Award Specific Form

VII.NAME OF CATEGORY- ''INNOVATIVE USE OF MOBILE TECHNOLOGY IN e-GOVERNANCE'

1. Coverage – Geographical and Demographic

(i) Comprehensiveness of reach of delivery centers,
The Government of Karnataka under the aegis of **Project Implementation Unit, State Highway Development Project (PIU-SHDP),** Public Works, Ports and Inland Water Transport Department is taking up improvements and Upgradation of State Highways as a part of Improvements to Core Road Network in the State of Karnataka.

The scheme is being implemented in Two Phases comprising of improvements to Core Road Network of 7469 km at a cost of INR 2938 Crore. Further, the projects are being procured under various Packages on tender basis on e-procurement platform under the e-governance cell. The scheme is time bound and programmed to be completed within two years.

Number of Packages	136 Packages (Phase 1 – 66 packages, Phase 2 – 70 packages)
Total Length of Road under improvement	7469 Km (Phase 1 – 3724 Km, Phase 2 -3745 Km)
Cost of Project in INR	2938 Crore (Phase 1:1439 Crore, Phase 2:1499 Crore)
Dedicated SHDP Staff	Engineers – 28, Accounts – 7, Establishment-6
Number of Circles/ Divisions	9 Circles (Dharwad, Belgaum, Bellary, Gulbarga, Shimoga, Hassan, Mysore, Mangalore, Bangalore) / 40 Divisions
Number of PMCs& Contractors	7 PMCs 60 Contractors

For administrative purpose each district has minimum one division headed by Executive Engineer and each taluk has one subdivision headed by Assistant Executive Engineer. So each subdivision acts as delivery centers.

(ii) Number of delivery centers

Theproject is spread across **30 districts covering 175 Taluks in the state**.

(iii) Geographical
(a)National level – Number of State covered: One. State of Karnataka
(b) State/UT level- Number of District covered: 30 districts
(c) District level- Number of Blocks covered: 175 Taluks

Please give specific details:
Project Work is spread across the state.

(iv)Demographic spread (percentage of population covered)

Since project is spread across the state, the whole state population is covered.

2. Situation Before the Initiative (Bottlenecks, Challenges, constraints etc with specific details as to what triggered the Organization to conceptualize this project #):

PIU-SHDP was formed to improve Core Road Network of 7469 km at a cost of INR 2938 Crore. To execute this mammoth task it had only limited engineers and there was a stringent timeline to achieve it.

Initial Challenges faced by SHDP:
- To regularly monitoring the overall progress of the project which is spread across the State of Karnataka.
- Limited Staff and Time.
- Coordinating with different stakeholders of the project ie., Contractors, PMC's, DPR Consultants, PWD Engineers and SHDP Engineers.
- To centrally manage all the project related documents, so that it is easily accessible to all the stakeholders of the project
- Collecting day to day project related information from Site ie., Physical Progress, Financial Progress, Quality Results, Photos, Request For Inspection etc.,
- Better quality reporting to enable quick decision making.

All the above challenges compelled SHDP to use innovative technology which helps them to overcome these hurdles and execute the project effectively.

3. Scope of Services (Relevance of application for e-governance, Extent to which service is delivered through mobile #)

I. Scope of services with relevance to e-Governance:
   a. **Enabling quicker decision making**by the PIU based on factual and verifiable information.
   b. **Ease out bottlenecks** in the project by highlighting the issues that need to be dealt with.
   c. **Help faster escalation of issues** beyond the jurisdiction of the project staff that need interventions at higher levels of authority.
   d. To **ensure good quality** of construction with full compliance to the Engineering Designs & Drawings, Technical Specifications and contract conditions within the specified time schedule.
   e. Monitoring construction activities to ensure adequate Contract Administration and assist in taking remedial measures to **avoid slippages, cost overrun, delays** if any due to the construction agency or otherwise.
   f. **Ensure safety** during construction and adherence to Environment Management Regulations in vogue.

