Final Report

Upgradation, Implementation and Piloting of Online Data Portal for NEA's Distribution System

Report Submitted to

Nepal Energy Efficiency Programme (NEEP)
GIZ

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Section I: Description of the methodology and work plan for performing the assignment

1. Understanding of TOR and Background

The Nepal Energy Efficiency Programme (NEEP 3) is the third phase of a technical cooperation project for the promotion of energy efficiency agreed between the Government of Nepal (GON) and the Federal Republic of Germany. In the third phase NEEP is supporting the Ministry of Energy in establishing the Policy and institutional framework for Promoting energy efficiency in Nepal. The objective of NEEP during its third phase is that energy efficiency is in recognized as an energy resource in Nepal. Within the NEEP component "Support to NEA" the project strengthens the capabilities of the Nepal Electricity Authority (NEA) in managing the power supply and demand are: The field of activity is aimed as at strengthening the capabilities of NEA in such a way, that it is able to independently develop solutions to challenges arising from the management of supply and demand. NEA holds the monopoly over all segments of the power supply sectors, from generation to transmission and distribution.

On the demand side, the power distribution department of NEA receives support in the form of technical and process-related advisory services (coaching ,on-the-job training) on setting up a digital information system to analyse its customers 'consumption patterns. On the power supply side,NEA receives advice on the introduction of smart system in the supply infrastructure (distribution substations ,supply lines, transformers).

A large distribution loss has an enormous impact and the economic performance of Nepal Electricity Authority. Therefore, it is important to find a solution that will quickly (and accurately) identify and quantity losses of all types including thief by diversion or illegal connections, or errors in metering , billing and wiring . An effective solution has the potential to substantially improve NEA's financial performance and reduce operational risk. Total losses have two components: technical and non-technical. Technical losses occur naturally and consist mainly of power dissipation in electricity system components such as transmission and distribution lines, transformers, and measurements systems. Non-technical losses are caused by actions external to the power system and consist primarily of electricity theft , non-payment by customers, and errors in accounting and record keeping .These three categories of losses are sometimes referred to as commercial , non-payment and administrative losses respectively, although their definitions.

Vary in the literature .Meeting and billing for the electricity actually consumed by the users is integral to commercial management of an electricity utility, Another critical task is collection of billed amount. Effective performance in both functions is critical to ensure the financial viability of the company. From the operational Point of view, metering, billing and collection are separate functions and they require specific management approaches.

Optimization of technical losses in electricity transmission and distribution grids is an engineering issue, involving classic tools of power system planning and modeling. Technical losses represent an economic loss for the country, and its optimization should be performed from a country's perspective, regardless of the institutional organization of the sector and ownership of Nepal Electricity Authority.

Before making a proper planning on reducing distribution of any power distribution company, it is mandatory to get the real-time data of the distribution center and distribution substations. The current energy balance monitoring system of NEA should be upgraded based on innovation information technologies.

It is said that the total energy loss in NEA transmission and distribution system is around 24% . There are some distribution centers which have recorded energy loss more than 50%. The current data acquisition system for energy balance in DCS and substations is poor. There are also poor practices on monitoring , evaluation of those data. An easy and friendly method of data recording is necessary for better planning of activities to reduce energy loss. Every distribution centers and substances has well facilitated broadband internet connection now days, They are also using some online activities regarding revenue collection via the same link . The same facility can greatly help the NEA management to fetch the exact condition of distribution feeders, Transformers, HT/LT consumers. They are the basic things for proper planning of best methodology on distribution loss reduction..

1.1. Name and contact of the Consultant/Service Provider

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2. Our Understanding of the Current Status/Existing Process and Main Problems

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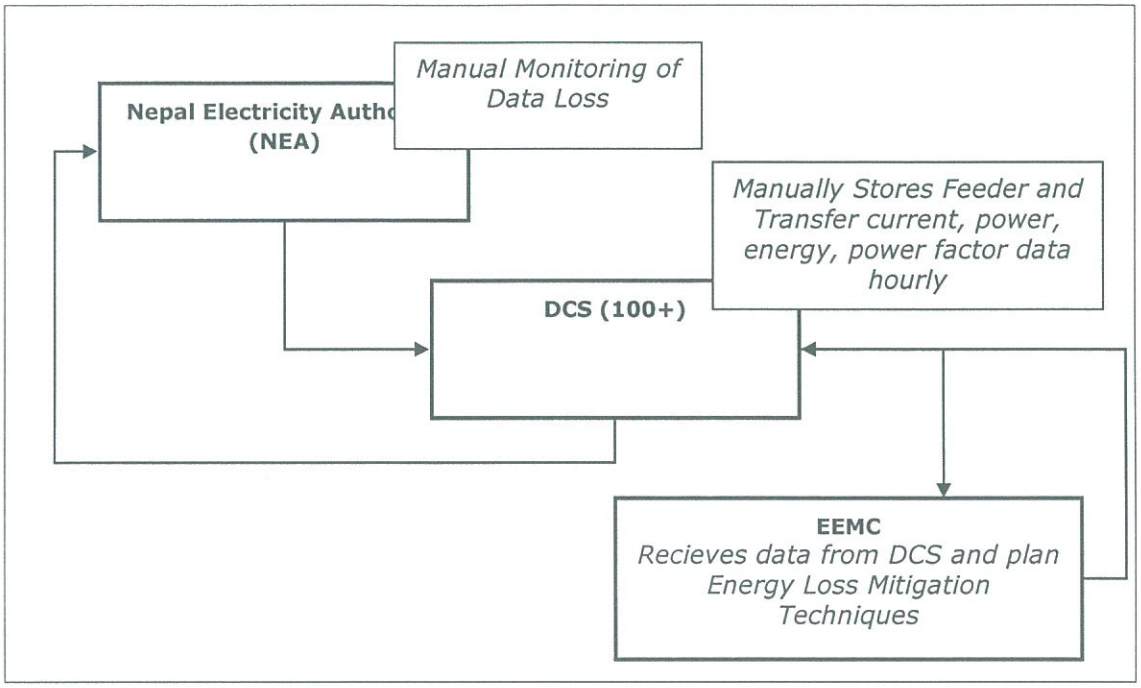


There are more than 100 DCS operating in the country which manually records the data of incoming and outgoing feeders. However, the data accessibility for the EEMC is very poor which is the sole entity for obtaining the results and provide Energy Loss Mitigation Techniques.

3. Objectives of the Assignment

The main objectives of the assignment within the GIZ Nepal Energy Efficiency Programme is to upgrade,implement, and pilot the Online Data Portal for NEA's Distribution System. The Specific objectives of the assignment are as follows:

- Upgradation of web based solution to record real-time data of NEA's distribution system and substations.
- Establish and maintain a robust Online, Real-time, Web Based, Database Monitoring System (ORDBMS) that enables to get real time data and statistics available for timely decision, policy making, monitoring and implementation for the Distribution Systems and Substation related activities.
- The web-based solution should integrate all the activities in every distribution centers and substations.
- Strengthen the monitoring capacity of the NEA's Energy Efficiency and Loss Department based on different parameters of feeder and transformers for proper decision making support.
- Modernize and strengthen the e-Governance system by implementing online web based Online Data Portal at central level and distribution systems/substations.
- Knowledge management for the employees involved in the operation of Online Data Portal.
- Installation and Commencement of Online Data Portal in 5 Distribution Centers (Minbhawan, Dhalkevar, Chandranigapur, Shivapur, Duhabi)

4. Scope of Work

The consultant needs to conduct and carryout the following activities to achieve the objectives and produce the deliverables and outputs. In this context scope of services of this consulting service consists (but not limited to) of the following:

3.1. Study of existing system of NEA's Energy Efficiency and Loss Reduction Department: The consultant need to understand thoroughly the business process of Energy Flow at operational level and its activities, Data collection formats/form, reporting process, Different Norms of Regulation etc. Consultant needs to analyze the shortcomings on the existing system and further requirement of the system. Based on the study, the consultant needs to upgrade and deliver an Online Data Portal system that facilitates real time data acquisition and extraction of data of feeders and transformers.

