

**CONDUCT PILOT CONSTRUCTION QUALITY MONITORING IN TWO DISTRICTS**  
**TERMS OF REFERENCE**  
**SINDH PUBLIC SECTOR MANAGEMENT REFORM PROGRAMME (SPSMRP)**

## **Background**

Poor governance in construction of public facilities, like school buildings, roads, or health units, is a considerable development concern. Construction is a major sector in terms of financial outlay of a government, and is responsible for the development of infrastructure capital that is central to growth, citizen services and improved quality of life. Therefore, monitoring of construction projects is a core governance task which must be performed at an optimal level to ensure quality service to citizens and minimum leakages in public sector finance. In order to monitor quality of construction for various schemes, the Government of Sindh through its Monitoring & Evaluation Cell at Planning & Development Department, wishes to utilize the research conducted by Lahore University of Management Sciences (LUMS), which aims to improve the construction quality through effective remote picture and video-taking protocols. The details are defined in the terms of reference below

2. Monitoring a multitude of projects through site visits is not a simple task. **The Monitoring and Evaluation Cell (MEC)** within the P&D department has the mandate to monitor an average covers between 30-50% of the ADP besides other directive schemes. This information is collected against a format which aims to collect qualitative information against a set of identified parameters. MEC presently has 22 field monitoring officers in two regional offices (and will be doubled in the financial year 2016-17 with 4 regional offices) spread across various sectors of the ADP portfolio. These field monitors are assigned a monthly schedule to monitor a set of schemes each month as identified by the Director General of the MEC cell. They furnish monitoring reports as per the MEC monitoring report formats and upload PDF versions of the report on a digital system. The reports can be viewed online by the finance and line departments and access to them are being provided through department specific accounts. Though these reports are useful in their own rights, they currently have the following limitations:

- i. Online accessibility and usability of monitoring reports by line departments;
- ii. ***Monitoring quality of construction of the development portfolio;***
- iii. Capturing the location (GPS coordinates) of the monitored scheme;
- iv. Tracking of monitors as an evidence of their physical visits to enhance validity of monitoring reports;
- v. Obtaining Feedback from “beneficiaries” or citizens of randomly selected schemes.

3. For certain important projects (especially donor-funded projects), Government or donors create and appoint specific teams to monitor progress. In donor-funded projects, donor requirements often dictate more rigorous monitoring in which case **external consultants** are hired to do the job. These monitoring activities generate lessons on monitoring methods but are more often than not too specialized and costly to be applied across the portfolio, especially for scattered small schemes. For big projects, it is mandatory to allocate one percent of the cost of a scheme for third party monitoring.

4. MEC collects information on construction quality through field monitoring by its domain expert engineers/ monitoring officers. In addition to the MEC which is an

external monitoring body, information on physical progress is also periodically collected by **executing or sponsoring agencies**, though there is no set requirement, process or monitoring format against which this activity is carried out. There is significant variation in how executing or sponsoring agencies decide to monitor their schemes across all departments and specifically in the case of Works and Services, across individual Assistant Engineers (AEs) who operate at the scheme level.

5. The MEC cell has initiated a smartphone based monitoring pilot that aims to address some of the gaps identified above. The pilot provides real time information on certain key indicators of financial and physical progress in addition to geo-tagged location of each site. Though this pilot will make a range of spatial analyses across financial and physical progress indicators possible, construction of quality will be difficult to gauge through this process and will continue to be a challenge to monitor. The government will still have to rely on third-party validators to fill this important gap – monitoring of construction quality of small civil schemes where monitoring is costly and infrequent.

### **Proposed Project Design**

6. This project intends to explore simple cost effective methods through which current auditing and monitoring capabilities of the government can be extended to improve existing construction quality.

