GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

MINISTRY OF LOCAL GOVERNMENT RURAL DEVELOPMENT AND COOPERATIVES

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

ADDITIONAL FINANCING FOR RURAL TRANSPORT IMPROVEMENT PROJECT-II

TERMS OF REFERENCE (TOR)

FOR

Consultancy Services for Developing a Web based Rural Bridge Information Management System (RuBIMS)

(Package No. AF-S23)

CREDIT NO. 6327-BD (P166295)

LGED BHABAN, LEVEL-11, AGARGAON, SHER-E-BANGLA NAGAR, DHAKA-1207, BANGLADESH

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Terms of Reference
for
Consulting Services for Developing a Web based Rural Bridge Information Management System (RuBIMS) in LGED

A. Introduction

The People's Republic of Bangladesh received a credit from the International Development Association (IDA) in 2012 for the Second Rural Transport Improvement Project (RTIP-II). This recognition has been successfully being implemented since then by the Local Government Engineering Department (LGED) under Local Government Division (LGD) of the Ministry of Local Government, Rural Development and Co-operatives (MLGRD&C). RTIP-II is aimed to improve and maintain/rehabilitate rural transport related infrastructure including inland water transport in 26 districts, covering mainly eastern parts of Bangladesh (excluding Chittagong Hill Tracts). The total project cost was estimated to be about US $417 million with IDA credit facilities of about US$ 300 million and the Government of Bangladesh (GoB) contribution of US$ 117 million.

In 2017, Bangladesh experienced widespread, devastating and prolonged flooding due to the extensive rainfall recorded from April to October as well as due to excessive water flow from the upstream rivers in India disrupting people's normal life and damaging the properties. The flood resulted in interruption in the transportation network of Bangladesh damaging numerous LGED roads, bridges and culverts constructed and maintained under RTIP-II and other projects. This circumstance needs urgent rehabilitation and maintenance of rural infrastructures in order to support the smooth connectivity of road network in the rural area. As a result, IDA and GoB decided to come forward with additional financing under RTIP-II to rehabilitate/maintain the damaged roads with an aim to improve rural accessibility in the 18 districts out of 26 RTIP-II project districts in Bangladesh and additional financing became effective on December 2018. These districts are Pabna, Sirajgonj, Tangail, Dhaka, Manikgonj, Gazipur, Narayangonj, Narsingdi, Mymensingh, Jamalpur, Sherpur, Netrokona, Kishoregonj, Munshigonj, Sylhet, Hobigonj, Sunamgonj and Moulvibazar. The total cost of RTIP-II (Additional Financing) is, therefore, estimated at about US$170 million (US$100 million from IDA and the remaining US$70 million from GoB funding).

RTIP-II (Additional Financing) comprises three major components includes Component A: Accessibility Improvement, Component B: Institutional Strengthening, Capacity Building and Governance Enhancement and Component C: Rural Transport Safety.

In addition to the various civil works, one of the main Project aims of RTIP-II, including its additional financing, is to further enhance the institutional capacity of LGED for effective rural transport infrastructure planning, development, execution, quality assurance, maintenance and sustainability. The RTIP-II assistance in this respect has been provided via the **Institutional Development, Governance Enhancement & Capacity Building** component, covering LGED action to enhance capacity, effectiveness, governance and accountability. Under the Component B, this consulting service for developing RuBIMS has been initiated.

B. Background

The Local Government Engineering Department (LGED) is one of the largest public sector organizations in Bangladesh entrusted with planning and implementation of local level rural urban and small-scale water resources infrastructure development programs. LGED and Local Government Institutions (LGIs) have under their jurisdiction around 353,000 km of roads, of which around 128,500 km (36%) are paved. There is approximately 20,15,000 m of bridges and culverts, but more culverts are needed on this network, of which 646,000 m remain to be developed (32%).

Against this backdrop, LGED has developed a computer-based software named as - Road and Structure Database Management System (RSDMS), which contains above all information that act as backbone of the rural road and road structure asset management system of LGED. The first version of RSDMS was released during 2000, which is then updated and enhanced several times to cater growing needs. This database

application is being used in planning as well as management of LGED's road network. Based on road and bridge/culvert condition data, the assessment of annual maintenance needs can be done by this software, while it helps draw up comprehensive maintenance program, including the rational allocation of funds based on a road category, surface type, traffic volume and social importance of the road. Various reports generated by RSDMS act as management information system while this application takes part in decision-making support to the management in order to plan and formulate an annual maintenance program. The current version of RSDMS is a desktop-based application that uses MS Access as backend database.

RSDMS has been designed to capture comprehensive data of the road network, including physical characteristics and condition data for associated bridges/culverts. However, it seems that the format so far considered to collect condition data of bridges/culverts is not adequate to quantify the appropriate assessment of health condition of the structure, and thereby RSDMS has some limitations to act as an appropriate decision-support tool to identify the right and effective maintenance action for bridges/culverts.

Against this backdrop, the previous version of RuBIMS (Rural Bridge Information Management System) was intended to be a comprehensive system for collection of all-inclusive data of rural bridges and for aiding informed rural bridge decision making. It has a smartphone-based interface that facilitates collection of bridge data. Apart from facilitating capturing of rural bridge data by smartphone, the system has also a web interface which is capable of suggesting the type of maintenance intervention that a bridge will require and produces a list of prioritized bridges under different intervention types. The system uses a detailed algorithm in deciding the intervention types and on bridge prioritization. However, after development of this RuBIMS system, deficiencies were observed. Given these deficiencies, LGED has decided to stop using the existing system and engage a consultant to design and develop a new, separate RuBIMS system.