3.2. Provide details of hardware and Network Requirements of the System: The consultant should analyze the volume of data and concurrent users of the system and propose the server requirements, PC configuration requirements and Internet Speed Requirements as part of the consulting assignment. The consultant should analyze available network technology in NEA and suggest with appropriate action to be taken in order to run the system well in intranet, internet and WAN.

3.3 Consultation with the concerned authorities of NEA's Distribution Centers: The consultant should consult with the concerned officials of NEA's Distribution Centers/Substations after signing the agreement. The consultant needs to have consultative meetings with the technical team (project coordinator) of NEA for the time schedule, planning and other implementation.

3.4 NEA's Input: NEA will assign a staff as project coordinator of the developing software project who will communicate with the Consultant for various inputs. Under the identification of the necessity of the Consulting firm, NEA can allocate a certain space and environment within NEA office for consulting personnel to carry out developing activities if required. In development of the Software, consulting firm will get support from the concerned distribution centers personnel on required input, clarity and expected result from a particular module and integration.

3.5. Upgradation of Web-based Online Data Portal: After determining the appropriate forms, formats and information the consultant needs to upgrade the Online Data Portal for the required information to cater the needs for monitoring, administration and reporting of the Distribution Centers/Substations related activities. The Online Data Portal should be able to produce and maintain the volume, storage and speed for instant online data entry, recording, retrieving, producing and analyzing the data and its contents. However, the system should have the following features and must satisfy the system requirements. The Online Data Portal and its operation need to have the following features:

A web-based System: The Software developed by the consultants should run smoothly in all web browsers with equal performance. The system should accommodate all the web-based system features. The users should be able to make entry in the forms or formats developed for information capture from the concerned offices and institutions.

- **Data Forms, Formats and Related Information:** The consultant need to determine the data contents, forms, formats and other information system after analyzing all the

requirements of the NEA with the technical team as well as concerned distribution centers officers. However, as general guideline it may contain the following:

User Related Information: There are different type of users in the Online Data Portal for NEA's distribution system. Admin user at NEA is responsible to create users of other distribution centers/ substations. User Information of different type of users at entry level and verification level are present in distribution centers/substations. Each type of users have their own access level of operation of Online Data Portal. The software system should be capable of maintaining the information of different types of users and their roles and permissions. Consultant should consult with NEA Energy Efficiency and Loss Reduction Department to know the different types of user, user information's and their roles and permissions.

Distribution Centers/Substations related Information: The software system should have modules/functionalities to track data related information like DCS total loss, DCS capacity, DCS incoming and outgoing feeders, capacitors, transformers related information and more. Consultant should consult with technical person of DCS/Substation to determine required information, input format as well as reporting formats.

Transformer Related Information: The software system should be capable of maintaining the Transformer Related information in the DCS/substations.

Feeder Related Information: The software system should be capable of maintaining all the information of incoming and outgoing feeders. Consultant should consult with technical person of DCS/Substation to determine required information, input format as well as reporting formats.

- **Data Entry or Uploading Functions:** The software should have both features of data entry online as well as uploading filled form where necessary which will be identified during the system analysis phase. It should also ensure the adequate safety/security mechanism while making entry or uploading the forms, formats or other required information. This system should also contain the sample forms or formats which can be downloaded and filled offline and uploaded to the system, populating the concern database tables.
- **Access Control:** The software system should have different access control features as per user levels and user privileges or user roles. This access control feature should be dynamic in nature so that rights of a particular module may be assigned to any user apart from his/her level.
- **GEA/NGIF Compliance:** The system should follow Nepal Government Enterprise Architecture (GEA) and Nepal Government Interoperability Framework (GIF). Compliance of these features by any government software system will facilitate the data interchange among different government agencies. System should support Nepali Unicode as well as English/Nepali dates. System should have Nepali User Interface where required and can be switched with a single click of a button at any level of its operation.
- **Security:** The software needs to be secured through layers of security system. The software security system should enable the smooth operation of the system without hacking or other security lacking. The system should have an integral security system. The security features should include the following:

  Coding level security- security issue should be taken into account while coding.

  Access level security: various session monitoring/tracking, password encryption, etc.

Database level security: access to database and their roles, read/write permission, access to database, session monitoring, etc.

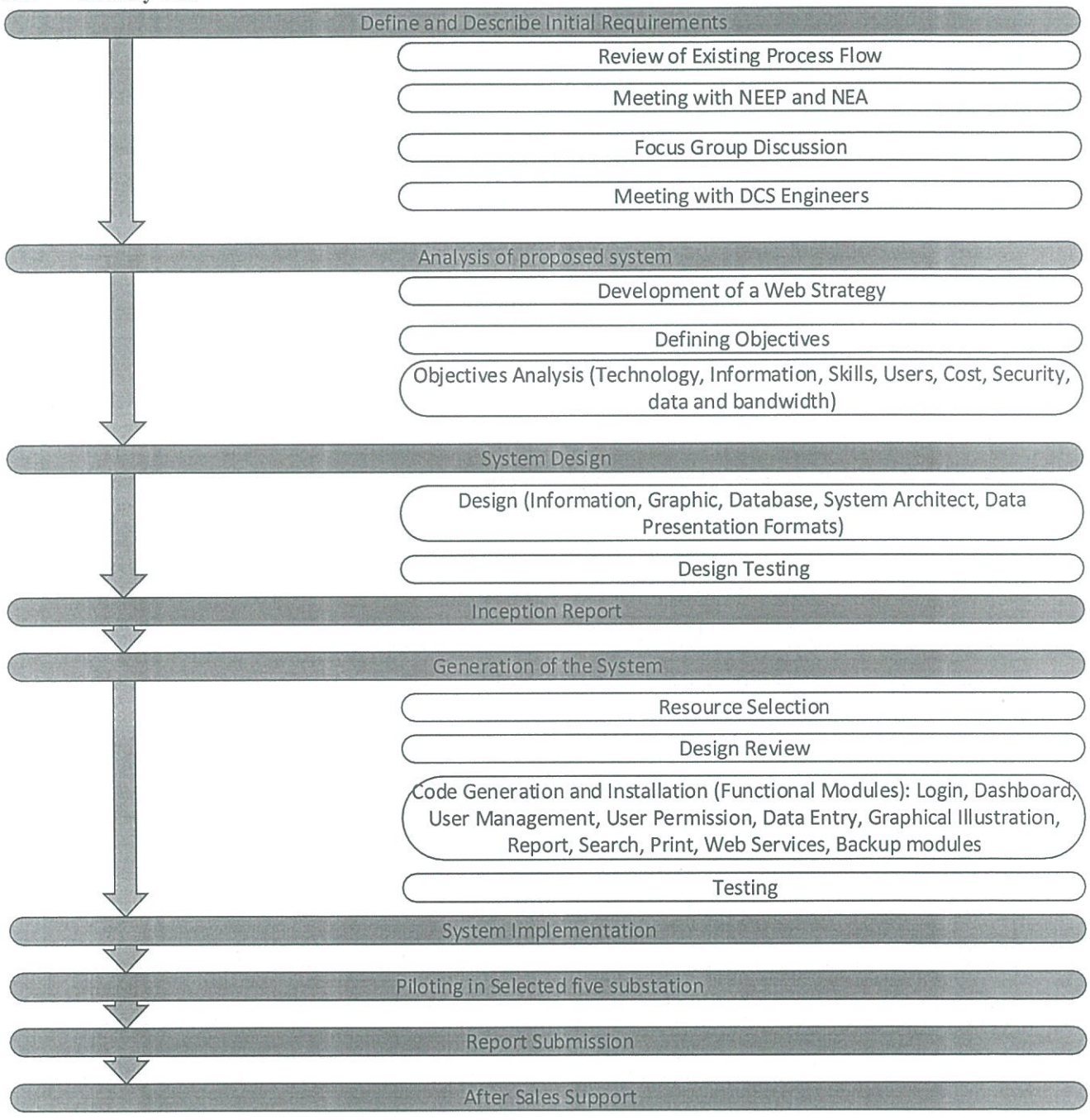
Network level security: access of system inside/outside NEA, IP and port filtering, etc.