II. Scope of services with relevance to services delivered through mobile essentially falls into three categories with three mobile applications for –

  a. **Capturing data** from work sites spread across the state of Karnataka–

    i. Instantaneous availability of first-hand information about the project directly from the point at which the data is generated.

    ii. Monitor the State Highway Development Project under execution at different geographic locations in the state where mobile connectivity is the only connectivity available.

    iii. Capturing and storing of the first-hand information from work sites which can be subject to audit.

  b. **MIS reports** on the project on the mobile –

    i. Reports of project status available on mobile for all including public.

  c. **Enabling feedback** on the project - Feedback on the project enabled for public through mobile app.

The three mobile applications that were deployed in SHDP:

- **Mobile Application for Work Inspection**: Used to capture data relating to Physical Progress, Quality Control Test, RFI as well as work related photos.
- **Mobile Application for Reporting**: The Physical Progress, Financial Progress, Quality Test, work photographs and strip maps can be viewed region wise or package wise with cumulative progress of the whole project and also helps to compare the results region wise.
- **Mobile Application for Feedback**: Citizens/Common Public can give their feedback related to SHDP works through this application.

4. Strategy Adopted
(i) The details of base line study done

The adoption of PMS by SHDP was on the basis of the positive experience of PWD in the implementing the same on another world bank aided project done earlier where PMS was successfully implemented. It was found that adopting PMS helped in getting the first hand information from work sites much faster than existing methods and also helped ease bottlenecks by enabling faster decision making. However in absence of mobile apps earlier meant that the data could not be captured at the point of occurrence. There still was an element of delay for the data to be transported to places having web connectivity for uploading into the web application. This left room for a possibility of selective reporting or at worst data massaging since there was no way to time stamp and GPS tag the information.

(ii) Problems identified
- Geographic spread of the project
- Project was very large with 136 contract packages which meant dealing with 136 construction teams working across the state and in some very remote areas.
- Non-availability of enabling IT infrastructure in such areas

- Data veracity, selective reporting and delay in availability of relevant data
- Challenge of change management in an ecosystem unused to such close monitoring and scrutiny
- Competency of contractorsas well as willingness to use technology that subjected their work to such levels of monitoring

(iii) Roll out/implementation model

PIU-SHDP team was small and timelines were very short (11 – 24 months to handle this big project. To have a better control on work progress, quality and time services of Project Management Consultants (Third Party) were taken. Project Management Consultants (PMC) act as a facilitator between SHDPand Contractors.

For faster movement of information and decisions, comprehensive **Web Based Project Management System(PMS)** was put in place. Further in order to plug the gaps identified in the baseline study, mobile technology was adopted.

Detailed training program was scheduled and all PMCs were trained on PMS and made responsible for daily data collection and entry into PMS. This helped SHDP to get near real time data from all work sites across the state.
The implementation process started with stationing of PMS team at the PIU-SHDP office.
PMS implementation has two stages:
- System Initialization
- Day to Day Entries

First stage: To initialize the system with all the core details of the project like Project Description, Scope of work, Bill of Quantities, Construction Program etc.
Second stage: To monitor day to day activities at site like Entering MeasurementsUpdating of Physical Progress, Quality Test Results and Work Photos. These data's are to be entered into the PMS by respective PMCs.

(iv)Communication and dissemination strategy and approach used.
Communication and information dissemination is done through using web and mobile applications. Smart phones were given to all engineers so that they get firsthand information from near in near time. Three types of **Mobile applicationsupported a by web based Project Communication Center (PCC)**. The three mobile apps weredesigned for:
- **Capturing data** from work sites spread across the state of Karnataka(Inspection App).
- **MIS reports** on the project(Reporting App)
- **Enabling feedback** on the project(Feedback App)

Communication and information dissemination between stake holders of the project plays a vital role in successful execution of a project. **Project Communication Center (PCC)**is a Web based module for dynamic interaction among users, which is a part of PMS. This module provided a common platform for all the members/stakeholders of the project to communicate

and share project related details. All the stakeholders were given username and password and this formed a closed group for the stake holders to communicate. Project Communication Center (PCC), also allows one to one communication between the project members.

5. Technology Platform used

(i) Description

Backend Vyavastha® Platform is a pioneering software product encompassing all aspects of Engineering, Procurement and Construction Project Management developed by Backend Bangalore, an ISO Certified Company for ISO 9001: 2008 and ISO 27001:2005, focused around building robust products and applications. Vyavastha® is built on .NET technology and covers integrating and managing engineering information and processes, end-to-end procurement workflow and proficient handling of construction site execution.