These Terms of Reference (TOR) are prepared for engaging a consulting firm using CQS method with lumpsum contract for the development of an inclusive Web based Rural Bridge Information Management System (RuBIMS) in LGED. A conceptual design or a wireframe of a module in RuBIMS (not necessarily implementation, no coding is required) shall be included in the Technical Proposal by the consulting firm, which explains their approach to creating a solution for a certain module (e.g., a feature in the inventory model how it might look like, why they would design the solution in such a way, how it might help certain user groups to accomplish the task, and how it meets the users' needs).

C. Overall Objective

The overall objective of the service is to design, develop and implement a comprehensive web based Rural Bridge Information Management System to record inventory and inspection data, store, process and analyze LGED's bridges/culverts along with their health condition. The software application and its database will become the core part of LGED's asset management system, which shall be used in data collection & analysis, planning, processing and prioritization of both the development and maintenance interventions of bridge assets. Apart from the web application, a mobile app shall also be developed to eliminate backlog paperwork and enhance productivity through capturing bridges/culverts related survey data accurately, precisely, and in real-time. All apps and databases developed under this consultancy shall be user-friendly, aligned with the needs of the users, customizable by LGED staff, expandable by LGED staff, secure, and shall otherwise meet best international practices for modern bridge inventory/information management systems.

D. Scope of Services

The overall scope of the services, associated tasks, required system features and functionalities, system compliance requirements are described below.

Management of Software Development and Implementation Planning

The consultant will be responsible including but not limited to the following project management activities: Integration of all activities and Human resources aspect of the consulting team; Control of Scope, schedule, cost & quality of the assignment; Communications; Risk management and Stakeholder management.

Prepare a Project Management Plan (PMP) for the assignment adapted to the project requirements to support the Procuring Entity (PE) in the management of this service. Submit a quality assurance plan for all deliverables and ensure quality assurance before submitting any deliverables. Manage the overall scope, schedule and quality of the service. Quantify changes to the scope of work (if any) due to additions or deletions of requirements. Coordinate and process Contemplated Change Notices and Contract Change Orders and send to PE for approvals. Prepare and update a list of the team members to be worked under this service, stakeholders, and their contacts including complete contact information, their preferred method of communication and present it to PE. Prepare a communication plan stating who, how, and when to communicate to all the concern related to the assignment. Prepare communication updates based on information provided by the consulting team and forward it to PE for approvals.

Given the urgent need for a fully functional RuBIMS system, the consultant shall use a selected methodology within the Agile project management approach to develop RuBIMS. International best practices within the Agile framework shall be incorporated into system development.

Coordinate with other consultant engaged in designing on RSDMS and exchange required information to ensure future integration of these systems. Provide interpretation of the technical requirements and help LGED Technical team in decision making. Respond immediately to any concerns, issues and Request for Information (RFI) questions from the Steering/Technical committee and maintain RFI log sheet.

Liaise with PE on a regular basis. Coordinate and arrange bi-weekly progress review meeting with PE, share RFI log sheet and seek for clarity on expectations and requirements of the assignment (if any). Provide bi-weekly reports to PE. Conduct end-of-service meeting and issue written report and moving plan to the support phase of the assignment. In addition to formal coordination requirements, routinely (daily if necessary) solicit and involve users from the beginning in each stage starting from understanding the needs and requirement, conducting workshop with LGED team and user in designing the conceptual design of the user interface, to the testing of the wireframe before handing over the design for implementation, and user testing after the implementation of the system development to ensure that the system meets the user's needs, and designed system is easy to use . Also, document design decision for development of the system. Consider including users in Agile sprint teams as appropriate.

Assist LGED in Change Management

Introduction of any management information or decision support system can guide organizational success, but there is need of integration of the tools within the organization through a formal change management process considering the importance of organizational and human factors. LGED initiated the Asset Management Implementation for the organization through creating a dedicated group, educating and collaboration with stakeholders. RuBIMS would be one of the main and integral part of LGED's asset management system. Hence, the basic goal for the implementation of RuBIMS is to ensure, plan, design and implement following a formal change management process.

The consultant shall perform an in-depth gap analysis including district and upazila level infrastructure and organizational readiness for use of asset management (RSDMS and RuBIMS) systems. As a very first formal step a maturity assessment shall be conducted to better analyze the readiness of the organization. Accordingly provide recommendation for required changes and help the Steering/Technical committee in implementing the system. Organizational culture of any organization can make any change initiative successful or a failure. But because of the maturity level as a public sector organization in general, LGED organizational culture is not very rigid rather very flexible towards any changes which is a very favorable environment for implementing the RuBIMS and RSDMS.

During development and implementation of RuBIMS, it is essential to identify dependent non-IT related activities, and the consultant shall thoroughly review, evaluate, and consider for implementation all lessons learned. Some lessons learned include i) to engage the major stakeholders and system users from the beginning of the assignment and throughout the system development process, ii) to identify potential members from stakeholder groups and form an internal change agent groups who will facilitate communication and buy-in from their respective districts/upazilas. The consultant will help the Steering Committee in identifying participative leadership and creating a sense of urgency within the stakeholder groups to make sure the team members becoming more committed in achieving the goal of the service.

Summary of Tasks

The successful consultants will perform the following major tasks, but not limited to, as follows:

I. System Requirement Analysis
II. System Design
III. System (RuBIMS) Development
IV. Carry out User Acceptance Test (UAT)
V. Management and Migration of Existing Data
VI. Execute a Pilot Data Collection Program
VII. Training and Knowledge Transfer
VIII. Deployment and Implementation of Final Version of RuBIMS
IX. Operations, Maintenance and Support Service

Detail requirement of above-mentioned tasks are given below:

Detail Task Requirement

Task-1: System Requirement Analysis

This task includes reviewing of:

- existing bridge management system of LGED (e.g. previously developed RuBIMS) LGED and stakeholder feedback, and other relevant documents;
- existing RSDMS along with its extended version for selection and prioritization of bridge/culvert under different maintenance interventions;
- the bridge/culvert inspection form practiced by LGED;
- operational strategy flowchart and procedure of bridge selection & prioritization by different interventions are being used by the Program for Supporting Rural Bridges (SuPRB);
- existing practice and procedure of bridge/culvert maintenance management;
- other related documents.

