Section 5. Terms of Reference

1. INTRODUCTION

The Government of Gujarat (GoG) through Roads & Buildings Department (R&BD) is responsible for maintaining and improving about 77,577 km of roads including the road categories of State Highways (SH), Major District Roads (MDR), Other District Roads (ODR), and Village roads (VR). R&BD, GoG, developed Gujarat Road Management System (GRMS) under World Bank assisted project Gujarat State Highways Project-1 (GSHP-1) for scientific network level planning and smart utilisation of funds with the help of computer applications during 2003-06. So far, R&BD has implemented GRMS in phases to include SH, MDR, ODR, and VR (Plan) road network and has used it for assessing both annual maintenance requirements/ improvements on the network along with the related budget estimates.

GRMS comprises of nine (9) key modules / sub-systems, apart from system administration and its corresponding database, as below:

- 1. Road Information System (RIS)
- 2. Traffic Information System (TIS)
- 3. Pavement Management System (PMS) and PMS-Practical/Simplified
- 4. Routine Maintenance Management System (RMMS)
- 5. Bridge Management System (BMS)
- 6. Environment and Social Information System (EIS)
- 7. Accident Information System (AIS)
- 8. Monitoring and Evaluation System (MES)
- 9. Budgeting and Programming Module (BAP)

All above mentioned modules / sub-systems are systematically interlinked with each other with logical, analytical functions. These modules communicate with each other through computer algorithms, for data transfer, processes, analyses with the common objective of annual work programme and multi-year work programme preparation. A detailed description of the current version of GRMS is provided in Annexure A, while the functional specifications desired for the proposed GujRAMS are provided in Annexure B. Bidders should note that Annexure A is more of a reference and that R&BD desires to maintain most of the core functionality of the older version.

Like any other Road Management System (RMS), GRMS database also has various types of data collected for preparing the annual / multi-year work programmes. R&BD has collected the data on select road network in different time periods since 2006, as per the priorities of the department. A detailed note on data available in GRMS is also provided in Annexure A.

In 2015, KPMG reviewed the GRMS as a part of their Assessment of IT-ICT-MIS Integration, Capacity & Gaps for the R&BD. As stated in their report, the use of GRMS after 2012 has been rather limited as no data was updated since then due to the following reasons:

• Technical challenges: Existing GRMS does not have any upgradation support from earlier IT-stakeholder agency. Currently no updates are applied on GRMS. The application Server is currently not live into production. The architecture supports integration with any MIS system. Regular update of data is not happening. Application of data is highly important. Most of the data is dynamic in nature and changes over a period of time. Hence it is prudent to use the data regularly to achieve the maximum benefits. Similarly not having web based platform unveils lot of dependency on so many uncertainties. But migration of client/ servers to Web

based solution for GRMS appears not to be very critical but will reduce the dependency on usage from client machines and maintenance of application will be much easier.

- Institutional challenges: Trained and skilled resources transfer as per Government norms. Success of full fledged training and technology transfer, to great extent hand holding and even beyond Client agencies preparedness to avail such assistance through outsourcing is critical. Any new stakeholder shall always keep in mind the development, O&M or even system maintenance/upgrade/ testing etc. in closest possible consultation and interaction with R&BD officials.
- *Resource requirements: Division offices are widely spread and the lack of connectivity and bandwidth hamper the usage of the application.*
- User-friendliness (features required, but not available in current GRMS): Currently Mobile App for handheld devices which can be used for data updation is not available. Provision for such apps will increase efficiency of GRMS usage.
- Obsolete technology: The existing version of GRMS was running on Windows XP platform, for which Microsoft has officially discontinued support in April 2014.

For the above reasons and to enhance the department's effectiveness in prioritizing and implementing its work programs, R&BD now intends to fully upgrade existing system with state-of-the-art technologies along with various enhancements identified by R&BD in the use of the Gujarat Road Asset Management System.

2. OBJECTIVE

The overall objective of the proposed services is to establish an enhanced and user-friendly Webbased Gujarat Road Asset Management System for R&BD (GujRAMS), Government of Gujarat, Gandhinagar (henceforth referred to as GujRAMS) to ensure that R&BD is able to effectively plan and prioritize its road improvement and maintenance works. This will help to improve the quality and delivery of R&BD services in the provision and management of the state road network.

Key objectives of the proposed assignment are to:

- Establish a web and GIS based GujRAMS that will provide readily accessible, relevant and valid information on the state road network, along with analytical tools for use in R&BD headquarters and all divisional field offices;
- Institutionalize the GujRAMS;
- Train R&BD Engineers in the use of the GujRAMS;
- Provide support during implementation, operation & maintenance of the GujRAMS

3. SCOPE OF SERVICES

The broad scope of this Consultancy services is to:

- Review functionality of existing GRMS to identify gaps toward desired requirements and to determine system architecture of the GujRAMS;
- Supply, configure, host and maintain a web-enabled and GIS-based state of the art GujRAMS, that would produce customized reports and data for informed decision making at the headquarters, and facilitate data entry and analysis at the field offices;
- Review and upgrade extant data collection procedures based on requirements of GujRAMS, and migrate all existing data into the GujRAMS;

- Determine annual maintenance needs for roads and bridges and help prepare annual work programs (AWP) and multiyear rolling work programs based on plan and non-plan budgets for network improvement and Annual Maintenance Plans (AMP) containing the identified needs based on the budget allocation;
- Suggest an institutional framework for the GujRAMS to ensure its sustainability and development over the long term, and impart training to the R&BD staff in its operation;
- Support transition of the GujRAMS to the designated production environment, including for any cyber-security compliances.

In line with the above objectives, the Consultant shall undertake the following tasks towards establishing state-of-the-art GujRAMS.

3.1. Task 1: Review of existing Gujarat Road Management System

The consultant will comprehensively review the existing GRMS, in terms of its coverage of related business processes and procedures, data collection and compilation, improvement and maintenance needs analysis and preparation of annual works programmes. The review shall also identify the availability of current resources, gap analysis and roadmap for GujRAMS implementation, including institutional setup, phasing of implementation (i.e., what percent of road prioritization through GujRAMS should be targeted over what period).

Upon reviewing the above and understanding the client's needs, the broad scope is to redesign, develop, install and host GujRAMS with the following components:

- Road Information System (RIS)
- Traffic Information System (TIS)
- Pavement Management System (PMS) along with Practical/Simplified PMS
- Routine Maintenance Management System (RMMS)
- Bridge Management System (BMS)
- Environment and Social Information System (EIS)
- Monitoring and Evaluation System (MES)
- Budgeting And Programming (BAP)
- Road Safety Asset Management System (RSAMS) (New module to be developed by merging existing functions of Accident Information System, and additional road safety assets)
- Enhanced Mobile Application for use by R&BD and feedback from general public

In addition, the GujRAMS should also include the following support modules:

- User Administration
- Data Aggregation
- Integration Framework

The Consultant will make provision for all existing functions and features of the existing GRMS (as provided in Annexure A) in the proposed GujRAMS and its various modules as per the consolidated requirements in Annexure B. For a better understanding, the Consultant should thoroughly study the system and some additional tasks and enhancements required of the GujRAMS as highlighted in Annexure A.

3.2. Task 2: Development of GujRAMS

3.2.1. System Development

The Consultant will develop the GujRAMS such that it can be accessed by any web browser on any operating system. For this purpose a Web-based architecture shall be adopted **preferably based on open source platform**. The indicative architecture is provided in Figure 1.

The Consultants will use their own infrastructure emulating the proposed environment for development. The Consultant will provide licenses and associated costs for AMC during the 3-year support period for all the proposed technologies used for application/database/GIS map/Web servers as follows:

- Enterprise database license and all associated middleware
- Two (2) licenses of HDM-4 version 2
- GIS software and GIS Map Server
- Two (2) licenses of any Desktop Network Editor

The Consultant shall specify optimal hardware, network, backup, DR and other security infrastructure requirement and their models/specifications, considering enterprise use of the software, robust performance, clustering, and back-up facility and specify indicative costs for the same in their technical proposals. The State Data Center may provide the infrastructure (if available).



Figure 1: System Architecture

In case of non-availability of the proposed hardware in the SDC, the Consultant shall provide assistance to procure the same through Gujarat Informatics Limited (GIL)¹. The Consultant will collaborate with State Data Centre (SDC) and DST/NIC and agree to a compatible server specification along with OS for procurement by GIL. The consultant may assume as a minimum that an octa-core processor with Windows 2012 R2 or higher OS will be used for database and application servers. For a map server, quad-core processor with Windows 2012 R2 or higher OS may be used.

The necessary hardware and communication facilities must be in place before completion of the User Acceptance testing. R&BD will not be responsible for any delay in the project because of late delivery of the hardware by GIL. Therefore Consultant will initiate the procurement of hardware very early in the project.

Details of the hardware/software/web-GIS/Security and user administration requirements are given in Annexure B.

3.2.2. User Acceptance Test and Compliance Testing

A user acceptance test plan will be prepared by the Consultant and submitted to R&BD before undertaking a User Acceptance Testing (UAT). The test plan will use data collected in this project for 2500 km and data already existing in GRMS. The test plan will consist of but not limited to each functional aspect described in **Annexure B**. The consultant will demonstrate each function using software tool in step by step procedure to representatives of R&BD who will evaluate and accept each tool and suggest refinement (if any) to be undertaken on it.

Following successful acceptance, the consultant shall migrate all the data and deploy the application in the hardware procured by GIL at the staging arrangement of SDC. GujRAMS will undergo compliance testing before hosting the system (in the production environment at SDC) including functional as well as non-functional (security audits) as required by DST and SDC / NIC at its own cost through certified CERT-In auditors. The security vulnerabilities identified by the auditor will be rectified by the Consultant within least possible time. Upon security clearance, Consultant will host GujRAMS at the production environment.

3.3. Task 3: HDM-4 Calibration

R&BD intends to establish HDM-4 model in medium to long-term (5-7 years). Therefore, the Consultant shall do a Level 1 Calibration through desk study with collection of secondary data, which should include climate, vehicle operating cost, unit costs (RUE and RDWE)², characteristics of representative vehicles, economic analysis data (discount rate and analysis period), pavement characteristics (RDWE) and traffic composition and growth rates. The Consultant will also update VOC, Unit Costs of treatments as per prevailing rates and used in the Simplified PMS also. R&BD engineers shall also be trained to undertake Level 1 calibration.

¹ Consultants should note that R&BD already R&BD has made an agreement with Gujarat Informatics Limited (GIL) for purchase of new servers (See Annexure B under Hardware Requirements)

² Road User Effects (RUE) comprises of vehicle operating costs (VOC), travel time, safety and emissions, while Road Deterioration and Works Effects (RDWE) comprises of the deterioration of the pavement and the impact of maintenance activities on pavement condition and the future rate of pavement deterioration

In addition, the Consultant shall identify the approach, methodology and data requirements, including road sections and phasing for Level 2 and Level 3 Calibration (see Annex E for details of calibration of HDM-4).

3.4. Task 4: Review and Upgrade Data Collection Procedures

The existing data collection procedure for GRMS is mostly based on visual assessment. For current and future needs, the data collection procedure needs to be augmented with more sophisticated, reliable and mechanized methods. Therefore, as part of these services, R&BD has decided to enhance the data collection procedure of selected items using automated road survey vehicle (See Table 1) with laser, DGPS, DMI, high resolution cameras to collect selected data such as pavement condition, rutting, IRI, and road geometry such as gradient, rise & fall, horizontal curvature, cross slope, altitude etc. so that it can be used for PMS.