Backend Vyavastha® is designed based on the principles of innovation, flexibility and collaboration for effective application across areas of diverse verticals that necessitate varied functional requirements and have spread over distinct geographical locations. Vyavastha® focuses on enhancing customer collaboration to develop and supplement solutions that automate business process map incorporating people, data procedures and systems. Vyavastha® platform provides detailed project analytics, dashboards and reporting capabilities through technology built communication tools and modules.

Project Monitoring System [PMS] software application is built taking an SOA architectural approach. With SOA, integration becomes forethought rather than afterthought. In PMS software application, a separate layer called Service factory is provided to implement web methods as requirement arises. This layer is also capable of hosting Windows Communication Foundation services.

PMS software application is made up with various components logically grouped into multiple layers. This design helps to differentiate between the different kinds of tasks performed by the components, making it easier to create a design that supports reusability of components. Each logical layer contains a number of discrete component types grouped into sub-layers, with each sub-layer performing a specific type of task. By identifying the generic types of components that exist in this solution, a meaningful map of an application or service can be constructed, and then this map is used as a blueprint for our design. Splitting an application into separate layers that have distinct roles and functionalities helps maximizing maintainability of the code, optimize the way that the application works when deployed in different ways, and provide a clear delineation between locations where certain technology or design decisions must be made.

(ii) Interoperability

Backend's Vyavastha® platform architecture can easily integrate into mobile application technology environment for providing an interface to deliver a personalized and interactive user experience.Backend's custom based Mobile Application solution help organizations build

their communication networks in robust and remote environments. Backend incorporates vast and diverse experience in software development in designing these mobile applications. This results in cost-effective and timely solutions for various businesses.

(iii)Security concerns

PMS Software Application works with Microsoft.NET framework and Microsoft Internet Information Services (IIS) to provide web application security.

Keeping in mind that security is a path, not a destination we analyzedour infrastructure and applications, and identified potential threats and understood that each threat presents a degree of risk. As security is about risk management and implementing effective countermeasures we adopted the following:

- **Input and Data Validation**

Server side objects (strongly typed) are used to prevent any data mismatch. Database tables' integrity is maintained with strong relationship design and constraints, which help to reject wrongly passed data.

Pages are designed with input-validation on, which prevents user submitting any malicious markup or scripts thereby avoiding sql injection.

SQL query generation is discouraged, instead of that well defined query in procedures are designed with strongly typed parameter, which in turn prevents SQL injection.

Query string parameters are validated passed through strongly typed parameter of methods in Business Objects. And special care is taken while coding not to pass any sensitive data through query string, parameter. To prevent Canonicalization attacks, application is designed not to use user-defined name as stored filename. Application generates a unique name and keeps mapped information database.

Validators are used to check size of input and malicious inputs are rejected by application as server as set to input-validation on. Usage of cookie is minimal in the application.

- **Authentication**

For login authentication strong password policies are implemented. As per the existing password policy, the password must be seven characters long with one special character and a numeric character.

Credentials are stored in an encrypted form in restricted database in server.

Application uses authentication mechanism, which does not use clear text credentials to be passed over the network.

Separate folder (Pub) is used to keep pages encapsulated for anonymous access.

The login gets locked after 3 failed login attempts to prevent Brute force attacks. Only the administrator is given the rights to unlock the user.

Membership classes of ASP.NET 2.0 is used to protect Cookie replay attack.

- **Authorization**

Use of least privilege account in server for application (Currently Network Service)

ASP.NET Role Provider for SQL server is used to provide authorization to the pages in a folder.

Each task needs a role to be defined in Role Provider with enforced separation of privileges. Use multiple gatekeepers: at each layer of the application stack relevant validations are done instead depending on client side input validation. Using encapsulation system resources are secured against system identity disclosures.

- **Configuration Management**

Least privileged service accounts (Network Service) are used, Strong authentication and authorization on administrative interfaces are implemented and Remote Security Authority (RSA) is avoided by having only local administration.