It is expected that the consultant will carry out detailed requirement study and analysis on each and every scope item for RuBIMS to be developed. Under this scope of work, the consultant will analyze in detail the functions, processes, documents, actors, sites and infrastructure of the relevant prevailing system precisely. Whilst carrying out this task, apart from understanding existing features and functionalities of RuBIMS, the consultant shall be engaged in extensive discussion with all the related stakeholders (mainly with Road Safety and Road Maintenance Unit (RSRMU), SupRB Project Management Unit (PMU), RTIP2 PMU, Asset Management Unit, Design Unit and ICT Unit of LGED) to acquire additional requirements to be incorporated within the web and mobile based application of RuBIMS. At this phase, the consultant's ultimate objective will be finalization of the System Requirement Specification (SRS) in details under the scope of this TOR and obtain required approval from the Steering/Technical Committee of LGED. The Consultant shall prepare a report detailing analyses, findings, and recommendations for this task.

Task-2: System Design

The Consultant shall prepare a complete detailed functional design as per the standard of software engineering approach for the proposed systems tasks.. This is a very vital and important phase of any software development life cycle (SDLC). Considering the ultimate development and implementation scope, the proposed system design should be robust, scalable, user friendly and interoperable with other existing and future LGED systems. The system design will be based on approved SRS (outcome from task-1), which will be further validated by Steering/Technical Committee of LGED. The Consultant shall coordinate very closely with the LGED team, and especially system users, when completing the system design to ensure that the system design meets the users' needs.

At this system-designing phase, the consultant will perform the following designing related tasks and produce various standards in the System Design Documents (SDD):

- Identify module, components, user journey, tasks, input/output and functional features
- Specifying technical and functional requirements
- Application and user flow, and user interface design
- Description of UI and requirements
- Preparing the use cases
- Define Integration and interoperability scope
- Design system architecture
- Determine process and data flow
- Database design
- Entity Relationship diagram (ERD)
- Application Programming Interface (API) design
- Finalizing tools, technologies and frameworks to be used, etc.

Task-3: Development and Testing

At this stage, the consultant must take prior acceptance or approval from the concerned authority on tools, technologies and framework that will be used for the development of both the web and mobile application. Based on approved SRS and SDD, the consultant will prepare a comprehensive development plan which shall include a time bound schedule consisting development item wise start date, test date, review date, acceptance date, completion date etc. At the development stage, consultant must follow the standard code convention, code level documentations, header of each file, algorithms, interfaces, code compression and APIs should be supplied with proper description and documentations. All kinds of standard testing tasks those are required to be performed at the development phase, should be mentioned in the work plan. The Consultant shall coordinate very closely with the LGED team, and especially system users, when completing development to ensure that the system meets the users' needs.

The consultant must propose a testing plan and their acceptable limits for the applications starting from development to deployment. The consultant should submit a testing plan which may include standard test approaches. Some are mentioned below as examples for reference:

- Unit testing
- Functional testing
- Compatibility testing
- Smoke and sanity testing
- Regression testing
- Stress testing
- Alpha testing
- Beta testing

- Functional vs non-functional testing
- Destructive testing
- Software performance
- Usability testing
- Accessibility testing
- Security testing.

Task-4: Release beta version of RuBIMS & User Acceptance Test (UAT)

After releasing the developed and tested application as Beta Version, this will enter in the phase i.e. UAT and Deployment. In this phase, the actual user feedback and review will be taken and finally the application will be accepted by the Steering/Technical Committee of LGED after passing certain tests. Here, it is expected that, considering the type of users and their role in the application, the consultant will propose a comprehensive UAT plan which may cover the followings:

- UAT activities to be perform (planning, designing test cases, selection of testing team, executing test cases and documenting, Bug fixing, sign-off etc.)
- Types of user wise roles and test items distribution
- Resource requirement,
- Activity wise time requirement
- Activity wise test case, test results/ deliverables
- Detail user feedback / test reports
- System update plan

Task-5: Management and Migration of Existing Data

Under the process of system transformation, before deployment of the final version of the software applications, the consultant shall migrate all the existing data of prevailing systems onto the RuBIMS backend database. In this case, the consultant will be requires to perform different relevant activities that may include softcopy conversion, data filter, data cleansing, data verification, data process, data entry, data migration and overall data management. The selected consultant must create reports of migrated data and shall obtain required confirmation and approval of LGED Technical/Steering Committee.

Task-6: Execute a Pilot Data Collection Program

Under this task, the consultant will collect the bridge inventory and condition data of two selected upazilas (name of upazilas will be finalized before start of data collection program) using both manual form and smartphone/tablet based apps developed under these ToR, and upload the data onto the web-based RuBIMS. The consultant will closely work with the LGED to seek guidance from LGED as well as to keep LGED informed with respect of the issues that may arise in the execution. During data collection and uploading the same onto RuBIMS, the consultant will test both the web and mobile application for any anomalies, and logs those to address in the final deliverable.

After uploading collected data onto RuBIMS, the consultant will run the analysis module of the system to justify that RuBIMS is capable of storing data, uploading of condition assessment data in using both mobile and web application platform, processing of data, analyzing and creating report for annual maintenance need. The new system must be able to generate reports using desired filtering tools, can determine appropriate intervention type based on inspection data, able to make prioritization of bridges/culverts following given criteria, and can prepare of annual maintenance program for bridges/culverts based on given criteria.