As such, the Consultant will review all the data collection formats, business processes and standard operating procedures in detail, and prepare a revised data collection procedure report including revised data collection formats, if any, covering all data requirements of GujRAMS and include in it the procedure for automated data acquisition, data collection forms etc. Data Collection procedures for bridges shall include latest technology to collect bridge condition and performance assessment. The formats for data capture, the templates to be developed for data upload, and the methodology to be used for data upload into GujRAMS shall be exhaustive so as to satisfy the requirements of all modules within GujRAMS. At the same time, the formats and templates shall be defined generically so as to be compatible with data collection equipment to be used by other vendors/service providers in future for the remaining road network. The finalization of revised data collection formats, procedures shall be done in regular consultation with R&BD as per the GujRAMS requirements.

Based on the detailed review, the consultant shall identify pertinent issues and redefine business processes and prepare revised data collection procedure(s) for roads and bridges and various associated assets to comprehensively address data collection procedures.

Detailed data requirements are given in Annexure B.

3.5. Task 5: Undertake Data Collection and Migration

3.5.1. Data Collection and Input

Based on the upgraded/revised data collection procedures/formats under Section 3.4 above, the consultant will collect data on a pilot project of about 2500 km of roads (to be finalized in discussion with R&BD) on roads/pavements using automated equipment including high-resolution R-o-W images and Video to improve the quality and reliability of data. It should be noted that the Consultant would be responsible for obtaining the vehicle and any other equipment on the field for such data collection. About 500 km of road network will be selected in each of the five regions in Gujarat (North, South, Central, Saurashtra and Kutch) for undertaking this pilot project, encompassing all road categories (SH/MDR/ODR/VR). The consultant will subsequently validate and input the data in the system, and use this data system calibration and testing.

	Table 1: Data Collection and Preparation				
Sr. No.	Description	Unit	Quantity to be done		
	For RIS, TIS, RMMS, BMS and RSAMS	•			
1	Prepare Location referencing system (Linear & Spatial) and re-establish GIS layers (Use existing spatial data)	km	74,315		
2	Prepare Location referencing system (Linear & Spatial) and re-establish GIS layers as per the new districts and divisions (Use existing spatial data)	District	7		
	Field Data Collection				
	Collect following data for about 500 km in each region as identified in discussion with R&BD.				
3	 a) Koad Inventory, Geometry, Centre-line angliment, Koad Condition (refer existing data collection procedure report for list of distresses), Rutting, Edge Break, Road Roughness using laser, DGPS, Video, High Resolution camera fitted automated data acquisition equipment, b) FWD & Test Pits with pavement composition, maintenance history, subgrade soil classification, and CBR c) Location, Inventory & Condition of Bridges, Culverts, and other assets in RMMS d) Location, Inventory and Condition of Road Safety Assets Data Collection Procedure Manual (in reference to the earlier manual) will be updated to reflect the new data capture forms, templates, and upload procedures used to collect the above data. 	Km	2500		
	Traffic Information				
4	Compile and Import of Traffic Data collected from 2011-12 to 2017-18 (may need to be updated as per latest data set available)) including assignment of latest traffic data for annual work program preparation for SH, MDR and ODR including link station association.	Per Station for seven years	750 (SH) +50 (MDR)		
	Accident Information				
5	Accident Data collection from district police HQ as per GujRAMS format along SH, MDR, ODR, VR network for years 2011-12 to 2017-18, & compilation, data uploading in GujRAMS, preparation of black spot locations maps	Per District for seven years	33 districts		

3.5.2. Data Migration

The Consultant shall migrate all data available in the current GRMS to the new system with updated Route/Measure (Km/ Chainage); GIS based spatial Location Referencing System, history data shall be maintained as well into the new database, along with location referencing including any changes to such referencing. The quantum of data held in the database is provided in Annexure A. The Consultant may refer to the data collection manual of GRMS to better understand the data and format of compilation.

3.6. Task 6: Training

3.6.1. Training in GujRAMS

The consultant shall train three hundred (300) engineers of R&BD, the engineers on system use, data collection and interpretation. Consultant shall train ten (10) R&BD engineers as trainers to continue training programmes and provide training material for all the engineers. Training shall be organized at circle office level and at Staff Training College, Gandhinagar. Trainers shall be trained to prepare

training materials as well. Three (3) days training for each batch shall be arranged for about fifty (50) engineers.

In case of COTS, consultant shall train about thirty (30) more engineers for configuration and customization of COTS. This training program should be at a minimum for 3 weeks. The consultant shall suggest appropriate time requirement for this training in the proposal (if more than 3 weeks).

3.6.2. Training on system use and data collection

During the three year period of support, the Consultant will impart training to R&BD staff for a maximum of 7 days to 250 participants twice in a calendar year. Consultant will prepare training material and arrange its own professional capacity to impart training at Gandhinagar. R&BD will arrange for venue, stay and travel for participants. The Consultant will train R&BD staff for using various modules of GujRAMS and use of equipment for data collection. The data collection agency's equipment will be used to impart training.

3.6.3. Development of Training Material

R&BD is imparting training to department engineers/officers on various aspects and uses of GRMS through class room lectures and through hands-on experience. This current practice requires physical presence of trainers. Now R&BD intends to augment this with audio/video training materials on GujRAMS so that users can refer these manuals at any time. As such, the consultant shall develop audio/video training material on all aspects of GujRAMS as per requirements given in Annexure F.

A sample presentation of this multimedia material shall be presented to R&BD Chief Engineers (CEs). Based on the recommendations / suggestions of CEs, if any, the Consultant shall revise the training material, and then integrate it with R&BD's e-learning program, after due consultation with the Client.

3.7. Task 7: Institutionalization of GujRAMS

The Consultant shall study the industry standard practices or best case studies either in India or overseas, for the best arrangements to institutionalize the GujRAMS within R&BD. Based on this, the Consultant will make recommendations for an specific group/organizational unit (or cell) to be responsible and/or identify the necessary locus of dedicated 'core' responsibility, of PPU/PIU, R&BD for the asset management functions and GujRAMS operations, and the change management strategy and capacity building required to ensure sustainable competencies and knowledge.

For this task, the consultant shall work with other consultants responsible for relevant IDAP recommendations. Based on study and discussions, the Consultant will recommend suitable institutional framework to maintain GujRAMS and procedure to use GujRAMS in-line with business requirements of R&BD. This framework should at a minimum answer the following:

- Who should operate the GujRAMS?
- How should GujRAMS be managed and where should it be ideally housed (including option of GERI, HQ)? Should a GujRAMS Cell be created?
- How frequently should GujRAMS be updated?
- How to source and collect data along with quality framework, frequency, modality and necessary timing, and support for updating GujRAMS?
- What institutional changes or measures would be required to mainstream use of GujRAMS?
- What kind of change management strategy should be adopted?
- How to disseminate GujRAMS outputs to wider stakeholders?

The Consultant shall also identify the staff mix and prepare detailed responsibilities and job descriptions for all positions in the GujRAMS cell/unit or specific group responsible for GujRAMS. The Consultant will also prepare a budget estimate for annual operation of the GujRAMS cell/unit or specific group, with details of all staffing, equipment, data collection (contracted or in-house), field travel etc. in line with R&BD policies. The Consultant is also expected to provide necessary support to R&BD in establishing the cell or locus of responsibility.

3.8. Task 8: Maintenance and Support

The consultant shall provide technical and system maintenance support to R&BD on completion of system development. During the maintenance and support period of 36 months, the Consultant needs to deploy two full time professionals in R&BD (as described under Section 8) and undertake following tasks by additional professionals as needed:

3.8.1. System Maintenance and Support

GujRAMS software, after successful development/customization, UAT, Cyber Security Audit, and hosting, will be delivered to the client under the following terms of maintenance support. In the financial proposal, the consultant will mention the cost for the maintenance support for three years. These costs will be used in financial evaluation. This support and maintenance will involve following tasks/activities;

- <u>User support / hot line:</u> The user support includes resolution of technical issues, resolving any problems that may arise during the normal use of software by the officers. This includes provision of dedicated e-mail ID (response time not more than 24 hours) and voice-chat (express resolution) through a dedicated telephone number (during client's normal working hours).
- <u>Administrative and Technical Assistance</u>: This involves tasks not only limited to troubleshooting, bug fixing, providing support for any technical issue, but also system and database administration, or issues arising from any integration/technology upgrade at the SDC etc. Further, software shall be upgraded to adapt to any change in version of database/middleware/internet technology/internet browser version during the 3-year maintenance support period without any cost to R&BD. The technical support includes on-line chat (during client's normal working hours), dedicated e-mail ID (response time not more than 48 hours) and voice-chat (express resolution) through a dedicated telephone number (during client's normal working hours).
- <u>System Integration</u>: GujRAMS is envisaged to manage road network referencing and road asset data of R&BD. Consultant will provide support to share the data as agreed by R&BD with other applications. Similarly, any GIS layers shared with R&BD will be interfaced with web-GIS application.
- <u>Other Services:</u> This will include services to provide and install periodic updates, patches, undertaking minor enhancement and refinements required in the interface, menu, additional attribute, reports to improve its effectiveness based on the feedback information collected from its use. A technical document mentioning the details of the requested enhancement of software updates/patches and the type and extent of changes conducted on the software must be clearly mentioned. The consultant will be responsible for testing the patches and upgrades, and successfully deploy the same on the servers.

3.8.2. Support for Annual Work Program and Annual Maintenance Plan

During the course of the project and 3-year support period, data for the remaining state road network will be collected separately by R&BD through contract with a specialized data collection agency. In the latter case, the R&BD may task the consultant with formulation of any Terms of Reference required for such data collection. The Consultant will also assist/advise R&BD in collection and quality assurance of annual data collection in the field.

The consultant will validate and upload any such data that is collected during the project period (including the 3-year maintenance period) into the database. The consultant will also provide support for data analysis and for preparation of Annual Work Programs (AWP) and Annual Maintenance Plans (AMP) every year and provide support for the budget preparation, and impart training to R&BD as needed on any aspect of GujRAMS.

- Support for data verification/validation and upload: The Consultant will assist client's representative to validate the data submitted by the data collection agency. The scope will primarily involve a desktop analysis of all the data necessary for GujRAMS (such as inventory and condition of roads, culvert and bridges, pavement structure and traffic) for consistency. Further, consultant may have to accompany the client at site for field verification on sample basis. In case of any data inconsistency, consultant will hold discussion with the client and suggest appropriate correction measures. Upon successful validation of data, consultant will upload the data to the GujRAMS database using inbuilt tools. Consultant will also collect data regarding maintenance/rehabilitation/upgradation work performed in the financial years and update these in the system.
- <u>Support for preparation of maintenance plan & budget:</u> The consultant will run GujRAMS tool to prepare AMP for the following year and undertake rate analysis, update unit costs of treatments, VOC/VOT, traffic flow/fleet characteristics in HDM-4/PMS, prepare homogeneous/analysis sections for PMS analysis. The Consultant shall also undertake strategy and programme analysis using HDM-4/PMS for the entire network of the state and assist client's representative to prepare maintenance, rehabilitation and upgradation programme for the state road network and assist in budget preparation.
- <u>Other Services:</u> The Consultant will make periodic presentations to the senior officials of R&BD, during WB mission visits, and support to any such requirement as identified time to time by R&BD.

4. GujRAMS LICENSING REQUIREMENTS

The system (whether custom developed or a COTS software) shall be handed over to R&BD with all the rights (including source code and intellectual property rights) and for unlimited users and usage. Source code of GujRAMS shall be given to R&BD along with appropriate third-party licenses of the customized GujRAMS, for HDM4, and appropriate licenses for GIS software, map servers, network editors and other necessary software to enable use by concurrent users for a period of three years (post acceptance of the system). If non- open source software will be provided, the Consultant should give full details of any licensing costs for use by 50 concurrent users (x users in each of y divisions, x users in each of y circles and z users in GERI and xy users @ R&BD headquarters), in both the Technical and financial proposals.