- **Session Management**

Session is not used at all to keep any important data. Partition of the application is based done by anonymous, identified, and authenticated users leading to reduced session timeouts. Access to the session store is allowed only through Authentication and authorization.

- **Exception Management**

Use structured exception handling (by using try/catch blocks). User is shown a meaningful error message through an error map file and actual exception is logged to another database along with the Event Log. Exceptions are caught and wrapped only if the operation adds value/information. Sensitive system or application information is not revealed to the user. Private data is not logged such as passwords.

- **Auditing and Logging**

Failed logons are logged in separate database with an Event Log. Transaction log is stored in separate database for future audit. Exception log is also maintained in database for handling relevant exceptions.

The conventional fortress model and the reliance on firewall and host defenses are not sufficient when used in isolation.We securedour application by applying security at three layers: the network layer, host layer, and the application layer. Additionally, our application is designed and built using secure design and development guidelines following timeworn security principles.

(v) Service level Agreements(SLAs) (Give details about presence of SLA, whether documented, whether referred etc. #)

A Contract has beenentered into between SHDP and vendor which covers the service levels agreed upon and in force until end of the project period. By locking the involvement of the Vendor till the very end of the project and using cloud technology helped mitigate the risk of failure due to insufficient vendor support; risk of technology obsolescence in terms of both hardware and software.

6.Citizen Centricity (Give specific details on the following#)

(i) Impact on effort, time and cost incurred by user

Use of mobile technology in SHDP Governance has substantially reduced the effort, time & cost incurred by the user to collect project related information. User can freely download the reporting app which provides the complete project related details like physical progress, financial progress, quality control test results, work photographs and strip maps. He can give feedback about the work or check the status of this submitted feedback. All these can be done through SHDP mobile applications. By this citizen staying at remote place of the state can get the information at his fingertip without spending his effort, time or money.

(ii) Feedback/grievance Redressal mechanism

Public can freely download the Feedback Mobile Application. User needs to register and give his feedback about the work or work related issues using the Feedback Mobile Application. User can also check the status of his submitted feedback/grievance.

(iii) Audit Trails:

Mobile application allows capturing and storing of the first-hand information from work sites which can be subject to audit trails.

PMS keeps a record of users(based on their userid) and their operations performed during a period of time. These audit trails are useful both for maintaining security and for recovering lost data. In Work Measurement section a step by step record of each edited quantity of the bill is maintained till the payment is made, this audit trails helps us to reconstruct and examine the sequence of steps and trace back to the source(original quantity), so we can validate the accuracy of the quantity billed.

(iv) Interactive platform for service delivery:

Services delivered through mobile essentially falls into three categories with three mobile applications for –

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        ii. Monitor the State Highway Development Project under execution at different geographic locations in the state where mobile connectivity is the only connectivity available.

        iii. Capturing and storing of the first-hand information from work sites which can be subject to audit.

    e. **MIS reports** on the project on the mobile –

        i. Reports of project status available on mobile for all including public.

    f. **Enabling feedback** on the project - Feedback on the project enabled for public through mobile app.

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(v) Stakeholder consultation

Communication and Information dissemination is done through using web and mobile applications. All MIS reports, feedback status are made available in public domain, by this all stakeholders are uniformly updated. This helps stakeholders to actively participate and contribute in SHDP state of affairs.

7. Demonstrate Innovation in use of Mobile Technology for e-governance(Give details about the mobile technology used (platforms, SMS, Pull & Push, Apps, Mobile Payment,), innovation applied in use of mobile technology to deliver information or Services to target audience #)