- **Data Storage and Back-up System:** The consultant should be able to identify and recommend to NEA for proper data storage mechanism including necessary hardware change required to support software services efficiently.
- **Data Export System:** The database system should be able to export the data to other application program such as SPSS and STATA, Excel or other useful application programs for analysis and generation of analytical report as and when required. The upgraded system should be able to generate the log sheet for any substation and of any day.
- **Data Analysis/Graph generation Program:** The database need to be developed based on the entered data that is necessary to carry-out any analysis. It should also be able to calculate and analyses the indicators from the data and indicator content to generate various analysis charts/graphs wherever required.
- **System Installation and Configuration in Five Distribution Centers:** After the upgradation of the online data system the consultant needs to install the system with related feeder, transformer information and other configuration information in selected distribution centers (Minbhawan, Dhalkevar, Chandranigapur, Shivapur, Duhabi)
- **Training to DCS Users and Knowledge Transfer:** The consultant needs to train the DCS Operators in selected DCS for the use of Online Data System. The consultant shall prepare the technical, user and operational training module, training materials and session plans for the successful design, development and operation of the system. The trainings should be conducted for NEA's distribution centers/substations staff of selected 5 DCS of Nepal. 1 days training should be conducted in each selected DCS and consultant should assign Trainer and Co-trainer for the assignment. The training shall be organized by NEA and facilitated by the developing firm and events shall be conducted under the discussion of NEA and consulting firm. The consultant should be available to provide training in all the five selected DCS.

Support and Maintenance: After successful implementation of software solution and Project Completion Report accepted by NEA, the system should be kept under warranty period for one year. On completion of warranty period, the system will stay under maintenance period where a regular support, maintenance and regular updates should be carried out by the consulting firm. NEA will have to pay the consultant for the annual maintenance of software. The support level depends upon the complexity of the task which should determine the service should either be remote support, on call support or stationed support

5. Project approach, methodology, plan, activities and deliverables

5.1. Activity List



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Define and Describe Initial Requirement

a. Review of Existing Process flow and Existing System

First and foremost task in the development of the proposed system will be to analyze how the document , information flow from office user Software monitored by e-governance Section regarding the information process and administrative process management. The objectives of the assignment and detail activities to be incorporated in the proposed system. The study will be carried out through Participatory observation, studying existing system and processes in use including the DCS data record.

For the development of online data portal it is mandatory to understand the existing DCS process flow and tools and technologies and methodologies used in the system. Architectural issues in the existing system must be known before the architectural changes and the study of software language used in the system and its relevance needs to be understood.

b. Meeting with NEEP and NEA Officials and Focus Group Discussion

NEA Officials and the representatives from DCS are the important stakeholders of the proposed assignment. The requirements will be finalized with few numbers of meeting with the different department officials of NEA. The forms and form formats for different task carried out in the DCS Office and other forms required for the successful operation of the system will be identified through the series of meetings with the NEA. Technical Representative of the different respective departments are the end user of the system. Focus Group Discussion will be carried out in this assignment with representatives of few ministries and departments regarding the process of data storage and entry of the different documents regarding the project. The list of documents to be stored in electronic copy will be identified from the end user. The feedback obtained from the group discussion will be helpful for the successful completion of the assignment in terms of usage, simplicity and robustness of the proposed system.

Analysis of the Proposed System

a. Development of a Web Strategy

Web Development Strategy will be made before carrying out the detail task which outlines three core elements that describes the goals of proposed system. These elements are helpful for guiding the rest of the development process

- *A well-defined statement of **'where'** the organization wishes to be*
- *An assessment of where the organization is' **now'***
- *A brief implementation plan of how to get from the **'now'** to the **'where'***

This step is iterative as the strategy set out by management may have unrealistic goals (which is why the inclusion of a Web developer/consultant can save time and resources during this phase). This phase is probably the most crucial phase of the methodology, since mistakes or omissions here could prove costly later.

b. Defining Objectives

Once the organization's Web strategy has been agreed upon and a Strategic Planning Document has been produced, the ways in which the development will achieve these goals can now be identified. At this stage, the Web developer is fully involved with the running of the project and should be aware of the current Internet and Web technologies in order to fulfil these objectives effectively.

The output from this stage is an Objectives Document that outlines the objectives of the site along with any other factors that may enable the developers to access the viability of the site post-implementation.

c. Objectives Analysis

During this step the objectives described above, together with the available resources, are analysed in order to ascertain to what extent they are achievable. This analysis can be sub-divided into six tasks, which are as follows:

1) ***Technology Analysis*** - identification of all technological components and tools required to construct, house and support the site.
2) ***Information Analysis*** - identification of any information that the user requires, whether static (Web page) or dynamic (fed "live" from a database server).
3) ***Skills analysis*** - identification of all the differing skill sets required to complete the project

4) ***User Analysis*** - identification of all intended users of the site. This is a much more complex process than with traditional IS development as the range of users, and technologies used by the users, may vary considerably.

5) ***Cost Analysis*** - an estimated cost for the development of the system is calculated, or an estimate of what is achievable with a predefined budget.

6) ***Security Analysis*** - an estimated level of security in the user level and system level.

7) ***Data Analysis*** - an estimated volume of data usage in different MOHA and system as a whole and observation of the requirements of the archival and backups

8) ***Bandwidth Analysis*** - an estimated bandwidth required in the server and internet capacity in the individual MOHA is considerably important.

Technical Methodology and System Development

Project Planning

The assignment will be carried out through **Scrum Agile Project Management** .Scrum is the leading agile development methodology for completing projects with a complex, innovative scope of work. When using agile techniques and its most popular method, Scrum, a team uses specific roles, artefacts.