In case any software is used to re-compile GujRAMS installation in the support period for any upgrade, such software along with all the source code shall be given to R&BD. The Consultant shall clearly state all associated costs in case any software used in the development of GujRAMS requires annual renewal of licenses.

In case the Consultant proposes COTS, facility to configure COTS should be made available with all necessary training and documentation; no encrypted data should be stored in the Database (except User ID/Password related to users). The Consultant must provide detailed design of database and about its overall entity relationships and data management along with data extraction methods. Consultant will need to provide detailed Configuration and Customization Manual (for each screen, function, report, etc. and process followed in configuration and customization of GujRAMS) to enable R&BD to make any changes in future. In case the Consultant needs to undertake any customization in COTS, same facilities and support shall be provided to R&BD along with documentation. Consultant must include details on Configuration and Customization of COTS along with screenshots and efforts required in configuration of System. COTS should be made available to R&BD for unlimited users, road categories, road length, with no limitation to integrate additional modules. Consultants should submit draft of License Agreement along with their Proposals.

5. ASSIGNMENT DURATION

The entire GujRAMS project shall be implemented in two parts:

- In the first part expected to last about eighteen (18) months, the Consultant shall undertake system design/upgrade, development, testing and validation (using limited data collected on the pilot project), migration of all data, training and implementation of the enhanced GujRAMS using the migrated data.
- In the second part, the Consultant will maintain the GujRAMS on an annual basis, and provide necessary support and training for further three (3) years. The software and system maintenance period will also be for three (3) years after successful user acceptance testing. Also 2500 km data collection is the responsibility under this part.

6. DELIVERABLES AND PAYMENT SCHEDULE

During the course of the assignment, the Consultant needs to submit following deliverables / reports at defined times. On successful acceptance, the Consultant will be paid a percentage of fee designated for each deliverable.

Sr.	Deliverables / Reports	Timeline (from	Payment	
No.		commencement of	(%)	
		services) -		
1	Inception Report	By end of 1 st month	2%	
	Task 1: GRMS Review Report	By end of 2 nd month	2%	
	Task 2: GujRAMS System Architecture/	By end of 3 rd month	306	
	Design Report (all the modules)		5%	
	Task 4: Data Collection Procedure Report	By end of 4th month	204	
	(Road and Bridge)		2.70	
	Task 5: Update of GIS layers and location	By end of 6 th month	20/	
	referencing for all roads including new		2 70	

districts		
Task 5: Data Collection of 2500 km	By end of 7 th month	3%
Task 2: GujRAMS Acceptance Testing Plan Report	By end of 8 th month	2%
Task 2: Operational Acceptance Testing and Release of Version 1 of RIS, TIS, AIS in consultant's server	By end of 9 th month	2%
Task 2: Operational Acceptance Testing and Release of Version 1 of BMS, EIS, PMS, RMMS	By end of 12 th month	2%
Task 2: Operational Acceptance Testing and Release of Version 1 of MES, BAP, Mobile App.	By end of 15 th month	2%
Task 2: Final GujRAMS Acceptance Testing Report and Release of updated GujRAMS (all modules)	By end of 15 th month	5%
Task 3: HDM-4 Calibration Report	By end of 15 th month	2%
Task 5: Data migration report into Web-GujRAMS database	By end of 16 th month	4%
Task 2: Security Audit and migration of GujRAMS to State Data Center (SDC)	By end of 17 th month	
Task 2: Final GujRAMS with all modules,existing dataGujRAMS User and SystemManual along with Troubleshooting Manual	By end of 17 th month	5%
Task 6: Training and Audio and Video Training Material	By end of 17 th month	2%
Task 7: Institutional Strategy Report including Asset Management Strategy and Standard Operating Procedure of GujRAMS	By end of 18 th month	5%
Programmers and User Manual (it should include details about Database, Programming File Details and Various Compiled component), Final Report along with source code and associated software	By end of 18 th month	
 Following reports shall be submitted irrespective of whether the solution proposed is COTS or a Custom-built GujRAMS: Configuration and Customization User Manual Configuration and Customization Administrator Manual Procedure Manual to integrate external application 	By end of 18 th month	5%
Quarterly progress report during Support and maintenance	By end of every quarter (for 3 years O&M phase)	@ 2.5% each quarter (12 quarters)
Annual Maintenance Plan during support period of 3 years	By end of every Dec	@ 6.67% each year (3 years)

7. SUPPORT FROM CLIENT

R&BD will provide the Consultant with access to the existing system along with Programmers Manual, User Manuals, System Administration Manual, Data Collection Manual and other relevant information available with department.

8. TEAM COMPOSITION AND QUALIFICATIONS

This project is multidisciplinary in nature. It requires a broad set of skills involving civil engineering and software development. The Consultant's team should therefore constitute a mix of skills and experiences, which include road works and software development. The Consultant firm should draw heavily on its experience in designing ICT based data collection and asset management systems and project management to ensure the right system is designed and implemented, and proper training is delivered. A minimum of 88 man-months of Key Professionals is envisaged for implementing Phase-1 (18 months) as given in the table below:

S.No	Key Staff	Person	Key Qualifications
		months	
1	Team Leader and Road	18	Graduate Civil Engineer with masters in Highway /
	Management System		Transportation engineer / Transportation planner
	Expert		with overall experience of at least 20 years, with
			working experience on at least two Road
			Management System (RMS) development /
			implementation projects. Must have worked on
			large road network and should have international
			experience. Must have worked on preparation of
			Annual / Multi Year Work Program and should
			have used HDM-4 extensively.
2	Project Manager	9	Post-Graduate in management with at least 15
			years of experience in handling development of
			asset management solutions for large projects in
			India or other developing countries. Should be
			knowledgeable of IT-ICT-MIS solutions and
			should have managed development and delivery of
			at least two such projects. Shall prepare work
			schedules/programs, ensure adherence to project
			and maintain appropriate
2	Highway Engineen	0	Communication with R&BD.
3	Highway Engineer	9	Graduate Civil Engineer with minimum 15 years of
			feesibility/DDD and should be familiar with all
			aspects of road network and road safety. Candidate
			will need to be familiar with location referencing
			and road safety aspects Relevant experience
			includes using guidelines of AASHTO/TRL/IRC
			etc., specifications and standards for highway
			projects relevant to international best practice.
			modern traffic and pavement surveying techniques.
			highway and bridge data collection. S/He should
			have expert knowledge in Highway design,

			junction design, asset management system principles, good working knowledge of using WIM, Axle pads, asset management, road safety and crash data analysis.
4	Pavement and HDM-4 Engineer	6	Graduate Civil Engineer with minimum 10 years of experience. Should have sound experience of pavement design and HDM-4, must have worked on at least 10 major highway projects and should have proven skills and knowledge. S/He should have exposure to codes and standards of AASHTO/TRL/IRC and pavement distress analysis and calibration. S/He should be proficient in developing road maintenance needs plans using HDM-4 and Decision Trees.
5	Transport Economist	4	A graduate in Civil Engineering, Commerce or Science with post-graduation in Economics or equivalent with at least 10 years' experience as Transport Economist and Financial Expert. S/He must have thorough knowledge of traffic forecasting models and in using/calibrating HDM-4 economic model for road maintenance analysis. S/He should be an expert level HDM4 user and a hands-on trainer. S/He should be an expert level HDM4 user and a hands-on trainer.
6	IT-MIS-ICT Specialist	18	A graduate in information technology/ computer engineering /any engineering discipline with minimum 10 years of overall experience. Good computer programming skills using various latest computer languages. Should have experience of large scale databases at state/national level and system development/management. S/He should be proficient in system administration, system analysis, development & management, GIS & economic model integration, web development with programming skills. S/he should have preferably worked on two projects of similar nature and complexity.
7	Software and DBMS Specialist	18	A graduate in Computer Science & Engineering/Information Technology/MCA with at least 8 years of experience in road information related database development and implementation. S/He should preferably have worked on two projects of similar nature and complexity. Proven experience in development of latest internet technology, web-GIS with Oracle/SQL Server is a must. Must be familiar with Postgres, .NET.

8	GIS Specialist	6	A graduate in any discipline with relevant post	
			graduate qualification and minimum 10 years of	
			GIS experience. Must have worked on GIS for	
			infrastructure / road related mapping assignments.	

Consultant shall also propose other technical experts for the assignment (Phase I) along with their time inputs; some suggested experts are given below:

S.No	Technical Expert	Qualifications
1	Highway & Pavement Engineer	Graduate in Civil Engineering, postgraduate in Highway Engineering. Should have a minimum 5 years of relevant experience in AASHTO/TRL/IRC etc., specifications and standards for highway projects relevant to international best practice, modern traffic and pavement surveying techniques, highway and bridge data collection. S/he should be proficient in estimating unit rates of different pavement and bridge works and in performing rate analysis of works and quantity surveying tasks.
2	Transport and HDM Specialist	Postgraduate in Economics or a graduate in Civil Engineering with experience in the economics of road construction, maintenance and proficiency in HDM-4. S/He should preferably possess relevant professional experience of 5 years on similar projects with at least two projects of similar nature and complexity. S/He should have exposure to codes and standards of AASHTO/TRL/IRC and traffic forecasting models and pavement distress analysis and calibration.
3	Bridge Engineers	Graduate in Civil Engineering, with postgraduate in Structural Engineering. The candidate should have a minimum 5 years of relevant experience in AASHTO/TRL/IRC etc., specifications and standards for highway projects relevant to international best practice, modern surveying techniques and bridge data collection. S/he should be proficient in estimating unit rates of different pavement and bridge works and in performing rate analysis of works and quantity surveying tasks. S/He should be proficient in Bridge and structure maintenance management programmes and should have hands-on experience in bridge design and bridge maintenance management in India.
4	Road Surveyor and Data Collection Supervisors	The person should have a diploma in Engineering, preferably Civil Engineering, and 3 years relevant experience in road, traffic surveying using automated equipment.
5	Environmental and Social Specialists	Graduate in Civil Engineering or relevant subject experts with postgraduate qualifications. The candidate

		should have a minimum 5 years of relevant experience in environmental and social aspects related to road sector. EIA, SIA and relevant knowledge on GoI/Multilateral Funding agency guidelines on assessment, mitigations and management is a must. S/he should be well versed with environmental and accial appraival and avaluations of road projects.
	~ ~ .	
6	System Designer cum	Graduate in Computer Science/Engineering or
	Software Analyst	equivalent, or in any Engineering with post-graduation
		in Computer Science with 5 years of professional
		experience. S/He should be proficient in system
		administration, system analysis, development &
		management, GIS & economic model integration, web
		development with programming skills. S/He should
		have preferably worked on two projects of similar
		nature and complexity.
7	GIS Analysts	Graduate in Engineering/Science with 5 year relevant
		and hands-on experience using GIS technology in road
		surveying, road / traffic data analysis, GIS
		applications, GPS/DGPS data collection, map Geo
		referencing, image interpretation etc.
5	Change Management	A management graduate with at least 6+ years of
	Specialist	experience in Project's involving Management and
		Institutionalization of change. Specific similar
		experience on Change Management will be added
		advantage.

Professional and Support Staff (for 3-year support period)

The consultant will provide the following support staff for selected positions in the 3-year support period following successful completion of phase-1 services. In addition, the Consultant will identify and propose suitable key professionals/technical experts and support staff to support maintenance activities (described under Task 8).

S.No	Professional/Support Staff			
1	Software and DBMS Specialist	36		
2	Highway and Pavement Engineer	36		
3	Logistic Support to PPU (Vehicle with driver for site visits etc.)	36		

ANNEXURE A PART 1: DESCRIPTION OF EXISTING GRMS

Introduction

The development of RMS for Roads and Buildings Department (R&BD), Gujarat was undertaken as part of the "Institutional Strengthening and Consultancy Services" [ISCS] project with loan assistance from the World Bank under Gujarat State Highway Project (GSHP) in the year 2003. The main objective was "to improve the quality and delivery of services in the development and management of the road system. The Road Management System (RMS) was intended to enhance the capabilities of the R&BD by providing a source of readily accessible, relevant and valid information on the road system as well as improved support for decision-making by providing modern, analytical tools".

