Terms of Reference

Punjab Sustainable Highway Development Project / Punjab Arterial Roads Improvement Program PSHDP/CQS/CS-3

For

Consultancy Services for Real Time Monitoring Portal Development and Its Maintenance

1. TERMS OF REFERENCE

1.1. Context

1.1.1. Project Management Unit (PMU), C&W Department is seeking an experienced consulting firm or consortium of firms in Pakistan to support C&W Punjab in development of a Roads Construction Physical and Financial Monitoring Dashboard.

1.1.2. The Project Management Unit (PMU), C&W Department has the mandate to monitor the development of roads. In this context the physical progress of development of construction schemes on a regular basis is desired. Information on physical progress of selected road development projects is periodically obtained from executing agencies. Tracking progress against specifically defined milestones for the entire developmenFt portfolio, enhancing verifiability and accuracy of the monitoring reports, assessing quality of construction on a regular and cost effective basis.

1.1.3. The Project Management Unit (PMU), C&W Department collects information on financial and physical progress of the projects/ schemes through field visits and submits report containing its observations, findings and recommendations to the C&W and head of concerned wing. The quality of information of monitoring reports could be enhanced through use of ICT such as geo tagging; use of smartphone for capturing pictures of civil works, plants, machinery and equipment; and tracking of monitoring staff. More precisely, the quality of monitoring reports produced by Project Management Unit (PMU), C&W Department can be improved by introducing following missing characteristics/elements:

- **Online accessibility and usability** of monitoring reports by line departments
- **Monitoring quality of construction** of the development portfolio
- **Monitoring Process flow of Communication** among various tiers of Consultants and Contractors
- **Capturing the location (GPS coordinates)** of the monitored scheme
- **Capturing precise Elevation using D-GPS** of the monitored scheme
- **Tracking of monitors as an evidence of their physical** visits to enhance validity of monitoring reports

1.1.4 In order to improve monitoring of the overall portfolio, it is envisaged to develop a web-based system (of physical and financial progress) on a single platform.

The common performance indicators and milestones will be developed by the consultant firm which will also impart necessary training to the officials of executive and implementing agencies for entering information against the common performance indicators and specific milestones of the projects.

1.2. Objective(s)

1.2.1 Development/ Procurement of turnkey technology services to deploy and maintain **an integrated solution that enables enhanced reporting, analysis and visualization for managing the Project roads development.** The solution will have following key components –

- Mobile Application for Project Management Unit (PMU), C&WD and executing agency staff for reporting and geo-tagging the filed activity along with recording DGPS elevation
- Development of Monitoring Dashboard for presenting overall work progress reporting
- Mobile application for work quality verifications and performing filed tests
- System to manage and monitor the financial progress of the development project
- System to manage online "Check Request" process from initiation to approval with time stamping.

1.2.2 **Objective of Mobile Application**: Mobile application will be developed for collection of data by field monitors and allow Project Management Unit (PMU), C&WD field monitors to digitally record and submit key information on a real time basis.

The application will allow the field monitors to geo-tag schemes, record pictures to report physical progress, report on any issues/obstacles, and report on financial outlays and overall progress (good, satisfactory or poor). Due to the limited availability of the Internet in the filed the mobile application must be able to work in offline mode. The mobile application will have the feature to record the DGPS readings (elevation, latitude, longitude) during survey along with its GPS parameters (Latitude, Longitude, Altitude). Only registered users in the system will be able to conduct surveys.