One of the most widely used mobile Operating System these days is ANDROID. Android is a software bunch comprising not only operating system but also middleware and key applications.These applications make life more comfortable and advanced for the users. Android is architected in the form of a software stack comprising applications, an operating system, run-time environment, middleware, services and libraries. This architecture can, perhaps, be best represented visually as outlined in Figure. Each layer of the stack, and the corresponding elements within each layer are tightly integrated and carefully tuned to provide he optimal application development and execution environment for mobile devices.
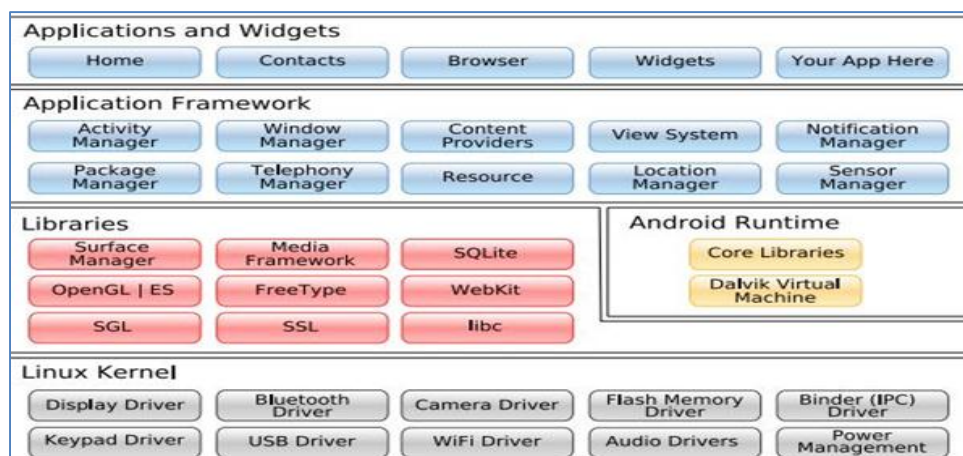
Android Architecture

Positioned at the bottom on the Android software stack, the Linux Kernel provides a level of abstraction between the device hardware and the upper layers of the Android software stack.

Based on Linux version 2.6, the kernel provides preemptive multitasking, low level core system services such as memory, process and power management in addition to providing a network stack and device drivers for the device display, Wi-Fi and audio

Linux kernel provides a multitasking execution environment allowing multiple processes to execute concurrently. It would be easy to assume, therefore, that each Android application simply runs as a process directly on the Linux kernel. In actual fact, each application running on an Android device does so within its own instance of the Dalvik virtual machine.

Running applications in virtual machines provides a number of advantages. Firstly, applications are essentially sandboxed, in that they cannot detrimentally interfere (intentionally or otherwise) with the operating system, other applications or directly access the device hardware. Secondly, this enforced level of abstraction makes applications platform neutral in that they are never tied to any specific hardware.

The Dalvik virtual machine relies on the underlying Linux kernel for low level functionality. It is more efficient than the standard Java VM in terms of memory usage, and specifically designed to allow multiple instances to run efficiently within the resource constraints of a mobile device.

The Application Framework is a set of services that collectively form the environment in which Android applications run and are managed. This framework implements the concept that Android applications are constructed from reusable, interchangeable and replaceable components. This concept is taken a step further in that an application is also able to publish its capabilities along with any corresponding data so that they can be found and reused by other applications.Android is implemented in the form of a software stack architecture consisting of a Linux kernel, a runtime environment and corresponding libraries, an application framework and a set of applications. Applications are predominantly written in Java and run within individual instances of the Dalvik virtual machine. The key goals of the Android architecture are performance and efficiency, both in application execution and in the implementation of reuse in application design

- Android based Mobile Applications are being used for monitoring, reporting and collecting feedback.
- **Mobile Application for Work Inspection**: Used to capture data relating to Physical Progress, Quality Control Test, RFI as well as work related photos.
- **Mobile Application for Reporting**: The Physical Progress, Financial Progress, Quality Test, work photographs and strip maps can be viewed region wise or package wise with cumulative progress of the whole project as also compare the results region wise.
- **Mobile Application for Feedback:** User needs to register and give his feedback about the work or work related issues using the Feedback Mobile Application. User can also check the status of his submitted feedback.
- **Special feature of the mobile application:** This can be used even in places where there is no network /mobile connectivity. The application allows the user to enter the data into application at the location even if there is no network/mobile connectivity and as soon as the user enters network coverage area, the data entered by the user automatically gets pushed to the PMS server.

- The **important feature in the mobile application is GPS location** and time stamping whereby the exact GPS location where a picture was taken can be located which helps to authenticate the information fed into the system.

