3= RAMS Status and BMS functional analysis D4= Action and operational Plan for BMS functions	I & II	D3= end of month 3(three) D4= end of month 4(four)	
3	Training plan and training materials and sessions D5= Detail Training material and training plan	II & VII	D5= end of month 7 (seven)	
4	Bridge Investment Plan D6= ToR and cost estimate for Bridge Investment Plan D11= Bridge Investment Plan	III	D6= end of month 7(seven) D11= end of month 19 (nineteen)	
5	National Bridge Condition Survey ToR and cost estimate D7= ToR for Bridge Condition Survey	IV	D7=end of month 7 (seven)	25% of contract price after submission by Consultant of deliverables D3, D4, D5, D6 and D7 and D11 acceptable to the Client
6	Support during Bridge Condition Survey procurement	IV	Linked to item No.7	
7	Scoping and cost estimate for BMS	V	Linked to item No.9	
8	Bidding documents for hardware and software	V	Linked to item No.9	

9	Support during hardware and software procurement D8= Supporting the procurement of BMS software and hardware (bridge database and evaluation tools) through preparation of bidding documents	V	D8 = end of month 8 (eight)	
10	Technical advice and quality review during development and acceptance of the BMS D9= Provide technical advice and quality review during development and acceptance process of BMS	VI	D9 = end of month 18(eighteen)	40 % of contract price after submission by Consultant deliverables D8, D9, D10 and, acceptable to the Client
11	Analysis of available data and macro-evaluation prior to establishment of the Bridge Investment Plan D10=Macro evaluation of BMS under RAMS	VII	D10=end of month 6 (six)	
12	Final Report		End of month 20	10% of contract price after submission by Consultant Final Report acceptable to the Client

***) – Deadlines set in this table refer to submission of final draft reports to PESR for their review and acceptance**