Task-7: Training and Knowledge Transfer

A detailed training plan & work schedule must be included with the overall work plan and Schedule as part of this proposal. A comprehensive training material on the use of both the web and mobile based Asset

Management System shall be developed by the consultant. The training materials shall include user manual, administration manual, quick start tutorial, online help, and frequently asked questions. The consultant should develop multimedia training materials for the users. These materials shall be available for viewing for all users through the web portal. User manual shall be written in Bangla, however, others manuals and materials may be written in English.

The Consultant shall conduct TOT training where at least 40 LGED officials shall be trained. These officials in turn will conduct training to all the respective users of LGED. Training duration, venue and participants shall be finalized with consent of LGED.

In order to ensure future maintenance and enhancement of the system, apart from the TOT training, the consultant shall be responsible to transfer knowledge on all the technical aspect of the developed web and mobile application, including coding structure, technological overview, methodology used, etc to the designated IT professionals of LGED. The consultant also needs to propose their smooth, efficient and effective knowledge transfer idea and plan here in this technical proposal with the training plan.

Task-8: Deployment and Implementation of Final Version of RuBIMS

This is the phase of SDLC, when the consent is being given to "GO LIVE" of the developed system after completed all kinds of development integration, testing and hosting. This is very crucial and sensitive stage because at this stage the system becomes available to access for all levels of users. The consultant will carry out all the activities related to deployment of both the mobile and web application of RuBIMS onto the Live Server environment, and will provide all the required technical support for implementation of the same.

Task-9: Operations, Maintenance and Support Service

After completion of development and successful deployment phase and accepted by the Steering/Technical Committee of LGED, when the implementation/usage period will be started, the consultant has to provide 02 (two) months maintenance and support service based on agreed service level agreement. Subject to the satisfactory performance of the consultant and LGED's business need, the contract may be extended for the provision of maintenance and support services or it may be offered vide another contract arrangement under the Operation supporting Rural Bridges (SupRB project) under LGED in future as a downstream contract. The consultant must provide a detail maintenance and support service plan and required technical experts in the technical proposal, which may include the followings:

- Support service types and mode of services
- Service desk functionalities
- Configuration management
- Change management
- Service layers for support
- Tools will be used for Support service management
- Communication management and modality
- Release management
- Incident management
- Problem management
- SLA (Service Level Agreement)
- Maintenance and support service related reporting
- Support service types
- Service Log Management

Apart from the above-mentioned issues, if the consultant thinks any other issue to be included in their plan, it would be considered as value addition.

A focal person/project manager of designated member of the consultant should be responsible for interfacing with LGED during maintenance support service. The Consultant should provide an online customer service system through which designated officials from LGED can record system related complaints and can view response status accordingly. A designated focal person should respond against each complain within 1 (one) hour from the time of a complain submission and should arrange to fix the problem within 24 to 72 hours depending on the complexity of the problem as determined by LGED.

Within this period, the maintenance team from the consultants should be responsible for fixing reported problems, take appropriate measures to handle system related security aspects, perform reasonable alteration in the application (e.g., inclusion of few data fields, changing attributes of UI components), generate new reports as per demand of the management, maintaining the backup and recovery of data and also assisting the client to maintain the system through the transfer of knowledge on a regular basis. The consultant should be responsible for regular data backup management, resolve technical difficulties and any further requirement analysis based on user feedback for smooth Operation.

E. Features and Functionalities of Rural Bridge Information Management System (RuBIMS)

All the required features and functionalities of RuBIMS will be finalized during requirement analysis phase. However, the RuBIMS will have at least the following mandatory features and functionalities:

- **User Management & Access Control:**

LGED has developed and maintained a Single Sign-On (SSO) module for management and controlling access of its users for all the web and mobile based applications. Both the web and mobile applications to be developed under these TOR should use the SSO module to get users' authentication and access control list, and should implement access control mechanism within the application accordingly.

- **Web Application**

Web application will have features to input, update, display, analysis of data, and to generate all the required outputs. While the web application is required to include several discrete modules (see below, the application should allow for fast and seamless user transfer between modules for a particular structure once that structure is selected. A publicly accessible webpage with restricted data access will also be developed. The web application must satisfy the compliance requirements as mentioned below and must have, but not limited to, the following features:

- **Dashboard:**

The software shall have a dashboard that display the key information of the application in summarized form (graph, chart, table, etc.). Filter options should be available in the dashboard so that data can be filtered by division, region, district, upazila, road type, etc. Based on information need, several dashboards may need to be designed for different level of users.

- **Data Management:**

Update of asset management related data is a continuous process. Generally, survey related data is updated onto the system once in year, however, few datasets are being updated frequently. The system shall have as such facility to manage two datasets for all of its pertaining transaction tables – 1) approved dataset and 2) working dataset. All the outputs (reports) will be generated based on approved dataset, while update made by the users will be stored in the working dataset. Approved dataset will be replaced by the working dataset once it is approved by Steering/Technical Committee of LGED.

In this regard, data validation, comparison and a complete work flow for approval process should be incorporated within the system allowing the database to be reviewed, compared and recommended for acceptance by different levels of LGED to the central management. Relevant comparison reports to view the changes will be generated by the system.

Data Achieving: The system should have facility to achieve all the transactional data tables in the respective history tables within the same database. The system should have facility to viewing historical data and to generate reports from historical dataset.