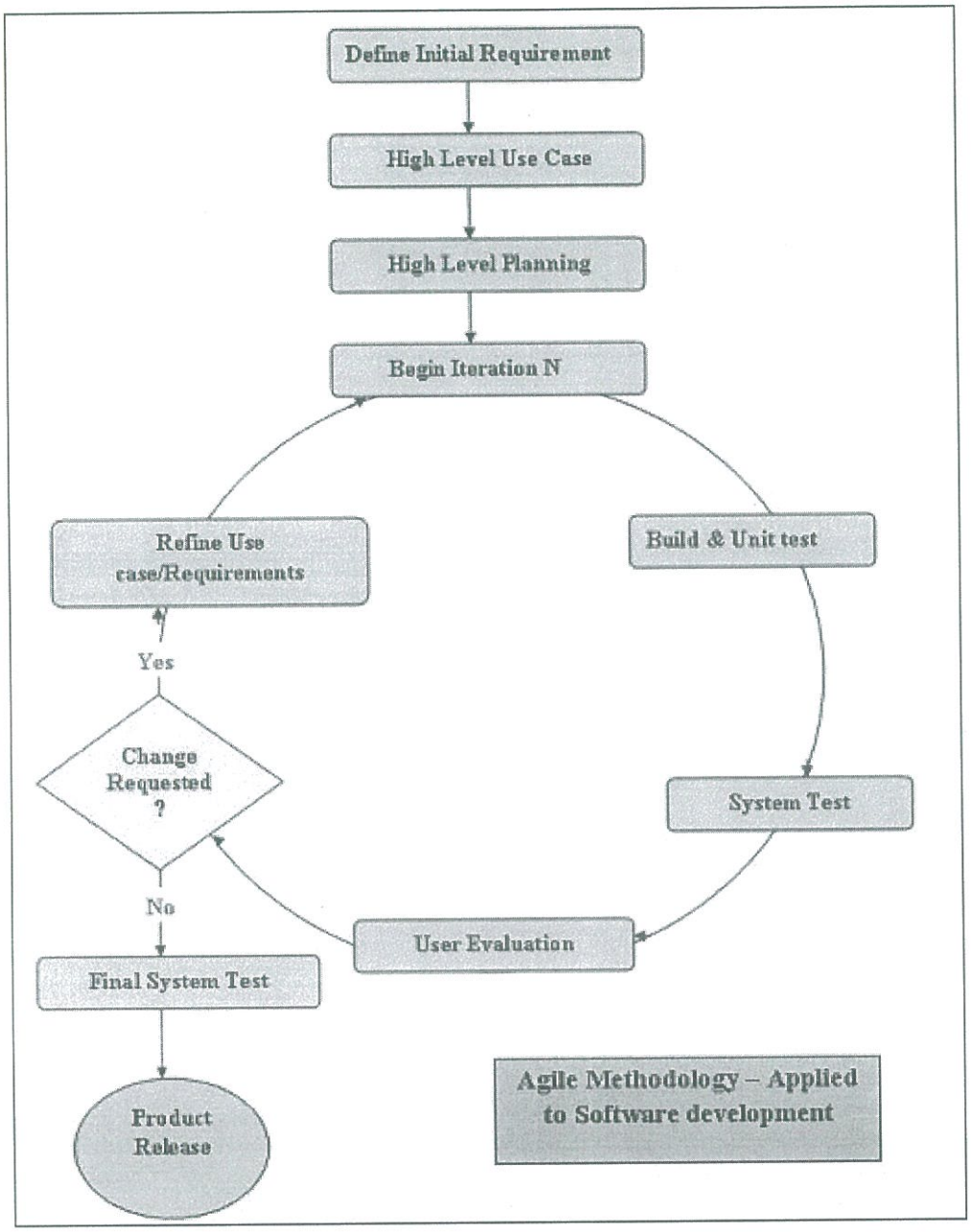

Fig: Scrum Agile Methodology

Scrum Activities	Functions
Initiating	Determine roles Decide how many sprints will compose each release and the scope of software to deliver
Planning	Create product backlog Create sprint backlog Create release backlog

	Plan work each day in the daily Scrum Document stumbling blocks in a list
Executing	Complete tasks each day during sprints Produce a shippable product at the end of each sprint
Monitoring and Controlling	Resolve issues and blockers Create and update burndown chart Demonstrate the completed product during the sprint review meeting Quality Assurance User Acceptance Tests (UAT)
Closing	Reflect on how to improve the product and process during the sprint reflection meeting

Table 1 Project Planning

Scrum Project Participants Role/Resources Involved in the Project

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The assignment will first assign roles to

Product owner: The person responsible for the business value of the project and for deciding what work to do and in what order, as documented in the product backlog. In this case **'The Team Leader'** will be the Product Owner.

ScrumMaster: The person who ensures that the team is productive, facilitates the daily Scrum, enables close cooperation across all roles and functions, and removes barriers that prevent the team from being effective. Scrum Masters will have authority over the process but not the people on the team. In this assignment **'The Team Leader'** will also function as the 'ScrumMaster'

Scrum team or development team: A cross-functional team of three people who will organize themselves and the work to produce the desired results for each sprint. A sprint normally lasts two to four weeks, during which specific work must be completed and made ready for review. In this assignment **Team Leader/Project Manager 1, Programmer, Support Staff (Electrical Engineer) 1, Support Staff (Computer Engineer) 1,** will form 'The Scrum Team'

Creating Artifacts:

In Scrum, an artifact is a useful object created by people. An artifact can be called a deliverable in other project management approaches. The following three artifacts are created with Scrum:

Product backlog:

A single list of features prioritized by business value. The highest-priority items should be broken down in enough detail for the team to estimate the effort involved in developing them. Some experts suggest scheduling about ten work-days for each item.

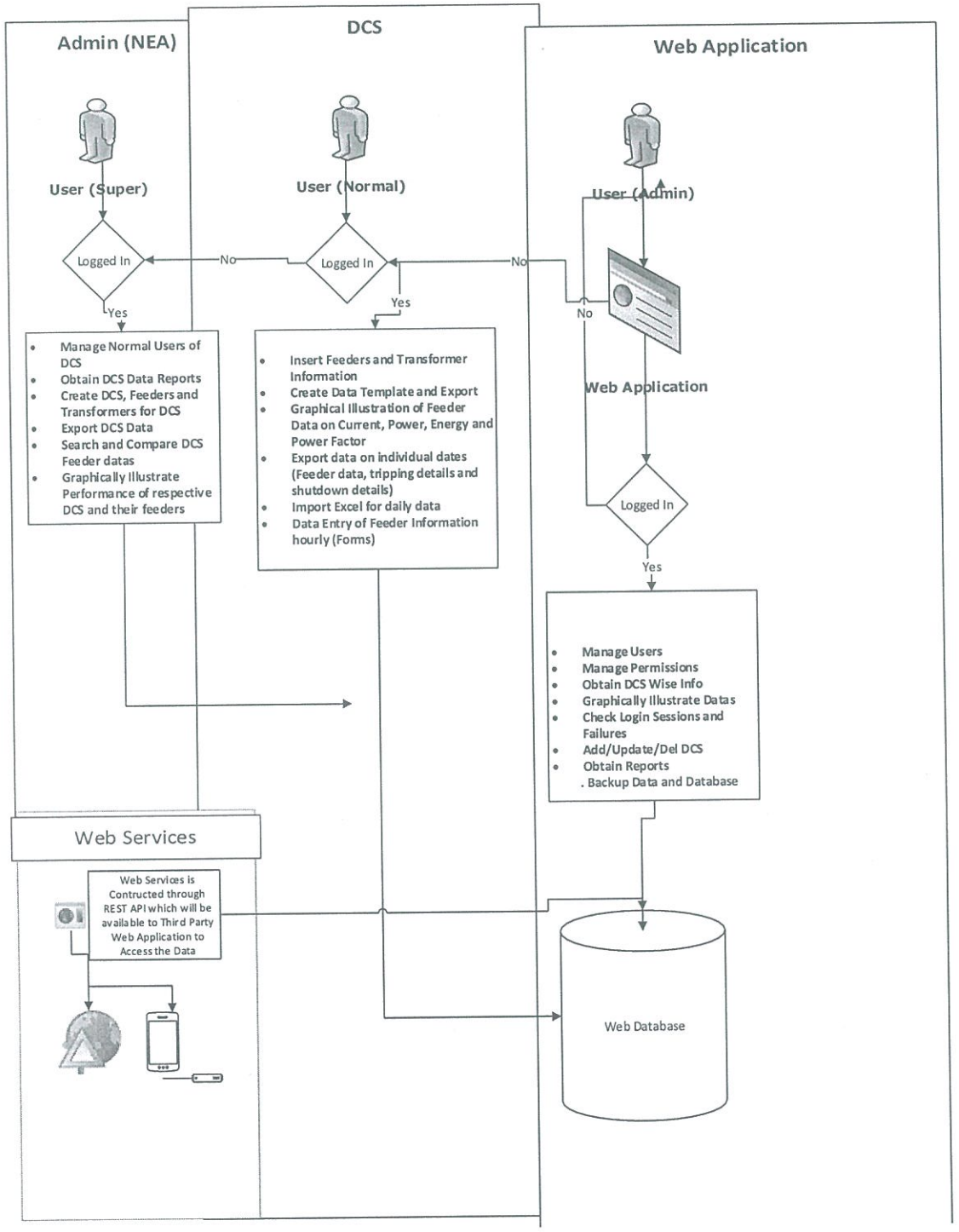
Sprint backlog:

The highest-priority items from the product backlog to be completed within a sprint. The Scrum team breaks down the highest-priority items into smaller tasks that take about 16 hours to complete. Examples of a sprint backlog and product backlog are provided later in this section under Planning.

Product Backlog	Sprint Backlog
➢ User story tem-plates, samples, and point person ➢ WBS templates, samples, and point person ➢ Project schedule templates, samples, and point person ➢ Ability to charge customers for some intranet products and services ➢ Ability to collect user suggestions ➢ Business case templates, samples, and point person	➢ User story templates, samples, and point person ➢ WBS tem-plates, samples, and point person ➢ Project schedule templates, samples, and point person ➢ Ability to charge customers for some intra-net products and services ➢ Ability to collect user suggestions

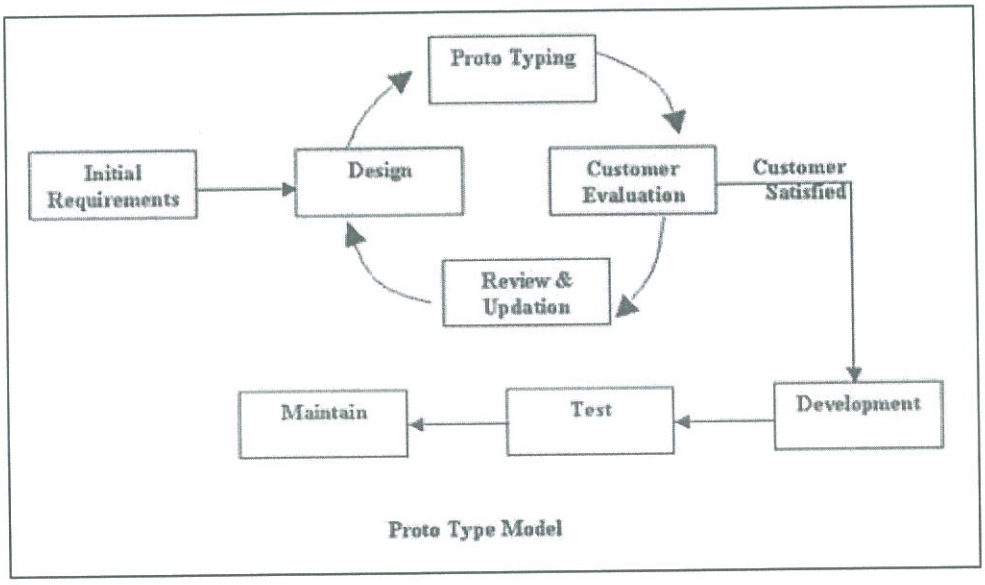
➢ Ask the Expert feature ➢ Stakeholder management strategy templates, samples, and point person ➢ Risk register templates, samples, and point person Etc.	

Logical Flow Diagram



System Development

The Prototyping Model is a systems development method (SDM) in which a prototype (an early approximation of a final system or product) is built, tested, and then reworked as necessary until an acceptable prototype is finally achieved from which the complete system or product can now be developed. This model works best in scenarios where not all of the project requirements are known in detail ahead of time. It is an iterative, trial-and-error process that takes place between the developers and the users.



The different steps in the system development using Prototype Model are as follows:

1. The new system requirements are defined in as much detail as possible. This usually involves interviewing a number of users representing all the departments or aspects of the existing system.
2. A preliminary design is created for the new system.
3. A first prototype of the new system is constructed from the preliminary design. This is usually a scaled-down system, and represents an approximation of the characteristics of the final product.
4. The users thoroughly evaluate the first prototype, noting its strengths and weaknesses, what needs to be added, and what should to be removed. The developer collects and analyzes the remarks from the users.
5. The first prototype is modified, based on the comments supplied by the users, and a second prototype of the new system is constructed.
6. The second prototype is evaluated in the same manner as was the first prototype.
7. The preceding steps are iterated as many times as necessary, until the users are satisfied that the prototype represents the final product desired.

8. The final system is constructed, based on the final prototype.
9. The final system is thoroughly evaluated and tested. Routine maintenance is carried out on a continuing basis to prevent large-scale failures and to minimize downtime

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Framework

Laravel Framework is the framework used in the design and development of the current system. The CMS is the Content Management System built by the consultant for the development of website and web applications for their clients. The CMS framework is built over '*Laravel* a renowned web development framework in PHP/MySQL. The development framework is Open Standard and is compliance with NASCII Standard.

Laravel is a free, open-source PHP web framework, created by Taylor Otwell and intended for the development of web applications following the model–view–controller (MVC) architectural pattern. Some of the features of Laravel are a modular packaging system with a dedicated dependency manager, different ways for accessing relational databases, utilities that aid in application deployment and maintenance, and its orientation toward syntactic sugar.

The following features serve as Laravel's key design points (where not specifically noted, descriptions refer to the features of Laravel 3):

- Bundles provide a modular packaging system since the release of Laravel 3, with bundled features already available for easy addition to applications. Furthermore, Laravel 4 uses Composer as a dependency manager to add framework-agnostic and Laravel-specific PHP packages available from the Packagist repository.
- Eloquent ORM (object-relational mapping) is an advanced PHP implementation of the active record pattern, providing at the same time internal methods for enforcing constraints on the relationships between database objects. Following the active record pattern, Eloquent ORM presents database tables as classes, with their object instances tied to single table rows.
- Query builder, available since Laravel 4, provides a more direct database access alternative to the Eloquent ORM. Instead of requiring SQL queries to be written directly, Laravel's query builder provides a set of classes and methods capable of building queries programmatically. It also allows selectable caching of the results of executed queries.
- Application logic is an integral part of developed applications, implemented either by using controllers or as part of the route declarations. The syntax used to define application logic is similar to the one used by Sinatra framework.