System Components:

Gujarat Road Management System (GRMS) integrates nine core modules and additional administrative features for performing system administration, data aggregation and maintenance.

- 1. Road Information System (RIS)
- 2. Traffic Information System (TIS)
- 3. Pavement Management System (PMS)
- 4. Routine Maintenance Management System (RMMS)
- 5. Bridge Management System (BMS)
- 6. Environment and Social Information System (EIS)
- 7. Accident Information System (AIS)
- 8. Monitoring and Evaluation System (MES)
- 9. Budgeting and Programming Module (BAP)

GRMS was designed and developed using Microsoft technology. The system server environment is Windows 2000/2003 based. MTS/COM+ was used as the Application Server and SQL Server 2000 for the database. The architecture employed is multi-tiered, component based and distributed to ensure running of the system in both client-server and stand-alone models (with data synchronization mechanism). The servers are located at HQ (Nirman Bhawan) and communication to field offices is achieved using GSWAN. GRMS has Commercial-Offthe-Shelf (COTS) used products like HIMS as its core engine to define RIS, BIS, PMS and RMMS. Further, it is also integrated with few custom developed modules



such as TIS, EIS, AIS, MES and HDM-4 as external application. The system has integrated third-party TatukGIS platform for visual display of attributes, querying, building dynamic thematic maps and spatial and attributedataoutputinindustrystandardformats.

Road Information System [RIS]: The main functions of RIS are; to establish and maintain a linear location referencing system for the road network and road assets, keep asset inventory and condition rating information. Other features include data input mechanism, validation, processing and supply of information to PMS and other modules within GRMS.

Nodes / Roads	Links / LRPs / R	Ps	0		
H002A:N13059-N13060 - 4600	Link Defini	tion L	RPs	RPs	
H003:N02211-N03221 - 2500	Link Detail			Link: SH003-H02211-H0	3224
H003:N03029-N03019 - 2000	Link ID	SH003:N02211-N0322	8	0 54002 1000	044
H003:N03221-N03031 - 14600	Link Name	LINK SH 144 TO DISTR	RICT LIMIT	0 Sh003.N022	ar 2
1004:N02147-N02167 - 3000	Abbreviation			500 SH003:N0221	1-SH00
1004:N02149-N02147 - 3200 1004:N02157-N02153 - 11800	Description	LINK SH 144 TO DISTR	RICT LIMIT	C10000	
1004:N02163-N02157 - 11200				500 SH003:K001	14
1004:N02167-N02165 - 4000	Length(m)	2500	1		
1004:N02179-N02149 - 4200	Road_ID	SH003	Refresh Result int		
1004:N02199-N02179 - 21200	Canhle			1000 SH003:K0014	4-SH003
4005:N10054-N10055 - 13200	Seq No				
1005:N10055-N10010 - 1000	Start Node	N02211	 Refresh 		
H005:N11015-N11016 - 11400	End Node	N03221	 Node List 	1500 SH003 K001	15
1005:N11016-N11017 - 2900 1005:N11017-N12009 - 200	District Code	02	-	Constant - Charles Market	353
1005:N11044-N11006 - 19200	Division Code	RBD02	-		
1005:N12001-N10053 - 16000	Division Code			1000 \$1003:00014	SHORA
1005:N12003-N12004 - 1800 🥪	Core Ntwork		Retired 1	1000 01000.10010	-01000
	Area Code	ACA011	-		
Rec: 177	Added By	EEAHMEDABAD		1.0000 0.000000000	2005 T
RP/RP Reference	Added Op	23050005		2500 SH003:N032	221

Traffic Information System [TIS]: The TIS has been designed and developed to meet the current and future needs of collection, storage and usage/analysis of traffic data. The system is capable of storing and managing regular and special traffic counts, origin-destination survey data and axle-load data. The in-built facility includes assigning traffic to the road network, estimating traffic growth and performing various analysis routines and generating outcomes.

Pavement Management System [PMS]: It was felt during the development stage, after interaction with R&BD, that a simplified PMS based on pre-defined decision tree matrix has more chances of being successful than a traditional complex HDM-4 based model. Therefore, PMS module was split into a simplified, PMS (PMS-1), and a HDM-4 based PMS (PMS-2) which is for advanced user. Tools in PMS processes the data to homogeneous sections and transforms the network data to take advanced analysis in either PMS-1 or PMS-2



PMS-1 "Practical PMS" is used for assigning road sections to preliminary annual works and maintenance programmes (reconstruction, strengthening, widening, periodic maintenance) based on technical criteria (including traffic and pavement characteristics) and pre–defined treatments with feasible economic parameters using HDM-4 based case studies. PMS-1 is, thus, used to prepare a long list of unconstrained annual works programme,

PMS-2 "HDM4-PMS" is used for transferring the data on the road sections to HDM-4 for strategy and programme analysis for multi-year planning.



Routine Maintenance Management System [RMMS]: RMMS is designed to standardize routine maintenance activities, prepare quantity standards, and assign routine maintenance treatments. The model calculates the need for routine maintenance works on the pavement, shoulder, road sign, culvert, road marking and other assets within R-O-W based on the inventory and condition. It then prioritizes road sections based on pre-defined priority index and calculates allocations for each district. There is also facility to assign maintenance contracts for the selected activities and modify work type and quantity, if necessary.



1 #None: Clean



2 Low: Blocked for < 10 % of opening





Bridge Management System [BMS]: The purpose of BMS is to monitor and manage the bridge 'stock' of the State (represented by the bridge inventory) so that data is available for sound decisions concerning the maintenance, upgrading and replacement of bridges. It maintains a permanent and easily accessible record of the condition of all bridges, based on the initial inventory survey and regular condition surveys thereafter. It also allows planning of structured programs for bridge works in conformity with R&BD policies, and the funding necessary to implement the works required to maintain the infrastructure. As an integral part of the overall GRMS, this module has been designed to store and analyze; bridges condition data, determine the ranking and priority of bridge maintenance works and, evaluate the need for repairs or replacement. It also provides data input for the determination of an Annual Works Programme.



Environmental & Social Information System [EIS]: EIS provides a systematic database of environmental and social information at area and at link level. It provides necessary data and a platform to undertake specialized analysis for Environment Impact Assessment (EIA) or Social Impact Assessment (SIA). EIS provides a comprehensive database of environmentally sensitive areas and automatically flags a road section if it is being short-listed for widening or other development activity. This is a valuable tool for all those engaged in the road development in the State.

Accident Information System [AIS]: The system is envisaged to act as the central database for accident information, identify black-spots and carry out analyses for safety-related studies. The referencing system for accident locations is based on the referencing system established in RIS and is integrated with other modules within GRMS, as appropriate.

Monitoring and Evaluation System [MES]: The objective of MES is to measure and assess project(s) performance in order that progress can be more effectively monitored, and in so doing control measure can be put in place. The main function of the MES is, therefore, to monitor financial and physical progress of three major components, i.e., civil works, GoGs and consultants' services.

Budgeting and Prioritization [BAP]: This module is designed to undertake budgeting studies and prioritization of works. The analytical model, assigns works based on user-defined budgets and allowed maintenance activities under each 'head'.

Implementation:

GRMS has been implemented at all levels of GoG decision hierarchy; Division, Circle and the HQ. Generally, successful implementation of a computerized application in a government department is considered very difficult. The implementation has been a challenge and it has been talked about as a success story at many national and international forums.



Figure 1: GRMS Dedicated Server

The chronology of implementation of GRMS is as follows:

- 1. Development Phase: 2003-2006
- 2. Implementation Phases:
 - a. Phase 1 (5 Pilot Districts-5000 km SH) 2005-2006
 - b. Phase 2 (All Core SH 6000 km) 2006
 - c. Phase 3 (All SH 19000 km) 2006-2007
 - d. Phase 4 (All MDR+ODR 33000 km) 2008-2009
 - e. Phase 5 (All VR 21000 km) 2010-2011

A policy planning unit is in place at central level under a Chief Engineer and engineers assigned to work exclusively for the GRMS. The staff of policy and planning unit participates in activities of data collection / compilation and use. This unit in R&BD ensure that funding and budget are allocated to appropriate areas.

Data Collection:

Data collection is the most difficult and expensive part of any asset management system, therefore, it was dealt with very cautiously. Only such data was collected which was required for strategic decision making model. Procedures were developed for a simplified visual condition survey. At the same time, the system is capable of accepting data collected by other devices, though it involved some modification of the processing. After the pilot implementation, data has been updated periodically by the Consultants under supervision of the R&BD through the Policy Planning Unit. The following data was collected and information generated up to 2011 i.e. five years of its implementation.

S.No.	Road	Data Description	Quantity (kms)	Year of Updation
		GPS Referencing	18800	2008-09, 2010-11
		Road Inventory	18800	2008-09, 2010-11
		Road Condition, Structural Strength, Roughness	18800	2008-09, 2010-11
		Culvert Inventory	18800	2008-09, 2010-11
1	SH	Road Signs (Inventory and Condition)	18800	2008-09
		Bridge Inventory & Condition	3300 (nos.)	2008-09, 2010-11
		Classified Traffic Volume Count	750 (nos.)	2008-2011
		Accident Data	26 Districts	2006 to 2011
		Environment and Social Information	26 Districts	2008-09
		GPS Referencing	31000	2008-09
		Road Inventory	31000	2008-09
2	MDR/ ODR	Road Condition, Structural Strength, Roughness	3200	2010-11
		Bridge Inventory & Condition	1500 (nos.)	2010-11
		Classified Traffic Volume Count	50 (nos.)	2010-11
3	Villaga Dood	GPS Referencing	21000	2010-11
	v mage Koau	Road Inventory	21000	2010-11

Table:	Data	in	GRMS	Database
I abici	Dutu		OINID	Dutubube

The following sections describe some of the enhanced requirements identified during the use of the current GRMS. The Consultant should not consider this as exhaustive and should do a thorough study of the GRMS to identify any additional requirements (as stipulated in Task 1)

1. Road Information System (RIS)

a. <u>Network Referencing System and GIS</u>

The existing RIS is implemented using node, link & km stone offset based linear location referencing system. R&BD engineers are facing difficulties in using this system in the field to correlate with R&BD's Km chainage system where Km Stones are not available. Therefore, R&BD wishes to upgrade the referencing system to 'Km Point' based on R&BD's Km chainage referencing system. This linear referencing will integrate with spatial referencing system (projected coordinate system UTM-WGS84 and linear route/measure systems), such that GPS reference can also be used for data collection.

Further, the network referencing system should be able to interface with linear and point asset data and produce thematic maps using variation of values on linear representation by dynamic segmentation method of GIS to be established using Km Chainage.

The current GIS facility is 'View Only'. There is no facility to edit the spatial data and to integrate with the linear referencing data in the database. Consultant will provide a web-enabled common GIS network editor linked with GujRAMS to read / edit the spatial data and referencing system simultaneously. Both the spatial and the linear referencing will be tight-coupled and integrated with each other. Further, the RIS shall have feature to add external shape files and/or digitise to create roads/sections and carryout spatial maintenance such as splitting, merging, calibrating chainage/direction, changing jurisdiction/classification etc.