This module will consist of all the related data management and analysis features related to pertinent bridges/culverts over the road network under LGED. Features and functionalities include, but not limited to:

- **Inventory and Inspection data of bridge/culvert** (insert/update/view/delete)
    - ➢ List of bridges/culverts by road
    - ➢ Location and identification
    - ➢ Physical characteristic
    - ➢ Super-Structure details
    - ➢ Sub-Structure details
    - ➢ Foundation information
    - ➢ Approach information
    - ➢ Channel information
    - ➢ Embankment and scour protection information
    - ➢ Design information and documents
    - ➢ Load Ratings
    - ➢ Repair needs, costs, and severity based on inspection
    - ➢ Construction and maintenance history
    - ➢ Inspection on condition of Non-Structural Elements
    - ➢ Inspection on Individual Component of Sub and Super Structure by damage type
    - ➢ Photo/video gallery, voice notes, sketches, etc.
    - ➢ Ability to automatically export inventory and inspection data for a single bridge to a PDF, XLS bridge inventory report.

- **Analysis and Planning**
    - ➢ Bridge Health Condition Rating: Bridges are very complex structures. Multiple elements are encountered at the time of inspection with multiple types of defect patterns. The significance of each element in a bridge structure also varies at a great extent. Moreover, age of the structure, environmental condition etc have an effect on deterioration of bridge element. Considering all of the possible scenarios, two important criteria needs to be calculated: a) Condition State (CS) - that deals with only the defects of the bridge elements, and to be calculated for Non-Structural Elements, Sun-Structure and Super-Structure separately; b) Structural deficiency (SD) - that combines CS value with other external factors.
    - ➢ Assessment of annual maintenance need, determination of intervention type following SupRB Operational Strategy flowchart.
    - ➢ Prioritization and selection of bridges/culverts following given criteria set in the Program Operational Manual of SupRB.
    - ➢ Optimization and preparation of annual bridges/culverts maintenance based on given criteria.

- **Document Module:**

Document module will be facilitating upload, view and download relevant documents by different category, such as – As-built Drawings, Design Standards, Construction and Maintenance Standards, Manuals, Circulars, Training Manuals and so on.

- **Report Module:**

Sufficient number of reports to cover all the required outputs of a standard bridge management system to be produced by the system. List of reports includes, but not limited to, inventory of bridges/culverts, inspection data sheet along with condition state of different bridge components and health condition index of the bridge/culvert, various analytical output, long and prioritized short list of bridges/culverts under different interventions, etc. List and format of the required reports will be finalized during requirement analysis phase. This module will provide facility to generate outputs from the system along with extensive filter and search options. Two types of reports will be generated, 1) Predefined Report (fix columns report) and 2) Dynamic Report (user chosen data columns based report).

Predefined reports will be fix column report. An interface will be appeared with list of reports along with filter options. User will select a report from the list, chose desired filter option(s) and finally generate the report. The application must have the features so that, apart from instant printing facility, generated reports can be downloaded in Word, Excel and PDF format.

In the dynamic report interface, a list of wide range of data columns will be available along with check box for selection and textbox/dropdown for filter option. Through this interface user can choose data column(s), put filter criteria and get output according to his/her requirement. There will be download option so that generated report can be downloaded in Excel.

- **Admin Panel:**

Facility for system configuration management, lookup table management, etc will be incorporated within the system.

- **Mobile Application**

A mobile application is required to carry out capture detailed field inspection of bridge/culvert. Apart from general apps features, and additional functionalities to be finalized during requirement analysis, the mobile app must satisfy the compliance requirements as mentioned below and must have, but not limited to, the following features:

- **Bridge/Culvert Survey:**

  - ➢ The app shall be designed to minimize the time required for bridge inspectors and other users to complete their required tasks.
  - ➢ The app shall have interactive and user-friendly interface.
  - ➢ The app shall have facility to capture GPS location of bridge/culvert.
  - ➢ The app shall have facility to input inventory data.
  - ➢ The app shall have facility to input inspection data.
  - ➢ All inputs on the inspection application must have the options of selecting data from drop down menu.

- ➢ All existing data must be displayed once any particular structure is being selected for inspection.
- ➢ The app must avoid repetitive data entry of the same information
- ➢ Error messages must provide very clear and actionable messages to the user in case of wrong data entry in any field.
- ➢ Users must be able to quickly search the database for bridges based on location, road number / chainage, bridge number, and other key fields. Relevant data from database shall automatically populate into the app so that the user does not need to manually enter each field.
- ➢ The app shall have facility to capture photos, videos, and voice notes of bridge/culvert and its different elements.
- ➢ The app shall have data filter and data searching option.
- ➢ The app shall allow surveyor to save survey information partially.
- ➢ User flow needs to be optimized to support user goals and identified tasks Shorten the user journey in the application with the intuitive menu structure "Don't make your user think".
- ➢ All existing data must be uploaded once any particular structure is being selected for inspection. Old data must be stored while new data is being added to all fields on the inspection form. Filtering options must the designed to add or not to add old data.
- ➢ The app shall allow users to either upload directly from the field to the database (if they have data service) or to save entries, to be uploaded once the user has data service.

- **Integration and Interoperability:**

Bridges/culverts are the part of road network. Road network data currently being maintained in the desktop-based Road & Structure Database Management System (RSDMS). Procurement of another service to convert the desktop based RSDMS to web-based application through a different consulting service is underway. RuBIMS has direct dependency with RSDMS since any bridge/culvert must be linked with its respective road, and most of the prioritization parameters (road type, traffic, socio connectivity) shall be calculated from road database. Hence, the selected consultant must work and exchange required information with the other selected consultant working on RSDMS. Accordingly, RuBIMS must be fully integrated with RSDMS and these two applications must be developed in the same database and application platform. Apart from these, RuBIMS database must also be interoperable with LGED's Geo-spatial database to perform different geospatial analysis and prepare associated maps and other Reports. The following are the key expectations on interoperability requirements:

- ➢ The system shall be designed in the same database and application platform on which RSDMS will be developed so that these two module can be integrated together.
- ➢ The system shall be designed to ensure interoperability for bridge/culvert datasets with existing map GIS portal of LGED using industry standard protocols or any other suitable means.
- ➢ The system shall have functionality to exchange data with other systems of LGED or external institute systems.
- ➢ The system shall have functionality to export/import files based on the standard template defined through web services and/or API.
- ➢ Full API documentation must be provided so that third party integrators can integrate their system with this system in future.