7. The project involves capturing geo-tagged construction information along the guidelines of a carefully developed picture (or video) – taking protocol by field-based staff, third-party assessors, or citizens. This information can be collected via smartphones (or tablets) that will subsequently be submitted to an online server through GPRS or a Wi-Fi connection. The submitted information will be made available to expert auditors/engineers at the back-end through an online interface that will allow visual inspection of data spatially and temporally for an assessment of quality of construction. Research/construction experts will devise the picture-taking protocol such that the pictures provide adequate information for assessment of quality<sup>1</sup>. This method, though not as technically intensive, will provide consistent and regular quality updates on quality within a limited budget requirement. Moreover, the picture taking and quality assessment protocol can be iterated over time on the basis of acquired experience to make it more effective.

8. Once the project is implemented<sup>2</sup>, the regular field activity will require:

- a) Two-Three field-based staff at the district level responsible for data collection and;
- b) Two expert auditors placed in a central location tasked with assessment of quality based on the collected data.

9. The field-based agents will not require any specific technical expertise but will have to be thoroughly trained in the picture taking protocol. The Government of Sindh will provide a monitoring schedule every month that will list all construction sites in the district which need to be monitored as per the protocol with sufficient detail for effective monitoring to take place. All collected information will be submitted to an online server through the smartphone. This information will be

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<sup>1</sup> Preliminary research on this picture taking protocol has been carried out by the Technology for Peoples' Initiative (TPI) at LUMS.

<sup>2</sup> Implementation requirements.

accessible to expert auditors (placed centrally) in real time and will be analyzed on a regular basis. Relevant reports will be produced by the auditors and shared with management at the district, provincial level and departmental level. These reports will also be made available through an online dashboard. The diagram below summarizes the information flow:



10. Researchers at the World Bank Research Department will be working with the project to evaluate the impact of the intervention. The evaluation will experiment with the dissemination of information collected by the program.

11. The project will initially focus on schemes that are high frequency and executed by mid or low-level contractors. These include:

1. **Government buildings (small school buildings or small health units)**
2. **Small roads/soiling projects such as farm to market roads or water course cementing and other construction in rural areas such as open drains.**
3. **Both new projects and repair/maintenance of existing ones can be monitored.**

N.B: Based on preliminary field-visits and research, these kinds of projects are likely to have the most cases of sub-standard quality. Larger projects have higher visibility and a different socio-economic-political context.

12. It is proposed that the initial pilot be carried out in two districts including Hyderabad and Naushehro Feroze and cover the 'Rural Development Department', Public Health Engineering Department, Works & Services Department, Local Government Department and Agriculture Department in the current Provincial ADP. Only schemes under a value of PKR 80 m will be considered. The protocol must be initially piloted on at least 150 schemes in each district across the three scheme types mentioned above.

13. The districts and departments for pilot extension will be identified in the 9<sup>th</sup> month of the project. The total scheme volume will be 700. Projects should be monitored multiple times throughout implementation..

N.B: Note that the scheme volume for piloting is determined by the fact that the firm will be required to hire 3 field-based officers. On average, each field officer would be able to record data on at least 5 schemes on the daily basis. This implies that in merely a month, 3 field officers should be able to monitor around 189 schemes to the very least.

## Scope of Work

14. The firm/consortium will be required to:
  - i. Procure 6 Android smartphones/tablets and network GPRS connections for the contractor to be distributed to field users. The devices should have the following bare minimum set of features:
    - a. 5 MP camera or better
    - b. 4.5” or higher screen size
    - c. Android OS Lollipop
    - d. 1 GHz processor
    - e. 2 GB RAM and 16 MB or higher memory card
  - ii. Requirements & Design:
    - a. In close collaboration with government counterparts and the World Bank research team, develop a construction monitoring protocol (what kind of photo/s or video/s need to be taken at what stage of project execution) for the small schemes of Rural Development Department, Public Health Engineering Department, Works and Services Department, Local Government Department and Agriculture Department – (a) small school and health buildings (SDO Buildings), (b) construction and rehabilitation of small roads such as farm to market roads (SDO roads), (c) soling and water course cementing open drains (ADLG), (d) water course rehabilitation/cementing (OFWM Wing, Agriculture department) which can be tested on the ground. Please note, the existing research protocol in Annex A can be used as a basis for further refinement of the protocol. The protocol must be developed through a combination of desk-based research and in-field visits of the different project types.
    - b. Carry out a complete mapping, detail, potential strengths and weaknesses, after matching with the detailed design documents, of the nature of analysis against each picture required in each of the protocols. This should include the production of scoring/rating for each stage of construction with relevant construction quality variables for each of the protocols.
    - c. Consolidate all requirements gathered, development of protocol for each project type, categories recommended and scorecards in a **‘scoping document’** and share with relevant stakeholders for approval.
    - d. Test each of the developed protocols in the field (before the pilot roll-out) and share reports from these tests with all identified project stakeholders. Provide a detailed assessment of the test including feedback from stakeholders, suggestions for improving the design, along with the relevant construction quality analysis resulting from the protocol.
    - e. Supplement the document produced in (e) with a proposed design and technical specifications’ document of the smartphone application through which data against the protocols will be collected, server,