1.2.3 **Objective of the Dashboard**: The dashboard will provide a real-time holistic view of the development portfolio by reporting on: a) Monitoring of Project construction b) Project profile of each lot of road with defined milestones (to be developed by consultant) c) Portfolio, sector, district or road/ lot level progress against milestones which will be updated by Construction Supervision Team at a defined frequency and against financial targets; d) Project Management Unit (PMU), C&W Department monitoring reports

The Dashboard will have the following key features:

- *Integration of data sources*– The dashboard will integrate data from different sources which include (i) project profile of each lot with unique ID, (ii) progress on project implementation (financial and physical) updated by implementing agency/ Supervisory Team , (iv) in-field monitoring.
- *Spatial data visualization of the development portfolio*. Data visualization should be available in Grids, Charts, and Gauges with data filters on all data fields with selectable and dynamic report column generation based on selection of headers.
- *One click + real time access to information on the web through a simple log in.*
- *Accessibility on smartphones and/or tablets.*
- *Attractive, informative and user friendly based on HCI design heuristics.*

1.3. Scope of Work

1.3.1 The firm is expected to perform the following core activities during the course of this:

a) Demarcation of boundaries of geographical divisions of Punjab where the Project roads are monitored.

i. The firm will establish at least 2 permanent benchmarks at every project corridor having very accurate location and height.
ii. Geographical boundaries of project roads will further be transferred using accurate system using D-GPS.

b) Requirements Analysis:
   i. The firm will conduct a thorough needs assessment by conducting detailed stakeholder consultations, system reviews and analysis of existing reporting practices to develop scope and requirements, documents to map process flows, define data requirements and reporting formats, develop common performance indicators and specific milestones for monitoring of physical progress and quality control monitoring of development projects/ schemes.
   ii. The firm should produce a scope document that translates these into system requirements for development of the Mobile application and the monitoring/reporting dashboard. The scope document will contain application wireframes, system flows, forms, report templates and dashboard mock-ups.

c) Development/Customization of Mobile Application:
   i. The firm will develop an android application for the Project Management Unit (PMU), C&WD field monitoring form either by developing a customized application or through an open source platform. The application should be dynamic enough to cater to all the requirements of the Implementing Agency.
   ii. The basic functionality required by the application is as follows:
      - Take Videos from Drones and Cameras
      - Take pictures
      - Record geo-location by Mobile Application
      - Record DGPS based Elevation and Location
      - Record date and time stamps
      - Be able to enter data with various types of fields like text, numeric, drop downs, radio buttons etc.
      - Capture data and work in both online and offline modes if connectivity is not available.

d) Development of Monitoring/Reporting Dashboard:

   (i) The firm is expected to draw on the requirement analysis to develop a web-based dashboard.

   (ii) The firm is expected to draw from and **integrate multiple data** sources to fulfill the reporting requirements: project profile of each lot of the project with unique ID, milestones, risks and financial targets; data received from the mobile application used by the Project Management Unit (PMU), C&WD, Consultants and the Engineer. Data recorded on financial progress for each lot of the project; reports on physical progress against milestones updated by implementing agency; construction quality reports for each lot of the project.

e) Check Request Management System:
- App will be able to and give access to the contractor to upload their check request number wise, RD wise, layer wise and material wise for all material / finished items in accordance with BOQ.
- Similarly, the consultant will be able to upload the action taken against each check request individually and upload the supporting material like reports, summary levels and other pictorial evidences in support of consultant determination / pass / fail results.

- App will be capable to summarize the pass check requests and indicate the missing RDs, lane and layers. The result / summary will be reflected in tabular form as well as in bar chart form showing the check request number, date, material or finished item as indicated in the BOQ, layers / thickness of material, width / lane number, Location / RD.

f) Contractor Submittals and their Disposal:

- App will enable contractor to upload its submittals regarding approval of shop drawings, request for approval of quarry, disposal of unsuitable or dismantle material, EoT, variation in quantities, emergency event leading to variation or EoT, accident on project site.

g) Inspection Report of Engineer / Consultant:

- App will enable to consultant to upload its site visit, date wise, instruction related to bad work / substandard work, EHS status, gender biasedness etc and contractor compliance report and subsequently acceptance by the Engineer.

h) Instruction of Implementing Agency:

- App will enable to PMU, C&WD to incorporate its comments on Engineer's discussion / recommendations for disposal of contractor submittals, contractor's check request, contractor invoices and directly comments on contractor submittals etc.