Mapping tool: The system shall be designed considering integration of upcoming improved web GIS platform, which will be developed under ADB aided project. The consultant will closely work with the

selected consultant working on the improved web GIS platform and shall design the system in a way where necessary mapping framework shall be in place so that final integration with the GIS platform can easily be carried out later on during maintenance and support services, which will be provisioned under separate extended contract.

F. Application Compliance Requirements

Web Application Compliance Requirements

- The software application shall be developed following Service Oriented Architecture (SOA).
- The software application shall be developed following MVC framework.
- Database must be optimally designed for scalability of the System.
- Considering the operating/client environment at different level of this application, it shall be developed in such a way so that it requires low bandwidth to run.
- The software application shall support cross browser platforms (popular web-browsers such Google Chrome, Microsoft Edge, Mozilla Firefox, Opera, Safari, etc.)
- The software application shall have ability to seamless integration with future module/ components/applications.
- The application shall be lightweight and rich client-side scripting.
- User Interface (UI) shall be developed based on the analysis of User Experience (UX).
- Analysis module must be highly responsive and shall take reasonably practicable time for processing.
- Report module shall bring the report within reasonable time and shouldn't shows blank layout.
- Latency shall be as minimum as possible.
- Any web interface of this application shall be fully responsive.

Mobile Application Compliance Requirements

- The mobile application shall be developed for Android and iOS.
- Interactive user interface.
- UI shall be developed based on the analysis of UX.
- Ability to collect data offline without being connected to the Internet.
- Auto sync capability while the device will get the Internet connectivity.
- Ability to upload survey results directly to the live server of LGED.
- Geo-tagging photo/video capturing facilities.
- GPS accuracy under both conditions shall be ensured at least 5 m.
- Capability to show Google map while survey.
- User interface must be very user friendly (must avoid tediousness)
- System needs better feedback, error check, and data validation
- Capability of displaying system notifications.

G. Tools and Technologies to be used

The following are the required software development tools and technologies. Alternatives may be considered at LGED's sole discretion.

- Software Development Methodology: Agile Scrum
- Application Model: MVC/MVP/MVVM Platform
- Development (Server End): Asp.Net, C#.Net

- Development (Client End): HTML, Bootstrap, Angular JS, JavaScript, CSS, etc.
- Scripting Language: jQuery, Ajax, JSON
- Development Language/Tools for Mobile Application: Java, Swift, etc.
- IDE: Visual Studio, Android Studio, Xcode, etc.
- Database: Oracle 11g
- Operating System: Windows
- Hosting & Deployment: IIS Server
- Reporting: Crystal Report, RDLC, etc.
- Testing: Jmeter/PostMan/xUnit

H. Security and Privacy Requirements

The consultant shall submit an extensive and complete security and privacy plan for the application considering the following issues:

- Project technical scope
- Functional and nonfunctional requirements and ultimate objectives
- User roles - Accessibility, Authorization and Accountability
- Importance of data management
- Technologies to be used for development & run
- Hosting
- Client and service side
- Overall standard application security requirements.

Apart from these, the consulting firm shall provide a checklist based on system and hosting security plan (i.e. fraud, hacking, money laundering etc.) and have to provide the test report of that checklist.

I. Hosting Requirements

The consultant shall submit primary hosting requirements for this application related to hardware, servers, network, security, storage, traffic, firewall, bandwidth etc. i.e. complete hosting infrastructure that will be requires for their developed application hosting considering the implementation scope. Based on their submitted requirements regarding hosting, the client will provide detail hosting infrastructure, facility and environment.

J. System Audit

This system will maintain an audit trail of any changes or updates made in any information that are considered as vital and shall maintain the audit log with information such as

- Log the users who are accessing the system
- Log the parts of the application that are being accessed
- Log the fields that are being modified
- Log the results of these modifications
- Log attempted breaches of access
- Log attempted breaches of modification rights
- Timestamp.

Ensure an audit trail is kept for all transactions and all audit transactions logged are kept on the trail file or trail database from where system can generate different audit reports as and when required.

K. Coding Conventions

The consultant must follow the standard coding styles to produce high-quality code for further uses of the code in terms of reusability, refactoring, task automation, language factors etc. The consultant shall submit a standard coding convention approach, which may include different conventions like commenting, indent style, naming, etc following the best international and national coding practices.

L. Documentation

The documents enlisted here give an overview of the minimum requirements only. The suggested standard and list of documents are as follows:

- SRS – Software Requirements Specification (IEEE 830)
- SDD – Software Design Description (IEEE 1016)
- SPMP – Software Project Management Plan (IEEE 1058)
- SQAP – Software Quality Assurance Plan (IEEE 730)
- SCMP – Software Configuration Management Plan (IEEE 828)
- STD – Software Test Documentation (IEEE 829)
- Technical manual and training manual (both for administrator and system user)

The consultant shall submit both the hard and soft copies of these documents. Soft copies shall be provided in original formats (e.g. MS Word, Visio) of the application software by which these documents will be developed. PDF or any other means of converted formats shall not be accepted.