- Reverse routing defines a relationship between the links and routes, making it possible for later changes to routes to be automatically propagated into relevant links. When the links are created by using names of existing routes, the appropriate uniform resource identifiers (URIs) are automatically created by Laravel.
- Restful controllers provide an optional way for separating the logic behind serving HTTP GET and POST requests.
- Class auto loading provides automated loading of PHP classes without the need for manual maintenance of inclusion paths. On-demand loading prevents inclusion of unnecessary components, so only the actually used components are loaded.
- View composers serve as customizable logical code units that can be executed when a view is loaded.
- Blade templating engine combines one or more templates with a data model to produce resulting views, doing that by transpiling the templates into cached PHP code for improved performance. Blade also provides a set of its own control structures such as conditional statements and loops, which are internally mapped to their PHP counterparts. Furthermore, Laravel services may be called from Blade templates, and the templating engine itself can be extended with custom directives.
- IoC containers make it possible for new objects to be generated by following the inversion of control (IoC) principle, in which the framework calls into the application- or task-specific code, with optional instantiating and referencing of new objects as singletons.
- Migrations provide a version control system for database schemas, making it possible to associate changes in the application's codebase and required changes in the database layout. As a result, this feature simplifies the deployment and updating of Laravel-based applications.
- Database seeding provides a way to populate database tables with selected default data that can be used for application testing or be performed as part of the initial application setup.
- Unit testing is provided as an integral part of Laravel, which itself contains unit tests that detect and prevent regressions in the framework. Unit tests can be run through the provided artisan command-line utility.
- Automatic pagination simplifies the task of implementing pagination, replacing the usual manual implementation approaches with automated methods integrated into Laravel.
- Form request is a feature of Laravel 5 that serves as the base for form input validation by internally binding event listeners, resulting in automated invoking of the form validation methods and generation of the actual form.

Ready-to-use bundles provided by Laravel through Composer and Packagist include the following:

- Cashier, introduced in Laravel 4.2, provides an interface for managing subscription billing services provided by Stripe, such as handling coupons and generating invoices.

SSH, introduced in Laravel 4.1, allows programmatic execution of CLI commands on remote servers using the Secure Shell (SSH) as an encrypted network protocol.

- Scheduler, introduced in Laravel 5.0, is an addition to the Artisan that allows programmatic scheduling of periodically executed tasks. Internally, Scheduler relies on the cron daemon to run a single Artisan job that, in turn, executes the configured tasks.
- Flysystem, introduced in Laravel 5.0, is a file system abstraction layer that allows local file systems and cloud-based storage services provided by Amazon S3 and Rackspace Cloud to be used transparently and in the same way.
- Socialite, introduced in Laravel 5.0 as an optional package, provides simplified mechanisms for authentication with different OAuth providers, including Facebook, Twitter, Google, GitHub and Bitbucket.

HVMC Framework will be implemented in the system so that future updates of the system and codes become very easier. In HMVC Framework hierarchy of the built modules are seen and each module is developed using model, view and controller.

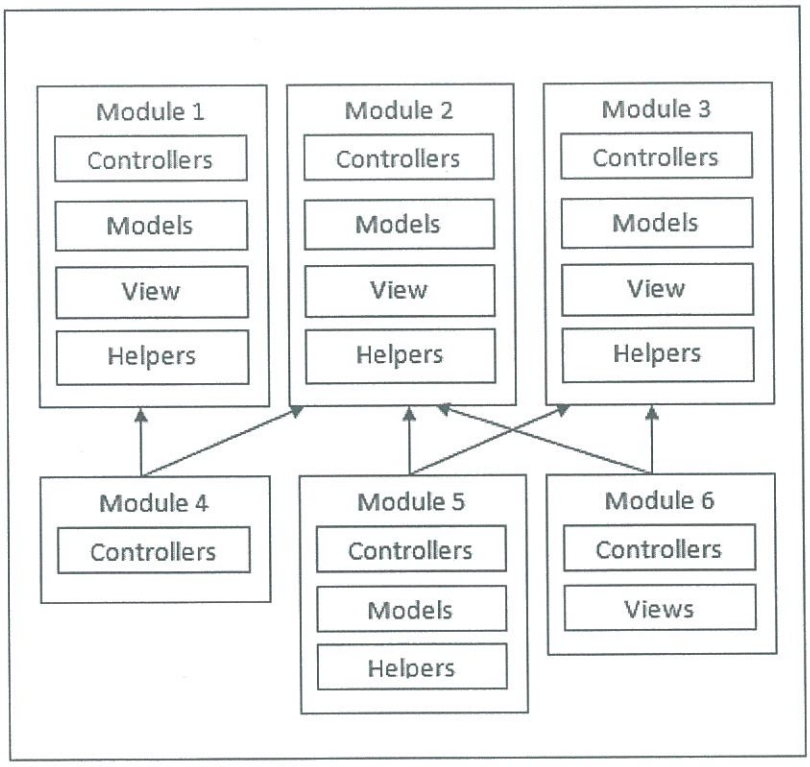


Fig: HMVC Framework

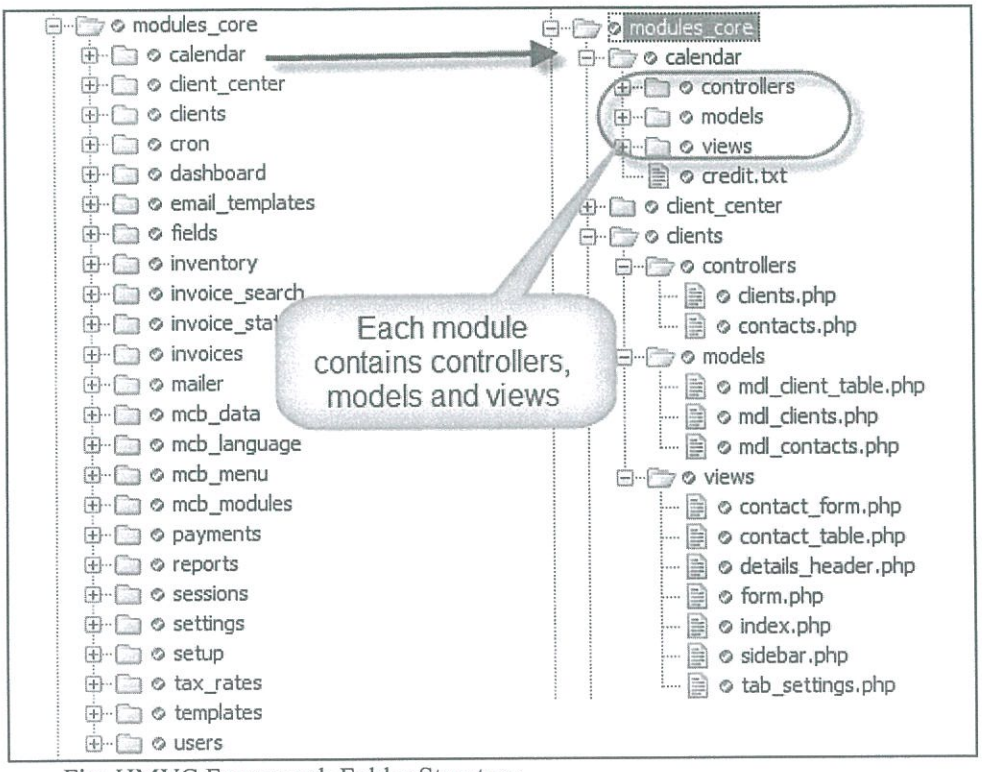


Fig: HMVC Framework Folder Structure

Design

The recent trends shows the design of web site and web application in '***Responsive Web Design***'. Design carried out to work on all devices browsers, android, iPhone, MacBook and iPad. We follow the trend in the development of the web based system using ***'Twitter Bootstrap'*** based on html, css and jQuery.