dashboard and any other components of the solution to be developed by the firm/consortium to meet the client's requirements as per this contract.

- f. Work with the contractors on ADP monitoring dashboard to integrate the dashboard solution and its requirements (such as unique ID).

iii. Development:

- a. Develop an Android smartphone application to collect and transmit geo-tagged and time stamped high-resolution images (DSLR-level) of development schemes. The application should:
  - i. Have safeguards to ensure data security in storage on and transmission from the mobile device
  - ii. Be compatible and stable across all recent versions of the Android OS & iOS, with backwards compatibility.
  - iii. Be designed, such that the user-experience and user-interface is in-line with the existing business processes and the finalized protocol (annexure), requires minimum overhead to record and transmit information (picture and location) and takes into account the capability of the end-user
  - iv. Transmit data at almost real-time
  - v. Have a backend memory management component that clears the application's non-essential data from the phone after usage, so as to not take up too much space in the user's device over time
  - vi. Store the data in the memory space if the transmission medium is not readily available. Also able to transmit the data to the server automatically (or manually through some interface button) as soon as the data connection is available.
  - vii. Process and transmit high quality/resolution images safely, with minimal loss of picture quality
  - viii. Be able to send users rewards for the successful submission of monitoring reports
- b. Develop a web-based dashboard, that has the following features:
  - i. It is secure, i.e. is not susceptible to malicious attacks, viruses, hacks or any sort of data manipulation
  - ii. Designed keeping the requirements and usage of auditors in mind
  - iii. Flows such that it allows auditors to sequence and compare relevant pictures arranged structurally across time.
  - iv. Provides auditors the ability to score and comment on any data-point that is viewable to them on the online dashboard
  - v. Develop scorecards agreed on in the requirements phase
  - vi. Develop provincial, district and sub-district level reports of various different types of developmental schemes, based on the requirements of the contractor

- vii. Display a map-view using geo-tagged data gathered from the field
  - viii. Allows for monitoring data to be fully downloaded in csv, xls or similar format.
- c. Conduct extensive quality assurance that:
- i. Ensures that the application runs smoothly across different Android devices
  - ii. Verifies that mobile GPRS coverage of the relevant network operator is sufficient for the pilot areas identified
  - iii. Processing time for the smartphone application is at a bare minimum, e.g. tagging location should not take too much time, the device should not hang or respond slowly to the application etc.
- iv. Pilot Rollout:
- a. Hire field-based staff and auditors to carry out an initial pilot in Hyderabad and Naushehro Feroze covering 350 schemes over 2 months.
  - b. Develop a hiring and training plan that outlines the strategy on how the firm (or consortium) intends to hire and train field-based staff and auditors and at what frequency.
  - c. Develop a training manual that is user-friendly and carefully outlines the picture taking protocol, construction projects to which it is applicable, the nature of analysis against each picture and a detailed guideline on how to use the scorecard.
  - d. Conduct training workshops for:
    - i. The field-based staff that practically takes them through the picture-taking protocol. In addition to sessions in the class room, the workshops to involve 3 practice sessions and one test session in the field. Supplement the training of the protocol with a training in the use of the smartphone application as well.
    - ii. The back-end auditors that explains the technical grounding behind the protocol, the suggested analysis against each picture and the development of the scorecard. Conduct dashboard/analytical trainings for auditors assigned to use the system
  - e. Share pilot reports with relevant stakeholders and carefully monitor project progress
  - f. Provide a report on the Pilot Roll-out along with suggested improvements.
  - g. Pilot Extension: After incorporating improvements suggested in the pilot report, roll-out pilot extension across 700 schemes.
  - h. Provide technical support for the system for up to 6 months after all trainings are provided