Recently GOG has declared seven (7) new districts from the erstwhile districts through its gazette notification. Consultants shall do the necessary amendments in GujRAMS database including modifying/ adjusting / creating location referencing and GIS-maps, to reflect the new districts in the database.

b. <u>Asset Information</u>

The RIS will be designed to input, store and report existing asset and its information. Further, it should also be enhanced to include following features:

- Provision to input, store, and report R-O-W line and features (like trees, poles, underground or visible utilities, social amenities etc.) details of the feature, GPS location, offset from the carriageway edge/centreline, side of the road etc;
- Provision to add more assets in consultation with R&BD;
- Additional data fields for storing (including option to bulk import) road geometry, and other data proposed to be captured using automated equipment including enhanced processing ability of these data to be used for PMS
- Ability to attach documents, multimedia files (images/videos) with assets and view in GIS;

c. Linear Charts

R&BD intends to have features in GujRAMS to produce dynamic linear diagrams/strip charts in various modules of GujRAMS using data held in it. The consultant shall identify and propose the requirement of linear diagram in all the GujRAMS modules and suggest PPU. As agreed by PIU the consultant will include the data features in each module in the dynamic linear diagrams by using a Web-based tool that will be integrated with GujRAMS. For example the linear charts to display R-O-W lines, carriageway, shoulder, R-O-W features, location of CD structures, bridges and various road data in strip charts.

The Consultant shall also design the GujRAMS such that it can establish mapping with F1 and F2³ with necessary changes in the current location referencing system for entire road network (excluding non-plan village roads), and dynamically generate F1 and F2 chart outputs. The Consultant shall finalize requirement of Location Referencing vis-à-vis F1 and F2 charts in consultation with R&BD, R&BD may require to add various other administrative requirement such as (MLA, MP constituency etc).

d. Integration with Work Monitoring System

The R&BD already has been using a system to monitor the physical and financial progress of road works in the state. *Details of the system are given in Annex C*.

The Consultant will provide support to integrate Work Monitoring System (WMS) with GujRAMS along with Data upload / download in GujRAMS format.

2. Traffic Information System (TIS)

The Consultant shall design a Web-TIS to provide all functions, asset data input (forms and excel based upload), storage, query, view and reports as in the existing TIS. In addition, it should have facility to process and input hourly data captured using Automatic Traffic Counter and Classifier (ATCC) machines. The TIS will be accessible via the common GIS-enabled platform.

3. Pavement Management System (PMS)

PMS module in GRMS has two sub-modules, a simplified catalogue based treatment assignment tool (PMS-1), and a HDM-4 based PMS (PMS-2) which is for advanced user. The Consultant shall design Web-PMS (1&2) to provide all functions, asset data input (forms and excel based upload), storage, query, view and reports as in the existing system. In addition, the consultant shall make at least the following refinements:

The HDM4 - PMS module available in GRMS helps in preparing the network files for HDM-4 analysis. However, the files extracted from existing version of GRMS are only compatible with HDM-4 Ver.1.3. Now a newer version HDM-4 V2.0 is available. Hence, a new tool/module/interface in GujRAMS needs to be developed for generating the network files which can be used in HDM-4 V2.0 or any newer version.. Also, the current HDM-4 interface only provides a function to prepare and extract relevant files for HDM-4 strategy and programme analysis. It is desired that the proposed interface shall have additional provision to import processed HDM-4 output inside GujRAMS for further data analysis and reporting.

4. Routine Maintenance Management System (RMMS)

In addition to making provision of existing functions, tools, asset data input (forms and excel based upload), storage, query, view and reports of the RMMS accessible in the GujRAMS, the Consultant shall enable the RMMS at the very least, to have the following additional facilities:

- Additional data fields to include headwall distance for culverts
- Provision of data fields to store inventory and condition data of causeways

5. Bridge Management System (BMS)

The Consultant shall transfer all existing functions, asset data input (forms and excel based upload), storage, query, view and reports from the existing system to the GujRAMS. In addition, the consultant will provide at least the following:

• Enable BMS to store all bridge-related data on the common GIS platform

³ F1 and F2 outputs mean Existing system of R&BD to update inventory in chart form; this reflects the Road, its Length, Hierarch, surface class and information on Cross Drainage (C.D) Works (which includes, Major bridge, Minor Bridge, Culverts) and also covers Traffic details.

- Enable BMS to provide data input, storage, reporting for R&BD's regular pre-monsoon and a post monsoon inspection forms, and detailed inspections including NDT testing.
- Enable BMS to generate additional reports to identify short-comings, safety hazards such as narrow bridges etc. to be finalized with R&BD
- Enable a provision to attach bridge drawings/GADs with bridges
- Recommendations for an improved rating system in GujRAMS, and
- Recommendations for incorporating a condition index for prioritization of bridges for maintenance/rehabilitation

6. Environment and Social Information System (EIS)

EIS provides a comprehensive database of environmental and social information at area and road section levels. The Consultant shall transfer all functions, asset data input (forms and excel based upload), storage, query, view and reports from the existing system to the GujRAMS. In addition, the consultant will make (but not limited to) following enhancements:

- Input of data (spatial / linear location & attribute) in Excel / CSV regarding the structures, utility services (both above and belowground), main features of the Environmental and Social components such as by each road and chainage (Linear);
- Input and store environmental and social information by Area (District) or by place in the common GIS platform;
- Modify / Deleting / Extract/ Report environmental and social survey data;
- Generate linear strip maps showing features.
- View location of features, thematic maps by region/district in the common web-based GIS interface
- Query selected attributes for view / report
- Identify features within a user-defined buffer, in case of widening to assist in optimal planning and costing for shifting of utilities
- Have a document repository for 'Guidelines' and 'Acts & Policies' which the User may refer to in assessing an existing road section and future projects;
- Internet links for to obtain relevant reference resources on environmental and social concerns.

7. Budgeting and Prioritization [BAP]:

The Consultant shall design transfer all functions, asset data input (forms and excel based upload), storage, query, view and reports from the existing system to the GujRAMS. In addition, the consultant will input processed data from HDM-4, BMS, RMMS and prepare reports for scenario comparison and budget prioritization for entire R&BD network as required from time to time before Annual budget preparation for R&BD.

8. Road Safety Asset Management System [RSAMS]

The system is envisaged to act as the central database for accident information, identify black-spots and carry out analyses for safety-related studies. The Consultant shall transfer all functions, asset data input (forms and excel based upload), storage, query, view and reports from the existing AIS to the RSAMS module in GujRAMS. In addition, the consultant shall make at least the following enhancements:

a. Road Safety Assets

R&BD is providing various road safety related furniture such as milestones, km stones, guard stones, informatory signboards, cautionary boards, village name boards, delineation of lanes with thermo-plastic paint, cats' eye, bollards, retro reflective signboards, metal crash barriers, different kinds of barriers in causeway, different kinds of carriage way dividers, bumps, rumble strips, zebra crossings, pedestrian crossings, street lights, and all Intelligent Transport System (ITS) components including traffic signals, CCTV cameras, speed sensors, variable message signs etc. on its roads for road user safety. The consultant shall have to enable the system to:

• Define the location and characteristics of these safety features

- Include forms to fill up the data of each road furniture required to be provided for safety of road users in the Web-based application along with condition assessment forms
- Download data in excel format
- Upload data filled in designated excel formats.
- Query and display these furniture and asset on the common Web-GIS interface along with other inventory features

b. Provision for iRAP Data

The International Road Assessment Programme (iRAP) is a registered charity dedicated to saving lives through safer roads. The iRAP software assesses road safety of roads on a 1-star to 5-star scale (5 being the best), and assigns Star Rating scores of the road sections / segments based on detailed inspection and assessment of more than 50 road attributes at 100 metre intervals. Such assessment of road network facilitates identification of road safety improvement opportunities. R&BD has used iRAP on some of its roads and plans to increasingly make such scientific assessments of road safety on its road network. As such, during this assignment, consultants are expected to review the iRAP documents and identify the availability of the relevant data attributes in current GRMS database. Thereafter, consultant shall make necessary provisions in the GujRAMS database to store the additional data attributes by creating necessary data fields. These additional data attributes are expected to be placed under the respective GujRAMS modules or a separate sub-module in RSAMS but accessible centrally via the GIS-enabled RSAMS interfaces. Upon completion of this task, consultant should ensure that the GujRAMS database contains provisions to store all the iRAP related data.

9. Enhancement of existing Mobile App

R&BD has developed a Road Mitra, a mobile app for recording of road condition along with photographs. *Detailed description of Road Mitra is provided in Annex D.*

The R&BD now intends to enhance Road Mitra (to be named as *Maru Marg*) and make it available to the public. Ideally, in addition to enabling recording of visual inspection of the assets by the R&BD, the application will both enable the R&BD to disseminate road related information to public, and enable the public to post grievances/feedback on roads for suitable incorporation of such feedback in planning and execution of future work improvement programs. It should also enable R&BD to monitor redressal of public grievances.

As such, the Consultant shall enhance the Road Mitra based on functional requirements provided in Annexure B, fine tune the same in consultation with the R&BD, and will integrate it with the GujRAMS.

I. FUNCTIONAL REQUIREMENTS

Functional specifications required for each of the following modules of GujRAMS is described. The specification is derived from built-in process/tools as per existing modules and further updated with future requirements of the proposed solution. The specifications are arranged by roles in each of the following modules in separate tables.

- System Security and User Management (SUM)
- Road Information System (RIS) including Network Management module
- Traffic Information System (TIS)
- Bridge Management System (BMS)
- Pavement Management System (HDM-4 linked) [PMS]
- Simplified PMS and Routine Maintenance Management System (RMMS)
- Environment and Social Information System (EIS)
- Road Safety Asset Management System (RSAMS)
- Monitoring and Evaluation System (MES)
- Budgeting and Programming Module (BAP)

Role	Function		Sub-Function		
			0.1.1	Get list of Users from State Single Sign On (SSO) facility (if available)	
			0.1.2	Alternatively Create own user with password	
	0.1	H. C. Min	0.1.3	Entry/Edit/Update user information Using Form	
	0.1	User Creation	0.1.4	Assign/Remove Jurisdiction	
			0.1.5	Assign/Remove Roles	
GujRAMS Admin			0.1.6	View/Print Users	
			0.1.7	Reset password	
	0.2		0.2.1	Define Districts and Divisions using form	
		Jurisdiction Creation and Management	0.2.2	Define road classification using form	
			0.2.3	Define other master data constituency, block etc.	
			0.2.4	Edit/Update data	
			0.2.5	View/Report data	
		Role Creation and	0.3.1	create new role(s) in each module	
	0.3	Management	0.3.2	Add/remove available functions to each role in each module	
	0.4	Login to GuiRAMS	0.4.1	Login screen using url or portal subdomain	
		0 0 0 0 1 1 1 1 0	0.4.2	On-line Password retrieval	

Table: System Security and User Management

Role	Function		Sub-Function		
	0.5	GujRAMS Homepage	0.5.1	Quick access to modules, dashboard, reporting, Web-GIS etc.	