Note that each stakeholder will have a specific role in the development, operation and maintenance of the dashboard. PMU of **Communication and Works department** will work with the consultant to provide scheme profiles which the consultant will develop further by defining generic milestones; **Implementing agency/ Consultants** will update each lot profile with risks and financial targets and provide periodic progress against related milestones and timelines.

The firm must carefully **define unique identifiers** for each lot, type of contract and clearly specify how analysis will be carried forward across years given

N.B: Currently schemes are not uniquely identified (by numbers) across years. Each scheme is however assigned a unique name. This exercise is to be done in collaboration with Project Management Unit (PMU), C&WD.

(i) The firm is expected to produce a fully completed online dashboard for selected stake holders over the course of 04 months (during the requirements analysis stage, the firm will **define generic milestones** for each lot/ type of the project contract against which physical progress can be measured for each related stakeholder only)

(ii) The dashboard will have the following features:

- Data input/upload modules that cater to the respective roles assigned to various sub-departments/wings. Inputs should be enabled through web based forms. Uploads should allow users to enter data by uploading pre-specified formats and columns through text, excel or csv files.
- Should be able to allow creation of more dashboards through assigning user roles by logins and passwords.
- Online interface aggregating different reports with multiple indicators accessible through user logins
- Access controls to allow data entry, uploading files, submitting inputs, administrative and viewing rights to various management tiers

- Tabs to allow access to different reports with granularity linked to reported data – Province, District, Sector, Project, Staff Member etc.
- Storage of all raw data in tables as per the required reporting formats
- Visualizations to show data in aggregated tables, charts/graphs (pie, bar, line, stacked etc) and integration with Google maps to show location based data details
- Rule based visualization indices creating color coding based on data range definitions (e.g. Red below X%, yellow below Y%, green above Z% etc.) integrated with graphs and maps
- Heat maps based on rules applied to data values/ranges
- Aggregation options to report data/indicators over customizable time windows
- Options to export raw data in standardized formats like MS Excel / CSV
- Conversion of dashboard reports to PDF documents maintaining visual and data formats
- Email functionality to auto generate reports and mail PDF documents to defined circulation lists

e) Deployment of Servers, Databases and Back-end Services:

a. The firm is expected to setup and deploy servers hosting the back-end architecture (web services and database etc.) to receive, store, sort, use and archive data ensuring 99% uptime and complete data backup ensuring security features of data.

b. The firm is also expected to deploy servers/back-end infrastructure and technology platforms to host and manage the data coming in from various systems, uploaded by users and analytics created for the dashboard.

f) Capacity Building of Project Management Unit (PMU), C&W Department and Executive Agencies

i. The firm will conduct trainings comprising of workshops and hands-on trainings on usage of mobile application for field officers and dashboard management for all implementing stakeholders.

ii. The training will involve Project Management Unit (PMU), C&W Department for using mobile application and geo tagging of schemes and executive agencies for entering/updating project related information on the dashboard though online login and any other staff that requires training.

iii. The firm is also expected to develop a training manual with step-by-step description and system/application screenshots for future reference of new staff coming on board.

i. Support and Maintenance:

The firm is expected to provide complete support and trouble-shooting for the deployed application, servers and dashboards to remove all bugs and ensure stability.

2. METHODOLOGY

i. The firm is expected to work in close liaison with Project Management Unit (PMU), C&W Department, all concerned executive agencies, to understand requirements, discuss proposed solutions and carry out extensive quality assurance for deliverables. The firm is also required to make frequent visits to the respective offices to conduct meetings and discussions for inputs and review as and when required.

3. DELIVERABLES

3.1 Deliverables from this assignment are as follows:

(i) Demarcation of boundaries
(ii) Scope Document: Should include a complete report on requirements/needs analysis including but not limited to reporting requirements of all stakeholders involved including other data sources, wireframes of mobile application for Project Management Unit (PMU), C&W Department, reporting formats and flows for the monitoring/reporting dashboard, defined generic milestones for each scheme type.