8. Adaptability and Scalability (Give details about Local language support, ability to leverage shared Government infrastructure, Standardization of technology used (hardware, software, application etc. #)

Following considerations are taken in order to scaling the application:
- Session state is stored in remote database server
- Extensive page fragment caching
- Data caching is used on frequently read data with proper dependency policy.
- Database is highly normalized for data store.
- For read only data (views and reports) data is de-normalized for faster access.

Scaling-up

With this approach, we upgrade hardware components, such as a CPU, may be replaced with faster ones, or by adding new hardware components, such as additional memory and network adaptors without any change being done on the application. The key hardware components that affect performance and scalability are CPU, memory, disk, and network adapters are changed on demand as the application is hosted in cloud setup.

Scaling-out

With this approach, we add more servers to your system to spread application processing load across multiple computers. Doing so increases the overall processing capacity of the system.
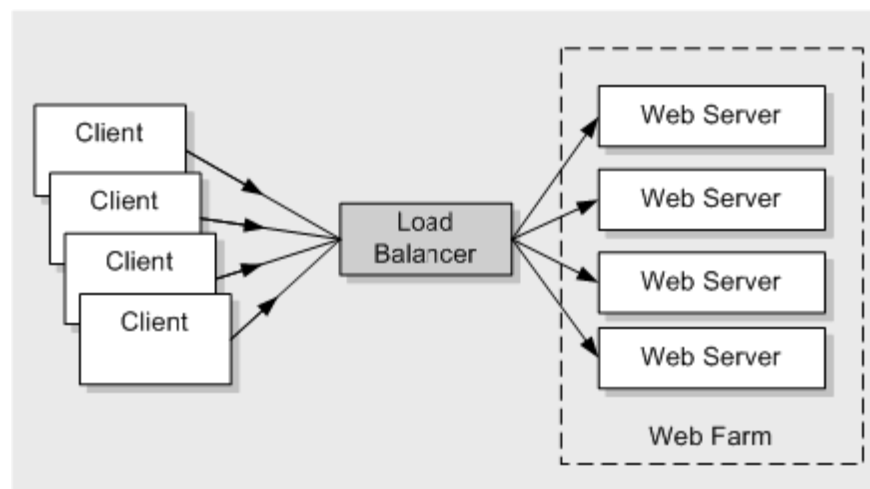
- Project Monitoring System is robust and easily scalable system since it is built on the **.**NET platform using n-tiered architecture.
- This is a cloud based system and does not require much hardware resources at the user end.

- Local Language Support (Kannada) is also available.
- Its easily scalable, number users and hardware resources can be scaled up very quickly with no down time.

9. Adaptability Analysis
(i) Measures to ensure adaptability and scalability

The system is fully scaled up for the SHDP since both phase I and phase II are monitored through the PMS. Data of all 136 contract packages are loaded in the system. Bills register and queuing happening through the system. Management Information Systems, Monthly Meeting Review are all generated from PMS.

Backend Vyavastha®platform is designed based on the principles of innovation, flexibility and collaboration for effective application across areas of diverse verticals that necessitate varied functional requirements and have spread over distinct geographical locations.

Backend Vyavastha®platform allows to adapt to rapidly changing business environment and focusingon enhancing customer collaboration to develop and supplement solutions that automate business process map incorporating people, data procedures and systems.

(ii) Measures to ensure replicability

Since all the important business process are fully mapped with the currently used PWD procedures/practicesand using of Service oriented architecture (SOA) and cloud technology enables us to replicate the solution with minimum customization and delivery time.

(iii) Restrictions, if any, in replication and or scalability
Highly scalable and replicable model, needsminimum timefor solution deployment enabling to go live parallel to project commencement Thereforeno restrictions in replication and or scalability.

(iv)Risk Analysis

Risk factors identified:
- Indifference of the project implementing unit.
- Lack of ownership and support from senior management.
- Technology obsolescence.
- Insufficient vendor support.
- Lack of domain specific Training
- Lack of contractual provision in the work contract packages to cover usage of PMS

Risk Mitigation:
- In SHDP, the involvement of the senior management was high in implementing this initiative.

- Cloud technology adoption and SLAs with vendor could mitigate the risk of technology obsolescence and vendor support.
- Domain specific training was made part of agreement.
- Making PMS a part of the contract in all the work packages.