M. Copyright

LGED shall have all proprietary rights including but not limited to patents, copyrights and trademarks. All kinds of source code including code documentation and other approved documents (all versions trail, products, developed applications, documents and all kinds of deliverables which bear a direct relation to or is made in consequence of the services provided by the consultant under this scope of this TOR will be owned by LGED.

The consultant shall properly deliver all the entire approved source codes and other deliverables to LGED. Any studies, documents, reports, graphics or other material prepared by the consultant under this scope of this TOR shall belong to and remain the property of LGED. These data/information shall not be used by the consultant for any further purpose without taking prior consent from the Chief Engineer of LGED.

N. Handover the Application

After successful development, deployment and after bringing the system in operation, the consultant shall transfer the system to LGED with all technical documentation as mentioned above including full credentials and detail source code, complete in all respect.

O. Facilities and Services to be provided by the Client

LGED will introduce the consultant to its stakeholders, users, administrators and field level officials to smoothly carry out the service. LGED will also provide document and related existing software for the purpose of study and understanding of the consultant. A team of counterpart officials will also be designated to work with the consultant for their smooth operation of service.

Existing data, relevant reports and source code of current software will be provided by LGED. Limited office accommodation and furniture in the Headquarters offices of the LGED will also be made available during these services, in accordance with the essential requirements of the proposed Project Management Unit (PMU). All

software applications and databases to be developed shall be hosted on LGED Servers as per arrangement with the ICT Unit of LGED.

P. Professional Staffing Input Required

The Consultant shall engage a team of following suitably qualified and experienced professional to perform the assignment.

At least 3 key professional staff are required to co-locate with LGED RuBIMS team members and/or LGED users to facilitate enhanced user input.

Sl. No.	Position	Qty	MM	Qualifications
			Key Professional	
1	Team Leader	1	6	At least Master's degree in Computer Science / engineering from a reputed public University or equivalent degree with minimum 15 years' professional experience with 10 years relevant experience in Software Solution Development, Implementation and Software Development Management. Minimum 10 years' experience in government project management, and minimum 5 years experience in Agile based system development for projects of similar scale. The applicant shall have to be PMP Certified. In addition, PMI Agile Certified Practitioner (PMI-ACP) will be given preference.
2	Bridge Management System Specialist/ Deputy Team Leader	1	6	At least Master's (preferably PhD) degree in Civil Engineering from a reputabled University with overall specialization in the development and application of systems for bridge management system. Chartered or licensed professional engineer in home country will be added advantage. At least 15 (fifteen) years' professional experience with minimum 10(ten) years' experience in road/ bridge asset management systems. Significant international experience in developing bridge management systems in both developed and developing systems will be given preference. Knowledge and experience in using advanced IT-ICT based tools and expertise in the development of multi-criteria based bridge maintenance and rehabilitation management methods to maintenance monitoring, budgeting, planning and programming will be added advantage. Preferred publication of best practices for bridge information systems for reputable road agencies and/or academic journals.

3	Bridge Engineer	1	4	At least Master's in Civil Engineering from a reputable University with minimum 15 years' professional experience with 10 years' relevant experience in bridge design, inspection and maintenance. Significant experience as a user of IT based road and bridge management systems. Knowledge in LGED bridges/culverts design criteria is preferable.
4	System Analyst/ Solution Architect	1	6	Minimum Bachelor's degree in computer science/ engineering from a reputable public University or equivalent degree. Proposed personnel should have at least 12 years' professional experience with minimum 6 years' relevant experience in system design, development or integration in IT/ICT/GIS related project. Relevant Certification will be added advantage
5	Database Developer	1	6	Minimum Bachelor's in computer science or equivalent. Proposed personnel shall have at least 10 years' working experience with minimum 6 years' experience in design and development of Oracle database.
6	Sr. Software Engineer	1	4	Minimum Bachelor's in computer science or equivalent degree specializing in programing. Master's degree in similar field is preferred. S/he shall have at least 12 years' of overall experience out of 6 years in web application development in MVC platform using .NET, C#, Bootstrap, Angular JS, JavaScript, etc.
7	Web Application Developer	2	12	Minimum Bachelor's in computer science or equivalent degree. S/he shall have at least 10 years of overall experience out of 5 years in web application development in MVC platform using .NET, C#, Bootstrap, Angular JS, JavaScript, etc.
8	Mobile App Developer (Android)	1	4	At least a Bachelor's degree in Computer Science or equivalent. S/he shall have at least 10 years of overall experience out of 5 years in mobile application development in Android environment using the .NET/Open Source platforms, Android Studio for large WAN/Intranet and public-facing Internet scenarios.
9	Mobile App Developer (iOS)	1	4	At least a Bachelor's degree in Computer Science or equivalent. S/he shall have at least 10 years of overall experience out of 5 years in mobile application development in Android environment using the .NET/Open Source platforms, Xcode, Swift, etc. for large WAN/Intranet and public-facing Internet scenarios.

			Non-Key Professional	
10	UI Designer	1	2	Minimum Bachelor's degree in any Graphics and Communication or equivalent with at least 3 years' working experience in in UX and UI. Expert skills in graphic, visual design and web design; able to prepare task flow, user flow, user journey, wireframe, and usability and user testing. Knowledge about web-design is a plus.
11	QA Engineer	1	6	Minimum Bachelor's in computer science or equivalent degree and 05 years' experience with minimum 03 years' experience in related field.
12	Technical Document Writer	1	4	Minimum Bachelor's in computer science or equivalent degree with minimum 05 years of working experience.
13	Surveyor	8	16	Minimum Diploma in Civil Engineering with minimum 5 years' professional experience with extensive knowledge of road and bridge data collection.