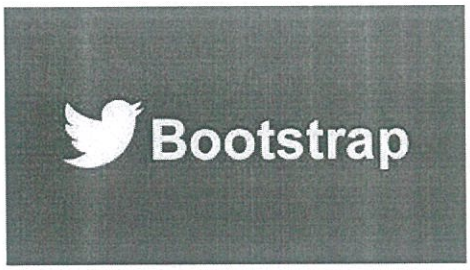


Fig: Twitter Bootstrap and Responsive Web Design

Language

PHP is the power open source web development language which will be used in the development of the system. ***AJAX*** will be used for display of different pages without refreshing that makes the web application as fast as possible which will be fully utilized in the development. HTML 5, CSS 5 , jQuery and jQuery UI will be used in the development of the proposed system to enhance the look and feel of the system along with performance enhancement.

Database

In the proposed system MySQL database will be used which has already been used in number of ministries web portal which is strong open standard database compliance with NASCII Standard.

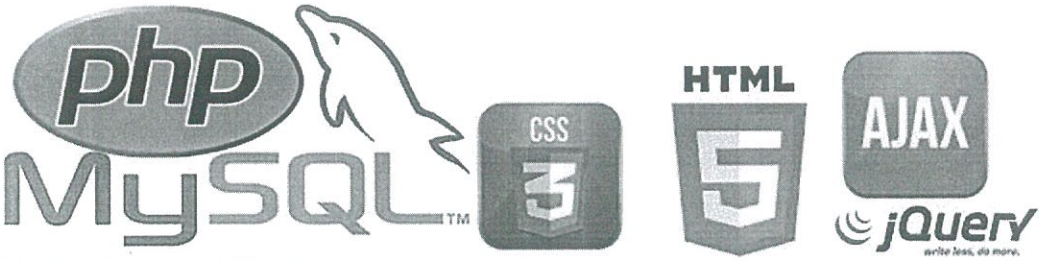


Fig 02: Tools and Technologies

Government Enterprise Architecture (GEA) Compliance

The consultant will abide by the step-wise approach for the existing applications to follow GEA Application Architecture include-

1. Identify the application type that your application represents.

2. If your type is above 2, enable the business logic as a web service.

3. Ensure the same web service that you build is used both the internal application as well as by the GEA portal through the web service.

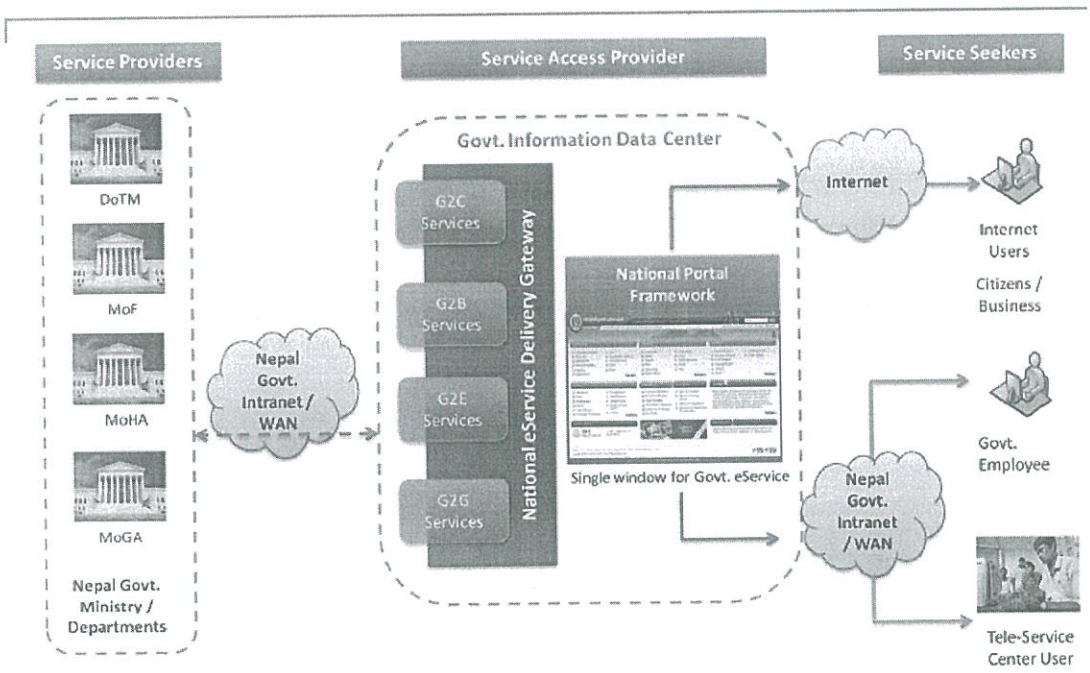
4. The same web service would be invoked by the client tier of the internal application.

The step-wise approach for the new applications to follow GEA Application Architecture specification includes -

1. The application architecture while being architected and reviewed needs to have the clear abstracted Client tier, web tier / presentation tier, business logic layer, each business use case to be available as a web service in the business services layer and data store layer, which host the databases.

2. Once the web services for each business use case is ready, host register these web services on the ESB's registry.

3. Utilize this web service published in your internal applications, as well share it with the other consumers who are authorized to access this information.



To adhere to the GEA architecture the consultant will adapt the following:

Scalability, Reliability & Flexibility: The technology is scalable with the emerging requirements and will continue to be reliable as the information handling needs of government increases.

Ease of Development & Maintenance: The complexity of the programming requirements for Online Data System will be examined keeping in mind maintenance requirements.

Total Cost of Ownership: The framework ensures that the Total Cost of Ownership (TCO) is kept at optimal levels. This will take into account estimates for software acquisition, likely updates, initial development, training, and maintenance costs.

Security: Security is one of the prime consideration and the various technical issues to address include data integrity, confidentiality, authorization, authentication, control, compliance, prevention from unauthorized usage and audit monitoring.

Open Standards: Usage of Open standards protocols, languages and software components help protect the site and technology against redundancy, unlimited license usage and also having the advantage of inter-operability and less TCO.

Ease of Integration: The Portal may be linked to other sources (websites, contents and portals). The portal architecture has provision to integrate with evolving requirements in the future.

Ease of Backup and Recovery: The architecture considers backup/archival of static as well as transactional data which can be deployed in production as and when necessary.

Rich User Experience: The architecture considers the following related to ODS software GUI

Browser Compatibility: Portal displays correctly in Internet Explorer and Firefox

Search Functionality: Portal provides extensive search functionality which is also simple and effective to use

Deployment and Design Testing

Testing during the early stages of development is far more cost effective than testing the coded software, and so for this reason the design is now tested to discover any inconsistencies or faults. This involves testing the Web application design against the goals and objectives described in the initial three steps outlined above, in order to ascertain whether the system can acceptably produce the information required by the user.

Software Testing is evaluation of the software against requirements gathered from users and system specifications. Testing is conducted at the phase level in software development life cycle or at module level in program code. Software testing comprises of Validation and Verification.

Software Validation and Testing

Validation is process of examining whether or not the software satisfies the user requirements. It is carried out at the end of the SDLC. If the software matches requirements for which it was made, it is validated.

- Validation ensures the product under development is as per the user requirements.
- Validation answers the question – "Are we developing the product which attempts all that user needs from this software ?".
- Validation emphasizes on user requirements.

Software Verification

Verification is the process of confirming if the software is meeting the business requirements, and is developed adhering to the proper specifications and methodologies.

- Verification ensures the product being developed is according to design specifications.
- Verification answers the question– "Are we developing this product by firmly following all design specifications ?"
- Verifications concentrates on the design and system specifications.