Table: Road Information System (RIS)

Role	Function		Sub-function		
			1.1.1	Create Road by either copying from external layer or digitizing overlaid image	
			1.1.2	Assign jurisdictions/Classification etc.	
			1.1.3	Search road by jurisdiction	
			1.1.4	Rename Road	
RIS/GIS	1.1	Road*	1.1.5	Split Road	
Admin			1.1.6	Merge Road Segments	
			1.1.7	Recalibrate Road by chainage	
			1.1.8	Retire Road	
			1.1.9	Search/ View /download roads	
			1.1.10	View data in Reports and in Web-GIS	
			1.2.1	Define inventory list and data entry Using Form by road	
RIS User			1.2.2	Data entry Using CSV Loader by roads (option to download formats)	
			1.2.3	Edit/Update	
RIS/GIS Admin	1.2	Road Inventory	1.2.4	Retire	
	-		1.2.5	Search, view data and download	
General User			1.2.6	View data Reports and in Web-GIS	
			1.2.7	View in Strip-chart	
RIS User			1.2.8	Upload/View photographs/documents	
		Pavement Composition	1.3.1	Define attribute list and data entry Using Form by road	
RIS User	1.3		1.3.2	Data entry Using CSV Loader by roads (option to download formats)	
			1.3.3	Edit/Update	
RIS/GIS Admin			1.3.4	Retire	
General User			1.3.5	Search, view data in reports and download	
RIS User			1.3.6	Upload/View Photographs/Documents	
			1.4.1	Define attribute list and data entry Using Form by road	
RIS User			1.4.2	Data entry Using CSV Loader by roads (option to download formats)	
	1.4	Pavement	1.4.3	Edit/Update data	
RIS/GIS Admin	- 1.4	Condition	1.4.4	Retire	
General User			1.4.5	Search and view data and download	
General User			1.4.6	View data in Report and in Web-GIS	
RIS User	1		1.4.7	Upload/View Photographs/Documents	
			1.5.1	Entry Using Form	
RIS User	1.5	Roughness	1.5.2	Data entry Using CSV Loader by roads (option to download formats)	
			1.5.3	Edit/Update	

Role	Function		Sub-function		
RIS/GIS Admin			1.5.4	Retire	
			1.5.5	Search and view data and download	
General User			1.5.6	View data in Reports and in Web-GIS	
			1.5.7	View in Strip-chart	
RIS User			1.5.8	Upload/View Photographs/Documents	
			1.6.1	Define attribute list and data entry Using Form by road	
RIS User			1.6.2	Data entry Using CSV Loader by roads (option to download formats)	
	16	Pavement	1.6.3	Edit/Update data	
RIS/GIS Admin	1.0	Strength	1.6.4	Retire	
General User	-		1.6.5	Search/View/download data	
General User			1.6.6	View data in reports and in Web-GIS	
RIS User			1.6.7	Upload/View Photographs/Documents	
DICILIA			1.7.1	Define attribute list and data entry Using Form by road	
KIS User		Culvert Inventory & Condition	1.7.2	Data entry Using CSV Loader	
			1.7.3	Edit/Update data	
RIS/GIS Admin	1.7		1.7.4	Retire	
General User			1.7.5	Search/View/download data	
General Oser			1.7.6	View data in reports and in Web-GIS	
RIS User			1.7.7	Upload/View Photographs/Documents	
			1.9.1	Define attribute list and data entry Using Form by road	
RIS User	1.0	DeWEster	1.9.2	Data entry Using CSV Loader by roads (option to download formats)	
			1.9.3	Edit/Update data	
RIS/GIS Admin	1.9	K-0-W Features	1.9.4	Retire	
General User			1.9.5	Search/View/download data	
General Oser			1.9.6	View data in reports, Strip Chart and in Web-GIS	
RIS User			1.9.7	Upload/View Photographs/Documents	
			1.10.1	Define attribute list and data entry Using Form by road	
RIS User			1.10.2	Data entry Using CSV Loader by roads (option to download formats)	
	1 10	ITS Factores	1.10.3	Edit/Update data	
RIS/GIS Admin	1.10	115 Features	1.10.4	Retire	
General User	1		1.10.5	Search/View/download data	
			1.10.6	View data in reports, Strip Chart and in Web-GIS	
RIS User			1.10.7	Upload/View Photographs/Documents	

* Functions related to GIS Network Manager Module

Role	F	unction	Sub-function		
			2.1.1	Define attribute list and data entry Using Form by road	
			2.1.2	Edit/Update data	
	2.1	Station	2.1.3	Retire	
		Button	2.1.4	Search/View/Download data	
			2.1.5	Upload/View Photographs	
		Traffic	2.2.1	Define attribute list and equivalency factors Using Form	
TIS Admin	2.2	Volume Count Vehicle Type	2.2.2	Edit/Update data	
	2.3	Axle Based	2.3.1	Define attribute list and characteristics Using Form	
	2.5	Vehicle Type	2.3.2	Edit/Update data	
		SCF (Seasonal	2.4.1	Define attribute list/ Add new set and data entry Using Form	
	2.4	Correction	2.4.2	Edit/Update	
		Factor)	2.4.3	Apply SCF to traffic volume counts to derive AADT	
			2.5.1	Define attribute list/ Add new set and data entry Using Form	
	2.5	Growth Factor	2.5.2	Edit/Update	
			2.5.3	Estimate future traffic by growth factor and by trends	
	2.6	Data Validation	2.6.1	Comparative charts to depict traffic by (direction) hour of the day for each day of volume count	
			2.6.2	Comparative charts to depict traffic by daily volume by each week day in previous years	
TIS User			2.6.3	Allow data validation by estimating traffic variation	
		Traffic Assignment	2.7.1	Associate traffic station to road	
			2.7.2	Assign proportional traffic (by vehicle type) to road sections	
	2.7		2.7.3	Edit defined proportion of traffic	
			2.7.4	Delete/reassign traffic	
			2.7.5	View data in reports, Web-GIS	
			2.8.1	Data entry Using CSV Loader (option to download formats)	
TIS			2.8.2	Edit/Update	
User		Traffic	2.8.3	Data View/download/Report	
	2.8	Volume Count	2.8.4	Delete/Retire	
TIC		Data	2.8.5	Validate, Commit or Reject data	
TIS Admin			2.8.6	Define traffic class	
			2.8.7	Assign traffic class to sections	
			2.9.1	Data entry Using CSV Loader (option to download formats)	
TIS	29	Axle Load	2.9.2	Edit/Update Axle Load Data	
User	2.7	Data	2.9.3	View/Download/Report Axle-load	
			2.9.4	Delete Axle Load Data	

Table: Traffic Information System (115	Table:	Traffic	Information	System	(TIS)
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Role	Function		Sub-function		
		2.9.5	Entry Axle-load Volume Count		
		2.9.6	Edit/Update Axle-load Vol. Count		
		2.9.7	View Axle-load Vol. Count		
		2.9.8	Delete Axle-load Vol. Count		
		2.9.9	Validate Axle-load with Vol. Count		
TIS		2.9.10	Commit Axle-load Vol. Count		
Admin		2.9.11	Reject Axle-load Vol. Count		

Table: Bridge Management System (BMS)

Role		Function		Sub-function
BIS Admin			3.1.1	Define attribute list
			3.1.2	Define bridge location by chainage in a road
			3.1.3	data entry Using Form
BIS User	3.1	Bridge Inventory	3.1.4	Data entry Using CSV Loader by roads (option to download formats)
			3.1.5	Edit/Update/Download data
General User			3.1.6	View data in Report and Web-GIS
		Bridge Condition	3.2.1	Define defect list by bridge components
BIS Admin			3.2.2	Define defect severity and extents
	3.2		3.2.3	Define defect priority and condition index parameters
			3.2.4	Entry inspection data using Form
DIC Lloor			3.2.5	Entry inspection data by different time periods
DIS USEI			3.2.6	Estimate bridge condition index for bridges
			3.2.7	Edit/Update/Download data
General User				View/Download/Report data in Web-GIS
	33	Multimedia	3.3.1	Upload/View Bridge Photo for condition and inventory
BIS User	5.5	Storage	3.3.2	Upload/View Bridge Design Drawings
D15 0301	3.4	Bridge Repair	3.4.1	Enter repair cost by defect
	3.4	Costs	3.4.2	Estimate total repair cost and report

Table: Pavement Management System-HDM-4 linked (PMS)

Role		Function	Sub-function		
	Define	4.1.1*	Select Sectioning Parameters		
PMS Admin 4.1	4.1	A Parameters and ranges (as per GujRAMS)	4.1.2*	Change Sectioning Parameters	
			4.1.3*	Define ranges for Parameters, and mathematical/ logical operators to derive representative value.	
PMS	4.2	Automatic	4.2.1*	Process data for sectioning using sectional definition.	

Role		Function		Sub-function
User /Admin		Sectioning / Manual Refinement	4.2.2*	Refinement of section definition using graphical strip charts showing values of selected parameter in linear km charts (Split/Merge)
		(As per GujRAMS)	4.2.3*	Update Sections
		Exclude	4.3.1*	Obtain list of project sections
PMS User	4.3	Project (Ongoing /	4.3.2*	Exclude sections
/Admin		Committed) Sections	4.3.3*	Update sections
		Finalise	4.4.1	Finalise Homogeneous Sections
PMS		Homogeneous Sections/ Data Transformation	4.4.2	Finalise transformation of road/traffic data for HDM-4 network file
User /Admin	4.4	(Strategy and Programme	4.4.3	Prepare Sections & Traffic data for export to HDM4 in MS Access format (readable by HDM-4 Version 2)
		Analysis Separate)	4.4.4	Export to HDM4 in MS Access
TIS/PMS Admin	15	Prepare Vehicle Fleet, Maintenance	4.4.1*	Prepare data on Vehicle operating costs for the vehicle fleet as required for HDM-4, and export to HDM-4 standard database
PMS Admin	т.9	Standards, Unit Costs	4.4.2*	Prepare data on Work Standards and unit costs (maintenance & improvement) as required for HDM-4, and export to HDM-4 standard database
		4.6.1	Import Road Network	
PMS Admin	4.6	Finalise Inputs in HDM-4	4.6.2	Update Vehicle Fleet, Maintenance Standards, Unit Costs
			4.6.3	Update any other additional parameters such as climate, traffic pattern, etc.
PMS		Assign Standards and	4.7.1	Assign Standards to Network
User	4.7		4.7.2	Run HDM4 Strategic analysis
/Admin		Run HDM4	4.7.3	Run HDM4 Programme analysis
PMS User /Admin	4.8	Export HDM4 results & Reporting	4.8.1	Export HDM4 results
	4.9	Loading HDM- 4 results	4.9.1	Entry to GujRAMS database using CSV loader
PMS User	4.10	Scenario Comparison for different funding levels	4.10.1	Use charts, trend lines, export data for multiple scenario and funding
/Admin	4.11	Prioritisation of candidate sections for the selected scenario	4.11.1	Use engineering and economic parameters, indices, social factors to build customised queries for prioritising works
General User	4.10	View and Report	4.10.1	View Reports

* Functions shared by module for Simplified PMS

Simplified PMS and	Routine Mair	itenance Manager	ment System	(RMMS)
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Role	Fu	nction	Sub-function		
		Simplified PMS	5.1	Define maintenance strategy (decision tree/ rule based/ index based – As per GujRAMS)	
PMS User /Admin	5		5.2*	Run treatment assignment & costs	
, , , , , , , , , , , , , , , , , , , ,			5.3	Edit/Update	
			5.4	View	
PMS User /Admin	5	RMMS	5.5	Define maintenance strategy (decision tree/ rule based/ index based – as per GujRAMS)	
			5.6*	Run treatment assignment & costs	
			5.7	Edit/Update	
			5.8	View	

* This function will be performed after completing Tasks mentioned as 4.1, 4.2, 4.3, 4.5 as specified earlier.