## Methodology

15. The firm is expected to work in close liaison with MEC, P&DD and ERU, Finance representatives 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.

16. The firm will also work in close collaboration with the joint World Bank and Government of Sindh research team at all stages of the project, allowing for a successful evaluation of the scheme.

## Deliverables

17. Deliverables from this assignment are as follows:

- I. Scoping Document: This will be a consolidated report on requirements gathered, protocols developed and an analysis plan for each of the protocols.
- II. In-field pre-pilot test of protocols: A report on at least 3 in-field pilots of each of the protocols and the related construction quality analysis
- III. Setting up of server, deployment of Native App Aggregate and Development of Form through Native Application for data collection as per the protocols and procurement of phones.
- IV. Development of Web-based Dashboard in two Phases. Phase I will involve a wireframe of the dashboard which should demonstrate:
  - how auditors will use the dashboard to make quality assessments and;
  - how quality rankings will be displayed. This part of the dashboard will be integrated with the wider ADP dashboard of the Sindh Government.Phase II will involve the development of the dashboard.
- V. Training Workshops: Training of Field Staff and auditors for monitoring construction quality in a selected district. Development of training manual.
- VI. Pilot Rollout covering 350 schemes of concerned departments (ref: Term No.11 & 12) across districts Hyderabad and Naushero Feroz.
- VII. A report on pilot with suggested improvements.
- VIII. Pilot Extension across 700 schemes of concerned department across districts Hyderabad and Naushero Feroz.
- IX. Support and Maintenance for the term of the project.
- X. All monitoring data should be made available to the research team in csv, xls or similar format.

## Timing and Inputs

Expected Start of Project: January 2017

Term of Project: 12 months from start of project

Deliverables / Month (after contract signing)	1	2	3	4	5	6	7	8	9	10	11	12
Scope Document												
Deployment of Native Application on Phones and Setting up Server, DB, Aggregate												
Testing of the Protocol												
Training of Field Staff, Training Manual												
Dashboard Phase I												
Dashboard Phase II												
Support and Maintenance												
Pilot Rollout (350 schemes)												
Pilot Report & further refinement												
Pilot Extension (700 schemes)												
Training for Other Staff												

## Deliverables, activities, days and payment

Deliverables	Activities/Methodology	Payment schedule
1. Scope Document	Including complete documentation of requirements gathered, protocols developed and the related quality analysis based on the protocols.	10%
2. Deployment of Data Collection System through Native Application	Server deployment	15%
	Native Application aggregate setup	
	Construction Quality Monitoring form development on Native Application	
	Installation of mobile application on phones and setting up of forms	
	Testing of forms and data collection through aggregate	
3. Development of Training Manual and workshops for field staff	Development, review and finalization of training manual with screen shots	10%
	Training workshops in a selected district	
4. Dashboard Phase-I	Develop auditor assessment interface	10%
	Develop Construction Quality rankings and a plan for how this will be integrated with the wider ADP dashboard	
5. Dashboard Phase-II	Complete functionality as per scope of work	15%
i. Pilot Roll out	Roll out initial pilot covering 350 schemes of concerned departments across Districts Hyderabad and Naushero Feroz.	15%



ii. Roll out Pilot Extension	Around 700 schemes of concerned departments across districts Hyderabad and Naushero Feroz.	20%
6. Support and Maintenance	Support and maintenance of servers, dashboards, hosting etc. and telephonic support to field users throughout the term of the project	5% (split into monthly payments)