(iii) Development of Mobile Application as per requirements of Project Management Unit (PMU), C&WD.

(iv) Development of Dashboard.

(v) Deployment of Server Application hoisting back end architecture and also deploy servers/back end infrastructure as desired in the scope of work.

(vi) Training Workshops: Training of all stakeholders for smartphone monitoring and dashboard usage for 4 different departments Support and Maintenance for the term of the project. On-going training and refresher trainings to be provided as and when needed.

(vii) Handing over of all source code documentation and transfer of knowledge to the IT team of Project Management Unit (PMU), C&W.

(viii) Providing complete support and maintenance of the systems as specified in the scope of work.

4. TIMING AND INPUTS

The contract will be for duration of 43 months starting date.
Expected Start of Project: August, 2022

5. DELIVERABLES WITH TIME LINES AND PAYMENTS SCHEDULE

Deliverables	Activities/Methodology	Time Line	Payment Schedule
System design document	Stakeholder Consultations	1.50 Months	10%
	Development of report templates and mock-ups		
	Document review and finalization		
Constituency boundaries	Maps collection		
	Digitization of boundaries		
Hardware deployment	Maps collection	2.50 Months	15%
	Digitization of boundaries		
System development and deployment	Database design and development		
	Mobile application development		
	Web based dashboard development		
Staff training	Training to staff on android application	1 Month	11 %
	Training to staff on dashboard		
Support and Maintenance	Support and maintenance of servers, dashboards, hosting etc. and telephonic support to field users throughout the term of the project	36 Months	1.50% Per Month
Completion Report and handover software to the Client		2 Months	10%
		Total:	**100%**

COORDINATION

The project shall require coordination of all involved authorities', departments; stakeholders; clients with the consultant of Monitoring Dashboard. The consultant shall be provided with timely updates, responses and comments from all involved. Coordinator shall be appointed by the Project Management Unit (PMU), C&W Department.

6. TEAM COMPOSITION

Team for the development of Monitoring Dashboard will be composed of experts as well as key officials of Department. The consulting firm must be a multi-disciplinary team of professionals and technical personnel. The firm must have the capacity to use different analytical techniques and software; and must demonstrate past experience developing this type of dashboard. The consulting firms with presence in Pakistan and Lahore will be preferred. In all positions, higher qualifications and experience would be preferred. Below is the tentative team composition but is not limited only to

the given expertise as this project must be flexible enough to accommodate any expertise as per requirement:

Personnel Description	Working Hours (Months)**
Software/Database Development Team	
1. Team Lead - IT & GIS Development	4
2. Software/Database Developer	4
3. GIS Developer	4
4. Android Developer	4
5. Web Developer	4
6. Staff Training	1
Operation & Maintenance of Software / Database Team	
1. Team Lead / Coordinator	36
2. Android Developer (Intermittent Period)	12
3. Database Administrator (Intermittent Period)	12
4. Survey / QA Engineer	36

POSITIONS BASED ON TERMS OF REFERENCE AND QUALIFICATIONS:

KEY EXPERTS

Sr. No.	Positions	Minimum Qualification & Experience
	Software/Database Development Team	
1	Team Lead - IT & GIS Development	Ph.D. (HEC accredited degree) or Masters (18 years of Education) in Computer Science, IT or relevant areas. At least 10 Years of Experience in case of PhD, or 16 Years' Experience in case of MS. • Experience to manage the large-scale of IT projects with their application for process automation and monitoring. • Experience in working with GIS application Development. • Must be able to lead and support/guide the team to accomplish the technical tasks.
2	Software/Database Developer	16/18 years of education in Information and Communication Technology/CS, IT, Software Engineering, GIS, or related discipline from HEC recognized/accredited university. • 08 years of experience with 16 years of qualification or at least 06 years of experience with 18 years of qualification of Software development and databases. .