Role	Function		Sub-function		
Koit	Index	Name	Index	Name	
AIS/GIS Admin			6.1.1	Define attribute list and data entry Using Form	
			6.1.2	Data entry Using CSV Loader by roads (option to download formats)	
AIS User	6.1	Road Accidents	6.1.3	Edit/Update	
			6.1.4	Attach photographs/ documents	
Conoral Usor			6.1.5	View Reports	
General Oser			6.1.6	View in Web-GIS	
			6.2.1	Define (Allow Entry/Edit) freq. of accident	
AIS /GIS Admin	6.2	Blackspot Identification Definition	6.2.2	Define (Allow Entry/Edit) no. of years using form	
			6.2.3	Define (Allow Entry/Edit) length of section	
			6.2.4	Run procedure to identify blackspots	
General User			6.2.5	View Reports	
General User			6.2.6	View in Web-GIS*	
AIS /GIS Admin			6.4.1	Define (Allow Entry/Edit) counter- measures for hazards using form	
			6.4.2	Entry of hazardous locations (point and segment) Using Form	
AIS User	6.3	Hazardous Locations	6.4.3	Data entry Using CSV Loader by roads (option to download formats)	
			6.4.4	Edit/Update using form	
Automatically by System			6.4.5	Update counter-measures	

Table: Road Safety Asset Management System (RSAMS)

Role	Function		Sub-function		
KOR	Index	Name	Index	Name	
General User			6.4.6	View Reports	
General Oser			6.4.7	View in Web-GIS	
AIS /GIS Admin			6.4.1	Define (Allow Entry/Edit) safety features list	
	6.4	Safety Features	6.4.2	Entry of safety features by road and chainage	
AIS User			6.4.3	Data entry Using CSV	
			6.4.4	Edit/Update using form	
			6.4.5	View Reports	
General User			6.4.6	View in Web-GIS	
AIS /GIS Admin			6.5.1	Define (Allow Entry/Edit) attributes	
		iRAP Data	6.5.2	Entry of data by road and chainage	
AIS User	65		6.5.3	Data entry Using CSV	
AIS Use	0.5		6.5.4	Edit/Update using form	
			6.5.5	View Reports	
General User				View in Web-GIS	

Table: Environment and Social Information System (EIS)

Role		Function		Sub-function
EIS/GIS Admin			7.1.1	Define list and Entry Using Form
			7.1.2	Data entry Using CSV Loader by roads (option to download formats)
EIS User		-	7.1.3	Edit/Update
	71	Trees (Species, location, girth size,	7.1.4	Retire
	/.1	and offsets from the carriageway),	7.1.5	Upload/View photographs/documents
			7.1.6	View Reports
General User			7.1.7	View in Web-GIS
			7.1.8	View in Strip-chart
EIS /GIS Admin	7.2	Detailed abutting Landuse (Forest, Waterbody, Wetlands)	7.2.1	Define list and Entry Using Form by road and chainage
			7.2.2	Data entry Using CSV Loader by road and chainage (option to download formats)
EIS User			7.2.3	Edit/Update
			7.2.4	Retire
			7.2.5	Upload/View photographs/documents
General User			7.2.6	View Reports
			7.2.7	View in Strip-chart
			7.2.8	View in Web-GIS
EIS /GIS Admin	7.3	Encroachment and	7.3.1	Define list and Entry Using Form by road and chainage
EIS User		Squatting	7.3.2	Entry Using CSV Loader by road and chainage

Role		Function	Sub-function	
			7.3.3	Edit/Update
			7.3.4	Retire
			7.3.5	Upload/View photographs/documents
			7.3.6	View Reports
General User			7.3.7	View in Strip-chart
			7.3.8	View in Web-GIS
EIS /GIS Admin			7.4.1	Define list and Entry Using Form by road and chainage
EIS User			7.4.2	Data entry Using CSV Loader by roads (option to download formats)
			7.4.3	Edit/Update
	7.4	Quality of Air, Water, noise and	7.4.4	Retire
EIS User		pollution levels	7.4.5	Upload/View photographs/documents
			7.4.6	View Reports
General User			7.4.7	View in Strip-chart
General User			7.4.8	View in Web-GIS
EIS /GIS Admin		Utilities (Underground and above ground)	7.5.1	Define list and Entry Using Form by road and chainage
			7.5.2	Data entry Using CSV Loader by roads (option to download formats)
	7.5		7.5.3	Edit/Update
EIS User			7.5.4	Retire
			7.5.5	Upload/View photographs/documents
			7.5.6	View Reports
General User			7.5.7	View in Strip-chart
			7.5.8	View in Web-GIS
EIS /GIS Admin			7.6.1	Define list and Entry Using Form by road and chainage
EIS User			7.6.2	Data entry Using CSV Loader by roads (option to download formats)
	_		7.6.3	Edit/Update
EIS /GIS Admin	7.6	and Archeological	7.6.4	Retire
EIS User		Properties	7.6.5	Upload/View photographs/documents
			7.6.6	View Reports
			7.6.7	View in Strip-chart
			7.6.8	View in Web-GIS
EIS /GIS Admin		Public Buildings	7.7.1	Define list and Entry Using Form by road and chainage
EIS User	7.7	and community facilities	7.7.2	Data entry Using CSV Loader by roads (option to download formats)
			7.7.3	Edit/Update

Role		Function		Sub-function
EIS /GIS Admin			7.7.4	Retire
FIS User			7.7.5	Upload/View photographs/documents
			7.7.6	View Reports
General User			7.7.7	View in Strip-chart
General User			7.7.8	View in Web-GIS
		Other social and environment data	7.8.1	Entry Using Form
EIS User			7.8.2	Data entry Using CSV Loader by roads (option to download formats)
		region/ district/ town/	7.8.3	Edit/Update
EIS User	7.8	village/location as applicable (details to	7.8.4	Retire
General User		be discussed with R&BD vis-à-vis as	7.8.5	View Reports
General User		per existing GRMS)	7.8.6	View in Web-GIS
EIS User			7.8.6	Upload/View Photographs/Documents

Table: Web-GIS Interface

Dolo		Function	Sub-function		
Kole	Index	Name	Index	Name	
		Selectable Layers (Roads, Bridges, Culverts, Traffic	8.8.1	Click on respective layer to make visible on display panel	
	0.1		8.8.2	Click to select assets and display summarized information	
	8.1	Stations, other	8.8.3	Annotate layers with chainages, names etc.	
GujRAMS		finalized with PWD	8.8.4	Set colour, transparency of the layer	
User		during design stage)	8.8.5	Select asset to view/download data report, documents, photographs etc.	
		Search and view assets by road	8.2.1	Select jurisdiction and search road	
	8.2		8.2.2	Select assets and zoom to the location	
			8.2.3	Select asset to view/download data report, documents, photographs etc.	
	8.3	Query on attributes of assets	8.3.1	Select Asset type	
GuiRAMS			8.3.2	Select multiple attributes of the asset including jurisdiction	
User			8.3.3	Specify values, conditions matching a criteria	
			8.3.4	Query to view the matching assets	
			8.3.5	View/download reports	
GujRAMS Administrator				Integrate external shared layers through Arc-GIS Server services	
			8.4.2	List layers	
GujRAMS User/General	8.4	Additional layers	8.4.3	Click on the layer to overlay	
User			8.4.4	Select to view values/annotations	
			8.4.5	Select colour/ transparency etc.	

Role		Function	Sub-function		
	Index	Name	Index	Name	
			8.5.1	Zoom and pan	
			8.5.2	Measuring length and area	
	8.5 General and tools	General Features and tools	8.5.3	Overlay online satellite images (google earth like), other available online map services without any additional charges to PWD)	
			8.5.4	Create points by specifying x and y coordinates	
			8.5.5	Click on road alignment to get x and y coordinates, chainage	

Table: Monitoring and Evaluation System (MES)

Role		Function		Sub-function
	Q 1	Create Work Type	9.1.1	Specify Type of Work
MES/GIS Admin	9.1	Create Work Type	9.1.2	Create Monitoring Parameters
	9.2	Create DOO Items	9.2.1	Specify Item / Sub-item
	1.2	create bog items	9.2.2	Specify Unit
			9.3.1	Search / Select division/ road / bridge/culvert
			9.3.2	Specify chainages / location
			9.3.3	Specify budget/ scheme/ cost/status etc.
MES User	03	Create	9.3.4	Edit/Update BOQ Items/quantities/costs
WES User	9.5	Projects/Package	9.3.5	Search, view data and download
			9.3.6	View data Reports and in Web-GIS
			9.3.7	View in Strip-chart
			9.3.8	Upload/View photographs/documents
			9.4.1	Search / Select division/ project
			9.4.2	Select Date
			9.4.3	Select BOQ Item / Sub-item
MES Hoor	0.4	Update Progress	9.4.4	Edit/Update quantity
MES User	9.4	of Project	9.4.5	Search, view data and download
			9.4.6	View data Reports and in Web-GIS
			9.4.7	View in Strip-chart
			9.4.8	Upload/View photographs/documents
MES/ RIS User			9.5.1	Define attribute list and data entry Using Form by road
			9.5.2	Data entry Using CSV Loader by roads (option to download formats)
	9.5	Update Work	9.5.3	Edit/Update data in form
		History	9.5.4	Retire
			9.5.5	Search/View/download data
			9.5.6	View data in reports and in Web-GIS
			9.5.7	Upload/View Photographs/Documents

Role		Function		Sub-function
	10.1	Create Budget	10.1.1	Create budget head/selection parameters
BAP/GIS	10.1	Head / Schemes	10.1.2	Create schemes
Admin	10.2	Add candidate sections/Works	10.2.1	Select Road
	10.2		10.2.2	Select road/bridge works
	10.3	Assign to Budget head	10.3.1	Search matching sections/works by budget
			10.3.2	Prioritise (by traffic/EIRR)
MES User			10.3.3	Set-cut off and schedule works
WES USE			10.3.4	Allocate funds
			10.3.5	Search, view data and download
			10.3.6	View data Reports and in Web-GIS

Table: Budgeting and Programming Module (BAP)

Table: Mobile Application (Maru Marg)

Role		Function	Sub-function		
			11.1.1	compact login/logout screen for employee and citizens separately	
R&BD/ Citizens	9.1	Login and Homepage	11.1.2	View menu buttons for each module such as Personal Profile, MIS Dashboard, Project Monitoring, Role/ User Administration, Grievance, Management, Master Data, Road Asset	
			11.2.1	Mark locations based on GPS based auto fly	
R&BD User	9.2	Road Management System (Community Participation/Emergency	t 11.2.2 Sel- y	Select predefined option (bad road, overtopping, landslide etc.), upload photograph and remarks	
		Response)	11.2.3	Functionality to view events and assign appropriate authority	
			11.2.4	Compliance made to the event by appropriate authority.	
			11.3.1	Summarised information about assets such as road and bridge statistics	
R&BD User	9.3	Asset Management System	11.3.2	Trends of traffic on network (veh. km, tonne.km, capacity levels)	
	(For Monitoring)	11.3.3	Summary of condition of assets (PCI, Roughness, summary of bridges/culvert condition)		
			11.4.1	Search a road to obtain selected information (inventory, traffic, condition etc.)	
R&BD User	9.4	Asset Management System (Map view and update)	11.4.2	Select a road/bridge and initiate visual survey and update ratings, photograph and remarks (direct upload data to GujRAMS database)	
			11.4.3	Summary of condition of assets (PCI, Roughness, summary of bridges/culvert condition)	
Citizen			11.5.1	User will have provision to raise Grievance request/ upload photograph / comment	
	9.5	Grievance Redressal	11.5.2	Functionality to track Grievances.	
GujRAMS Admin			11.5.3	Allot Grievance to division	

II. DATA REQUIREMENTS

Data collection procedures through visual inspection was established during development of GRMS software as part of the Institutional Strengthening Consultancy services (ISCS) (under GSHP-I) during 2003-06. Even though R&BD would like to automate data collection, it still wishes to retain the visual assessment procedure in the system as an alternative data collection procedure. To this effect, any addition of tables in the database, refinement of processing and analytical tools for RIS, TIS, PMS-HDM-4, Simplified PMS, RMMS and other modules may have to be refined/added. As such, the Consultant is expected to do a review of the existing procedure and suggest, finalize, and re-design the GujRAMS (in discussion with R&BD) to accommodate this requirement.

Further, various manuals/documents including 'Data collection Procedure Report' were developed during 2003-06. However, when this data collection procedure report was developed, only SH network was present in GRMS database. At later stages R&BD implemented GRMS to include MDR, ODR, and VR network in its database. To include these new road categories in GRMS database, various procedures specific to MDR, ODR and VR road categories were followed by department. However, these procedures are not documented in the existing 'Data collection Procedure Report'. For example, the nomenclature used for preparation of location referencing of MDR, ODR, and VR is different from the SH.