12. Duration of the Services:

The services for development, testing, UAT, pilot data collection and deployment of both the web and mobile version of RuBIMS shall be completed over approximately **eight (8) months**, and software maintenance over a period of **two (2) months** after successful deployment of RuBIMS. *Subject to performance of the consultant and in case it seems necessary, the maintenance and support service may be further extended the contract or vide another contract arrangement with SupRB project under LGED in future as downstream contract*.

13. Key Output and Deliverables:

This will be Lump-sum based contract with Key Performance Indicator (KPI) attached for each deliverable.. The list below are the major deliverables and associated KPIs.

The Consultant shall seek and obtain LGED approval to commence work on each deliverable. Approval to commence work on a deliverable will generally not be considered until the predecessor deliverable is approved. Due dates for each deliverable are intended to include 3 weeks for LGED's review and approval of the previous deliverable.

Deliverable-1: An Inception Report, outlining the Consultant's post-mobilization approach to the requirements of the main task elements, outlining any key issues needing further resolution by the Client for effective execution of the overall assignment, and presenting the finalized report on Software Requirement Specifications (SRS), developed based on LGED's feedback, and overall Work Program and task breakdown for the services period (*Output of Task-1*).

- Due 3 weeks after commencement
- KPI – SRS should be written following standard software engineering guidelines (e.g. IEEE 830 template) along with detailed requirement analysis report; SRS and comprehensive project management plan and detail work program should be approved by the Steering/Technical Committee of LGED.

Deliverable-2: Final version of the System Design Document (SDD), developed based on LGED's feedback (*Output of Task-2*).

- Due 10 weeks after commencement
- KPI - SDD should be written following standard software engineering guidelines (e.g. IEEE 1016 template) along with high-level, component-level and low-level design of both the web and mobile applications, which should be approved by the Steering/Technical Committee of LGED.

Deliverable-3: Beta version of both the web and mobile app of RUBIMS, report on User Acceptance Test and Migration of Existing Data (*Output of Task-3, 4 and 5*).

- Due 16 weeks after commencement
- KPI - Beta version of both the web and mobile app of RuBIMS should met all the features, functionalities, compliance, security and privacy requirements as described in the TOR. Complete set of existing data to be migrated. All the outputs should be approved by the Steering/Technical Committee of LGED.

Deliverable-4: A complete sets of bridge/culvert Inventory and Condition database for the selected upazila, and finalized report on data collection and analysis), developed based on LGED's feedback (*Output of Task-6*)

- Due 20 weeks after commencement
- KPI – Quality and completeness of collected and entered bridge/culvert inventory and condition data into RuBIMS should be ensured, and it is to be justified that after analysing the system can able to assess correct condition state of bridge/culvert and thereby determine appropriate intervention and proper prioritization.

Deliverable-5: Report on completed Trainings for LGED officials/staff to be conducted by the Consultant on Mobile App and web-application. (*Output of Task-7*)

- Due 24 weeks after commencement
- KPI - Evidence of effective knowledge transfer. 100% of training should be completed.

Deliverable-6: Final version of working web based RuBIMS along with iOS and android based apps for bridge inventory and condition inspection data collection with source code and software documentation, and a Final Report on Implementation, Testing and Commissioning (*Output of Task-8*)

- Due 32 weeks after commencement
- KPI – Bug free working version of both the web and mobile app of RuBIMS after incorporation of all the feedbacks and recommendations received from the users, which should be approved by the Steering/Technical Committee of LGED. Standard coding styles should be ensured to produce high-quality code for further uses of the code in terms of reusability, refactoring, etc. Acceptance of source code and software documentation from the Technical Committee of LGED.

Deliverable-7: A Draft Final Report after completion of maintenance along with a Final Report upon accommodation of recommendation and feedback provided by the Steering/Technical Committee of LGED. The report should have recommended future course of actions to be required to keep the system sustainable throughout its lifecycle. (*Final Output of Task-9*)

- Due 40 weeks after commencement
- KPI - Acceptance from the Technical Committee on both the web and mobile app of RuBIMS are running smoothly without any reported bug, and knowledge has been fully transferred to the technical team of LGED.

14. The payment schedule:

SL	**Reports, Documents and Deliverables**	**Percentage of contract price**	**Deadline for submission**
1	**Inception Report:** upon submission and acceptance of the Inception Report and Software Requirement Specifications (SRS) (described in Task-1). The report includes, but not limited to, a detailed methodology and approach, break up of activities, a time frame, work plan, milestones, manning schedule and a list of outputs of the study	10%	3 weeks after commencement
2	**2nd payment:** Upon submission and acceptance of final version of the System Design Document (SDD) needed for development of RuBIMS, developed Based on LGED's feedback [Output of Deliverable-2].	10%	3 months after commencement
3	**3rd payment:** upon submission Beta version of both the web and mobile app of RUBIMS, report on User Acceptance Test and Migration of Existing Data [Output of Deliverable-3].	15%	4 months after commencement
4	**4th payment:** upon submission of a complete sets of bridge/culvert Inventory and Condition database for the selected upazilas, and finalized report on data collection and analysis, developed based on LGED's feedback, and upon completing Trainings for LGED officials/staff to be conducted by the Consultant on Mobile App and web-application [Output of Deliverable-4 and 5].	25%	6 months after commencement

5	**5th payment:** upon submission and acceptance Final version of working web based RuBIMS along with iOS and android based apps for bridge inventory and condition inspection data collection with source code and software documentation, along with a Final Report on Implementation, Testing and Commissioning [Output of Deliverable-6].	25%	8 months after commencement
6	**6th payment:** upon provide maintenance of software and submission of Final Report upon accommodation of recommendation and feedback provided by the Steering/Technical Committee of LGED [Output of Deliverable-7].	15%	10 months after commencement