10. New Models of Service Delivery (Give details about type of partnership model use, Links to/Supported by Public/Private Organization Links provided to relevant websites etc. #)

The Project Implementation Unit –State Highway Development Project has planned to bring in efficiency at all levels by incorporating accountability. "Outcome Based Payment" is the service delivery model used here. This model has been implemented by engaging Project Management Consultants (PMC) to supervise the work done by the construction agency. The role of PMC is to act as a facilitator between Employer and the construction agency. PMC is responsible for supervising the work done at site by the construction agency and report to the employer and also to assist the construction agency during execution of the project. The consultancy fee of the PMC is directly linked to the performance of the construction agency i.e. "Outcome Based Payment". This new model of service delivery is more output driven, and role of each player in is clearly defined which clears confusions and conflict of roles.

Each PMC is given a Project Management System (PMS) software license to login and enter the activities at site on day to day basis. Each is entrusted to capture work related data like measurements, physical progress, financial progress, quality control test results and work photographs thus ensuring accountability for the data generated from site and the PIU-SHDP is able to review the work related information as and when the work is progressed at site.

PIU-SHDP in order to achieve more Transparency and Accountability a link is given in the website to the citizens to view the physical and financial progress of the scheme under implementation.

PIU SHDP has harnessed the mobile technology to a great extent by using two exclusive application to "capture data" – Inspection App and "Report Data"- Reporting App.
- **Mobile Application for Work Inspection**: Used to capture data relating to Physical Progress, Quality Control Test, RFI as well as work related photos.
- **Mobile Application for Reporting**: The Physical Progress, Financial Progress, Quality Test, work photographs and strip maps can be viewed region wise or package wise with cumulative progress of the whole project as also compare the results region wise.
- **Mobile Application for Feedback:** User needs to register and give his feedback about the work or work related issues using the Feedback Mobile Application. User can also check the status of his submitted feedback.

11. Efficiency Enhancement (Give specific details about the following #)
(i) Volume of transactions processed
- 136 Work Contracts (Phase –I:66 Contracts and Phase –II: 70 Contracts) ,

- Total Amount of transactions is Rs.2938 Crore (Phase 1: Rs.1439 Crore, Phase 2: Rs.1499 Crore)

(ii) Copingwith transaction volume growth
Adoption of cloud technology allows us to dynamically cope with transaction volume growth.   We can increase the resources on fly as required very quickly with no downtime.

(iii)Time taken to process transactions
As outlined in workflow and factoring approval time by the competent authority.

(iv)Accuracy of output
Time stamping and GPS tagging gives data accuracy and veracity**,**

(v) Number of delays in service delivery –
Not applicable.

12. User convenience (Give specific details about the followings #)
(i) Service delivery channels (Web, email, SMS etc.)

SHDP has adapted a multichannel service delivery model to deliver better and faster services to public. Complete progress of the project in terms physical progress, financial progress and quality control test details for disclosed to public through web and using mobile applications to take user feedback about the work or work related issues

(ii) Completeness of information provided to the users
Comprehensive information about SHDP i.e from formation of SHDP, its organization structure, objectives, work status and contact details is made available to public. Public can also see progress of the project in terms physical progress, financial progress and quality control test details are disclosed to public through their website.

(iii)Accessibility (Time Window),
 All information is available 24/7

(iv)Distance required to travel to Access Points
SHDP has given Smartphone to all its engineers; this enables them to access the first hand information from site through their smartphones. They can also access through computers.
Therefore there is no need for the user to travel to access points to get work related information

(v) Facility for online/offline download and online submission of forms,

All the documents/records related to SHDP have been stored in an online centralized document repository. An elaborate folder structure have been defined based the types of documents that

need to be stored. Stakeholders have access or can download from the repository based on their roles & responsibility assigned.

(vi)status tracking

User can track the status of the registered complaint or grievance using feedback mobile application. Public can freely download this application.