R&BD has also added some new data fields such as headwall distance in culvert inventory data collection format and transverse offset in encroachment data collection format, and amended some data collection formats to cater the department needs. Even though these revised data collection formats were used for the data collection in the previous assignments, they are not documented in the 'Data collection Procedure Report'. In some data collection formats, few columns have been retained for providing additional information about specific data attributes, but these columns are seldom used by the department while collecting and compiling the data. The Consultant shall rationalize all such fields.

In the GRMS database there are pre-defined area codes for all the department divisions for defining the access of the users belong to respective divisions. In this list of area codes, there are some divisions which are not in existence. Thus, The Consultant will finalize a list of area codes as per the existing and functioning divisions.

III. SOFTWARE, HARDWARE, USER ADMINISTRATION & SECURITY REQUIREMENTS

(a) Software Platform Requirements

GRMS was developed in compatibility with Windows- XP. With release of newer technologies and many new Microsoft OSs such as Windows 7, Windows 8 and Windows 10 upgrading GRMS has become inevitable. Therefore, R&BD has decided to do appropriate changes in the GRMS to make it web-GIS based, so that it can be used by any popular web browser compatible on any Operating System. The modules of GujRAMS will be used at R&BD HQ and in all field offices and few modules will be available for citizens. The main server running the application and database will be housed in the State Data Center (SDC) or as directed by R&BD. It will have a dedicated link (through extended LAN/leased line) to the P&PU at headquarters. The modules will be web-GIS based and will be hosted through a web server. These will be accessible to all field, regional, and HQ offices through a user ID and password. The user ID and password will also be used to authenticate the user for accessibility to various functions and levels of GujRAMS.

The data in GRMS is managed using SQL Server 2000 since the inception of GRMS. Now several upgrades of SQL Server and other options of RDBMS are available in the market including open source. Hence, consultant will explore and propose the best RDBMS to be employed considering the spatial and non-spatial data requirements and effective management including user/data security. R&BD will prefer open source databases, or a particular database if there is any potential advantage offered by it. Necessary table and data dictionary is required to be re-designed in the selected database to make it compatible with the available functionality in GujRAMS modules.

The required license of GIS software and GIS map server will be purchased by the Consultant and handed over to the client. If a desktop network editor is provided, at-least 2 nos. of license will be handed over the client. The licenses must also include AMC for 3-year support period, and allow upgrade incase a newer version is released. Consultant is encouraged to use any open source map server which allows free commercial use and no cost to R&BD in future. The Consultant will specify the cost of the license and versions of the GIS software.

(b) Web-GIS Interface Requirements

The system will enable view of existing data in spatial layers in different themes based on various road/bridge/culvert data and overlay external layers and maps with online satellite data services such as Google Map.

The software will have GIS capability to display the attribute data of roads in a user-configurable thematic map interface. It should have the following capabilities:

- Integrate road, culvert, bridge, R-o-W features, road safety and data stored in all the modules and display as layers in the Web-GIS
- GPS data integration (an interface to transfer data from external source/ equipment) and show on the GIS
- GIS map plotting/ thematic map preparation capability for the attributes of the road section and bridges as well as viewed in the GIS.
- The GIS interface should be able to query and display data along the length in a dynamically segmented section
- The GIS interface should be able to view background GIS data held in the client's GIS database
- The GIS interface should enable viewing of video/image data as stored or referenced, by the direction and chainage of the video lookup tables stored in the database

The GIS-based interface must have facility to overlay open-source map layers, and/or satellite imageries, and shared layers. There shall be no restriction on the number of layers that can be overlaid. The addition of layers must be user configurable and with appropriate access control

(c) Hardware Requirements

When GRMS started functioning for the first time in 2005-2006, database servers (database server, application server and backup server) were procured for the purpose of data transmission, analyses and storage. Now these servers are of out dated configurations, thus R&BD decided to enhance these servers with new servers of latest configurations and latest technologies, under buy back option of existing server. For purchasing the new server R&BD has made an agreement with Gujarat Informatics Limited (GIL). GIL will procure the server and make it available to the consultant. The server will be finally hosted at the State Data Centre (SDC) or NIC Data Centre after necessary testing/audit.

(d) Security and User Administration Requirements

The GujRAMSmust have a separate module for administration of the security and users. It should have following functions.

- (i) <u>Authentication</u>: The system will adopt Single Sign On (SSO) security system for authentication if in place in SDC with appropriate encryption level for user data. The consultant will make alternate arrangements to build own security module to create/manage users if the SSO facility is not available.
- (ii) <u>Authorization</u>: Following levels of user security management features must be present in the GujRAMS application:
 - User Management GujRAMS will request list of users through the Web interface to assign role and jurisdiction.
 - Role Management The system will define levels of system use (roles). This will allow grouping of select functions available in a module(s), and create roles for users. The functions must include separate mode for view only, and/or editing for all such functions and allow for assignment of role(s) to users.
- (iii) <u>Jurisdiction management:</u> The system will define (or add new) hierarchical jurisdiction of R&BD (subdivision, division, circle, districts), political jurisdictions (block, district, MLA/MP constituency etc.) or any other jurisdiction type as desired by R&BD in the future. Further, the system will allow to assign jurisdiction to a road or a part of the road for data reporting.

ANNEXURE C: DESCRIPTION OF WORKS MONITORING SYSTEM

The works monitoring system is developed for R&BD of Gujarat by NIC to monitor both Budgeted and Non Budgeted Works. The Budget and Work related entries are done at the R&B Secretariat and progress and expenditure related entries are done at the Circle and Division Level. This is a single integrated suite for R&B Civil Works of State, Panchayat and Capital Projects, machinery inventory and Quarters allocation and rent management. This application has the provision to maintain the quarterly returns of utilization of machinery and monthly demand and collection of Quarter's rent.



The site is functional since FY 2010-11 on the URL: http://rnbwms.guj.nic.in

Reports from the system are the basis for SE level review meetings and ministerial meetings. SOR is incorporated into the system. There is provision for rate finalization per year per division as per the existing norms. The application has been developed in PHP and PostgreSQL along with jQuery, PHPExcel and FPDF libraries. A customized forum based on PHPBB forum is incorporated for simple FAQs, Document Sharing and Knowledge Management between the offices.

The interoffice messaging is carried out electronically through the inbuilt messenger. WMS is a web based application.

Currently there are 151 different user account/IDs active in WMS.

The features of the application include:

- i. Provision to enter all Civil Work related parameters (Budget details, AA, TS, Tender, Work Order, Progress, etc.)
- ii. Integrated Contractors master (with provisions to view the total works per contract)
- iii. Adhoc reports can be prepared with the data exported either completely or selectively into standard excel work sheets
- iv. Notices to divisions, circles can be uploaded on to the system
- v. Generation of SE meeting agenda items
- vi. Provision to link work with assembly/loksabha constituency, department talukas, etc. thus making easy dissemination of pending works of any of the above classification
- vii. Application has the provision to maintain the inventory and quarterly returns of utilization of machinery and monthly demand and collection of quarters rent
- viii. Provision to enter the progress of the work both physically and financially along with the option to upload the site photographs
- ix. All activities of users are logged and complete audit trail is maintained and activities of subordinates can be reviewed by secretariat office
- x. Module for data transfer of new budget book
- xi. Facility to enter work wise estimate details
- xii. Facility to maintain records of extra/access and time limit approvals
- xiii. Facility for inputs from Architect and Design office
- xiv. Facility for other state departments to access the system for review of work
- xv. Provision to map works existing in WMS and maintain record history of WMS works
- xvi. SOR along with specifications of items are available through WMS

ANNEXURE D: DESCRIPTION OF ROAD MITRA MOBILE APPLICATION

The Work Tracking & Monitoring System-Road Mitra mobile application is developed for R&BD of Gujarat by BISAG (Bhaskaracharya Institute for Space Applications and Geo-Informatics).

GPS enabled application to upload a grievance of public along with photo.

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RoadMitra -Select-	
Tree falling	\odot
Pole falling	\odot
Structure Break	\odot
Break Road	\odot
Flooding	\odot
-Se Road Blockage	
Accident and Traffi	c Jam 💿
	Contract Select- Tree falling Pole falling Structure Break Break Road Flooding See Road Blockage En Accident and Traffi

It is functional on the URL: http://www.roadmitra.gujarat.gov.in/

Calibration of the HDM model focuses on the two primary components that determine the physical quantities, costs and benefits predicted for the analysis, namely:

- Road User Effects (RUE) comprised of vehicle operating costs (VOC), travel time, safety and emissions, and
- Road deterioration and works effects (RDWE) comprised of the deterioration of the pavement and the impact of maintenance activities on pavement condition and the future rate of pavement deterioration.

A Level 1 Calibration shall be done through desk study with collection of secondary data, the calibration should include Climate, Vehicle Operating Cost, Unit costs (RUE and RDWE), characteristics of representative vehicles, economic analysis data (discount rate and analysis period), pavement characteristics (RDWE) and traffic composition and growth rates. HDM often calls for a wide range of input data and calibration parameters. However, only the most important need to be established for with Level 1 calibration, and the HDM default values should be used almost exclusively.

A Level 2 Calibration uses direct measurements of local conditions to verify and adjust the predictive capability of the model. It requires a higher degree of data collection and precision than in a Level 1 calibration, and extends the scope. For RUE, it concentrates on speed, fuel consumption, tyre consumption, parts consumption and the fixed costs relating to utilization and vehicle life. For RDWE, it concentrates on the initiations of surface distress modes, rutting progression, and maintenance effects, and enhances the estimate of environmental impacts. For the economic analysis, it ties cost data more closely to observed cost and price levels through data collection surveys. Level 2 calibrations, require detailed input data collection than with Level 1.

A Level 3 calibration is generally comprised of two components:

- Improved data collection
- Fundamental research

Some data items can be estimated with reasonable accuracy using short-term counts, for example the hourly distribution of traffic volume, but the reliability is greatly enhanced by collection data over more Links over a longer period.

Fundamental research considers the relationships used in HDM. This consists of structured field surveys and experimental studies conducted under local conditions which lead to alternative relationships. For example, alternative functions may be developed for predicting fuel consumption or new pavement deterioration and maintenance effects functions for different pavement types. Such work requires a major commitment to good quality, well-structured field research and statistical analysis over a period of several years. Pavement deterioration research is a particularly long-term endeavor, typically requiring a minimum of 5 years.

ANNEXURE F: TRAINING REQUIREMENTS

The prepared training material shall be framed in a systematic manner to facilitate user access. All such material should be in simple English with clear audio in Indian accent. It should include some sample exercises for any necessary topics such as location referencing coding using a paper map. A separate list of distress parameters used in different GujRAMS modules shall be prepared & explained with related photographs/drawings showing the extent of distress. The material shall include at a minimum the following:

- Objective of GujRAMS
- System Installation and Maintenance
- GujRAMS Registration / De-registration
- Creation of User IDs, assigning roles, responsibilities
- Location referencing concepts & preparation of location referencing
- Data collection requirements, methods, formats
- Data validation, verification, and import in GujRAMS
- Adding GIS layers in GujRAMS -GIS
- Preparation of Thematic Maps
- Data Processing
- Preparation of standard reports in each GujRAMS module
- Use and concepts behind preparation of Decision Tree
- Generating Annual Work Programme (AWP)
- Preparation and Export of network files for HDM-IV uses
- Import of network Data in HDM-IV
- Location Reference Maintenance
- Data Aggregation

The Consultant shall prepare One hundred (100) copies of the approved material in CD/DVD format and submit them to R&BD.