Sr. No.	Positions	Minimum Qualification & Experience
		• Experience to handle the large-scale and spatial data and analysis Projects. • Must be able to support/guide the junior team members to accomplish the GIS related analysis, development, scripting tasks. • Developing database structures and features according to organizational needs. • Supervising, and maintaining databases. • Protecting data by developing data security and restoration policies, procedures, and controls. • Developing procedures to ensure data integrity and quality. • Expert in implementation of algorithms and can guide the team in respective tasks. • Perform any task as assigned by the lead.
3	GIS Developer	16 years of education in Computer Science, IT, Software Engineering, GIS or related discipline from HEC recognized university. At least 2 Years of Experience • Experience of designing, developing and managing large scale spatial databases. • Performing spatial analysis using the Post GIS extension. • Spatial software development. • Researching, designing, developing GIS applications/dashboards. • Testing and evaluating new applications/software. • Identifying areas for modification in existing programs and subsequently developing these modifications. • Writing and implementing efficient code and scripts. • Spatial Analysis dashboards development. • On demand generation of different spatial reports, Monitor and maintain database performance, Experience of Database performance tuning. • Must have knowledge of PostgreSQL, Post GIS and Oracle Spatial. • Perform any task as assigned by the lead.
4	Android Developer	16 years of education in Computer Science, IT, GIS or related discipline from HEC recognized university. At least 2 Years of Experience. • Designing, developing, debugging Android applications and web services. • Testing, debugging and evaluating applications. • Identifying areas for modification in existing applications and developing these modifications • Maintaining and upgrading existing applications • Training users.

Sr. No.	Positions	Minimum Qualification & Experience
		• Performing different assignments and developments as assigned by the task lead, Manager.
	Web Developer	16 years of education in Computer Science, IT, Software Engineering, GIS or related discipline from HEC recognized university. At least 2 Years of Experience. • Solid knowledge and experience in programming applications. • Proficient in My SQL. • Top-notch programming skills and in-depth knowledge of modern HTML/CSS. • Familiarity with at least one of the following programming languages: PHP, ASP.NET, JavaScript or Ruby on Rails. • A solid understanding of how web applications work including security, session management, and best development practices. • Adequate knowledge of relational database systems, Object Oriented Programming and web application development.
	Operation & Maintenance of Software / Database Team	
	Team Lead / Coordinator	16 years of education in Computer Science, IT, Software Engineering GIS, Civil Engineering or related discipline from HEC recognized university. At least 5 Years of Experience. • Must have to manage all project activities after TL and maintenance of the system. • Must have core knowledge and experience of IT and GIS projects. • Experience to handle the large-scale GIS development Projects. • Experience of spatial database design, development and management • Must be able to support/guide the junior team members to accomplish the GIS/and Software Development related analysis, development, scripting tasks. • Can train and guide the team for data preparation and analysis.
	Android Administrator (Intermittent Period)	16 years of education in Computer Science, IT, GIS or related discipline from HEC recognized university. At least 2 Years of Experience. • Designing, developing, debugging Android applications and web services. • Testing, debugging and evaluating applications.

Sr. No.	Positions	Minimum Qualification & Experience
		• Identifying areas for modification in existing applications and developing these modifications • Maintaining and upgrading existing applications • Training users. • Performing different assignments and developments as assigned by the task lead, Manager.
	Database Administrator (Intermittent Period)	16 years of education in Computer Science, IT, Software Engineering GIS or related discipline from HEC recognized university. At least 3 Years of Experience. • Experience building appropriate data models and designing tables to effectively support large data volumes. • Ability to troubleshoot and tune database configurations, ETL processes and SQL code for optimal performance. • Development and maintenance of effective Database • Database queries, trigger function. • Development and maintenance of REST based Web Dashboards. • Integration of Multiple Databases. • System Design and Analysis. • Provide data management support to users • Ensure all database programs meet company and performance requirements. • Research and suggest new database products, services and protocols.