13. Sustainability (Give details about sustainability w.r.t. technology (technology used, user privacy, security of information shared – Digital Encryption etc. #),Organization (hiringtrained staff, training etc. #), financial (Scope for revenue generation etc. #)

- Project Implementation Unit (PIU) main objective is to make sure the project is implemented in an efficient way. The main aim is to monitor the works. By adopting the Project Monitoring System the core processes like monitoring the Physical Progress, Financial progress, Quality Control is fully automated. By this automation of core processes sustainability is achieved.
- The system is built on the .NET platform using n-tiered service oriented architecture (SOA). The system has incorporated digital signatures to authenticate users for inputting the data.
- This is a web based system and each user has user name and password to login to the system. A strong workflow engine enables each user to have a set of privileges/rights based on his role/designation, Organization hierarchy and the roles and responsibility which is clearly defined. The user can access and share his information only and accountability is achieved.
- A hands-on training was designed for all the stakeholders of the project, which was delivered at regular intervals on usage of the system, its functionalities, and navigation procedures. A comprehensive User Manual is given to all system users.

14. Result Achieved/ Value Delivered to the beneficiary of the project-(share the results, matrices, key learning's, feedback and stakeholders statements that show a positive difference is being made etc):
(i) To organization
- Monitoring activities at site became near real-time and very easy
- Got 360 degree view of project progress in terms of physical, financial, quality, constraints, compliances as well as real time visuals of the work
- Reduced frequency of travel to the site
- Whole billing process became more efficient as well as transparent
- MIS Report generation became automated with more number of reports giving better insights into the project

(ii) To citizen

- better quality roads resulted in lesser travel time

- greater savings on fuel bills
- reduced number of accidents
- greater connectivity

(iii) Other stakeholders

- Information Dissemination & Reporting is uniform and simultaneous across the hierarchy of stakeholders
- Managing the daily Measurements sheet from site became simple and efficient
- Time spent on collecting data for report generation reduced substantially.

15.Extent to which the Objective of the Project is fulfilled-(benefit to the target audience i.e.G2G, G2C, G2B, G2E or any other, size and category of population/stakeholder benefited etc):

- Objective was to improve and upgrade the selected State Highways that are spread across the state of Karnataka with in a span of 11 months.
- Building of Road Infrastructure makes the wheels of economy move in this process, the Nation is benefited i.e G2G, G2C, G2B, Citizens of the state, business establishments (Public and Private) and the Government.
- Development of Road infrastructure mainly reduces the travel time (Time is Money), Reduction in fuel consumption, reduction in accidents ensuring safety to the road users.
- Good Roads ensures connectivity between states, districts, villages etc. This contribute to economic, social and cultural development of any country. Road connectivity helps people to get access to facilities like Schools, Hospitals, Government offices, Agri-Markets etc.
- Road Infrastructure Projects also infuse lot of money into the system which create huge Business opportunities and in turn Job opportunities.
- Employment increases the purchasing power of people in turn increase in consumption of products. This results in higher industrial production leading to good employment opportunities. This cycle will again infuse money into the system. So there is direct and indirect beneficiaries from these projects

16. Comparative Analysis of earlier Vs new system with respect to the BPR, Change Management, Outcome/benefit, change in legal system, rules and regulations

Brought about a Transformational and Irreversible change in the monitoring process
- First hand information from site in near real time.
- Brought more aspects of the project into Monitoring focus.
- e-Billing brought in efficiency and transparency in Billing process
- Streamlined and speeded up flow of project information
- Decision making became more effective due to availability of information on real time basis

- Information Dissemination & Reporting is uniform and simultaneous across the hierarchy of stakeholders

17. Other distinctive features/ accomplishments of the project:

- Use of **Cloudtechnology** with **domain specific Web application** integrated with **Mobile application**
- First of its kind in the Road sector
- Highly scalable and replicable model
- Use of mobile applications to capture real time data from the work site.
- PMS is a web based application, user could enter and consume data on move.
- **Smart Client** - Internet/Mobile connectivity never seemed to be a challenge for capturing data from site. Since this application allows the user to enter the data into application even if there is no network/mobile connectivity and as soon as the user comes into the coverage area, automatically the data entered by the user gets pushed to the PMS server
- All the project related data can be centrally managed, data disseminated, deficiencies monitored and progress is achieved quickly so that all the stakeholders have access to it.
- Mobile application provides the exact location of the photo taken.