Target of the test are -

- **Errors**- These are actual coding mistakes made by developers. In addition, there is a difference in output of software and desired output, is considered as an error.
- **Fault**- When error exists fault occurs. A fault, also known as a bug, is a result of an error which can cause system to fail.
- **Failure** - failure is said to be the inability of the system to perform the desired task. Failure occurs when fault exists in the system.

Testing Approaches

Tests can be conducted based on two approaches –

- Functionality testing
- Implementation testing

Quality Control, Quality Assurance and Audit

We need to understand that software testing is different from software quality assurance, software quality control and software auditing.

- **Software quality assurance**
- **Software quality control**

- **Software audit**

Generation of the System

Resource Selection
All the resources for the development of the web application, such as hardware, software, communications links and the necessary personnel, will be selected during this step. A number of different applications and servers may need to be integrated, so the technical specifications should be examined to ensure compatibility.

Design Review
Design Document from is compared with the available resources from the previous step to ensure the design can be achieved with the resources selected. If incompatibilities are found, the Design Phase and Resource Selection are reviewed. This is an iterative process, and if problems arise, Requirement Phase can be re-visited.

Code Generation and Installation (Functional Modules)
The coding step sees the generation of all of the software connected with the site and its installation onto relevant Web servers. This may just involve simply posting the site onto a Web server, but it could also involve more complex tasks, such as database connections

Modules Developed

I. Login Module

The module is helpful for the different stakeholder's of the proposed system to log in into the system to perform the desired task based on their access level. Admin User and DCS user can login into the system through login module. Dashboard arrives in accordance to the access level to different user's i.e. different type of user will have different dashboard. The parameters in this module will be username or email, password and user type (administrator, office user).

In this module the session log of all the users logged in into the system is maintained and the consecutive failure of the login attempt for 3 times will block the user. To unblock the user different module is provided which facilitates the admin user to unblock the user once blocked by the system.

II. Dashboard Module

After the login into the system the admin user and office user are directed towards their respective Dashboard depending on the permission and roles assign to the different user types. Dashboard module consists of the display of different information in graphical formats like pie chart, bar graph and html tables etc.

III. User Management Module

User Management module is the module accessible to the admin user of the system who is capable of adding different users and has rights to create users for different users/DCS etc.

The above figure shows the list view and form view of the user management module. Apart from that admin user are able to show the permissions assigned to different type of office users.

IV. DCS

DCS Module is accessible to Admin User To create/update/delete DCS Information.

V. Feeder Module

This master module will allow the administrator and DCS user to insert information about the different feeders.

VI. Transformer Module

The administrative Module is accessible to administrator and DCS user to insert information about the Transformer.

VII. Template Creation Module

The module is accessible to DCS user and administrator user to create the data template for data entry and/or excel import of feeder. There is the possibility to enter the feeder names for the respective feeders and the parameters. The Template is exportable in Excel format for data entry purpose.

VIII. Data Entry through Form Module

The Module is accessible to the DCS users to enter the hourly data of incoming and outgoing feeders through the form. Here, the entry form is obtained based on the template selection for particular DCS.

IX. Excel Import Module

The module is accessible to the DCS users for importing the hourly data in daily basis through excel file. The file fecilitates the entry of feeder data only. Arrange shutdown and Tripping details should be inserted separately.

X. Dialy data export

The module is accessible to both the administrator and DCS users to extract the daily reports of particular DCS and their feeders including feeder data and tripping/shutdown details.

XI. API Management Module

The administrative module is useful for the admin users to manage api for different functionalities of the system. The API is generated by the system to make the access of related information by the mobile app and access to other sources through direct api access,

XII. Web Services/SMS Integration Module

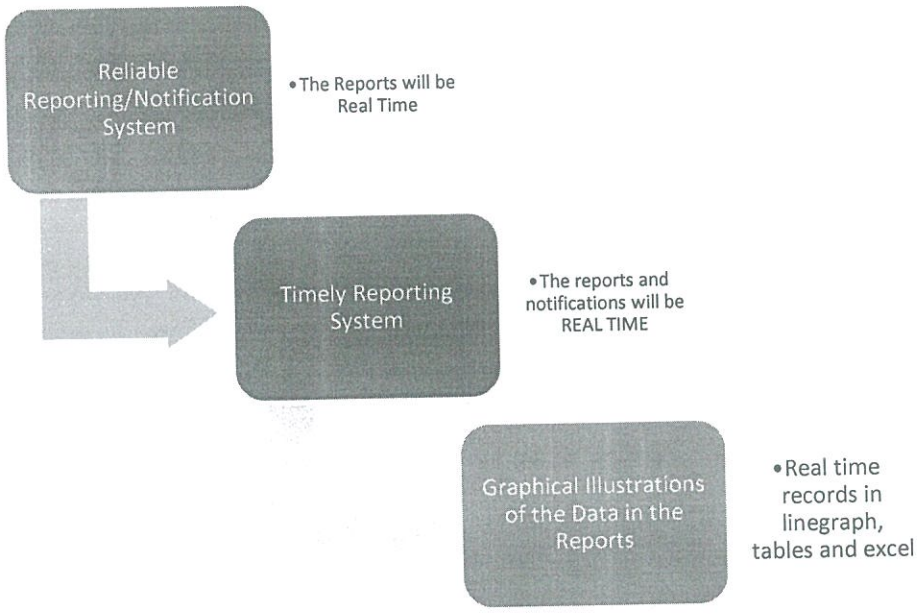
The important information of the proposed system needs to be disseminated to other systems also. Online Data System should have access to important information regarding the proposed system for information display. Web Service will be constructed for the purpose of important information through other systems. SMS Integration could be the important feature to be used in the system for prompt information convey to the program head and other important person of the system.

XIII. Search Module

The module is accessible to all types of users of the system. The module facilitates the user to search different modules of the system based on different criteria. The search module helps the users to find the exact information or set of information of the project/personnel/data/reports in the system. The parameters of the search module are the important parameters of each module of the system. Particularly there is options to search data by DCS, Feeders, date, time and templates.

XIV. Reporting Module

The module is accessible to both type of users based on their permissions. The DCS user are able to obtain the reports of their own office monthly, trimester or yearly. The admin user are able to obtain the comparative report or individual report. The report shall be obtained in .xlxs or docx format prespecified.



TEAM COMPOSITION AND TASK ASSIGNMENT

Name	Position	Education Qualification	Years of Experience
Rohan Bhattarai	Team Leader	MBA, BCIS	
Rabindra Maharjan	Power System Engineer	Phd in Electrical Engineering	10+
Subodh Raj Satyal	Programmer	M.Sc. in TIM, B.E Computer	9+
Abichar Bohara	Programmer	M.Sc. in TIM, B.Tech in Electronics Engineering	10+
Ashish Bhandari	Programmer	M.Sc. in TIM, B.Tech in Electronics and Electrical Engineering	10+
Bikash Bhattarai	Networking Engineer	eMBA, B.Tech in Electronics	12+

TIME SCHEDULE

S.No.	Particulars	Time of Completion (Working Days)
1.	**Project Sign-Off**	**1**
2.	**Upgradation of Online Data Management Portal**	**12**
3.	**Upgradation of Reporting System**	**15**
4.	**Web Hosting**	**1**
5.	**Training in Selected DCS and Substation**	**10**
6.	**Preparation of User Manual and Technical Manual**	**6**
	Total	**45 days**

MANNING SCHEDULE

S.No.	Names of Professional Staffs	Time Frame (weeks) W1	W2	W3	W4	W5	W6
		S M T W T F S	S M T W T F S	S M T W T F S	S M T W T F S	S M T W T F S	S M T W T F S
1	Team Leader						
2	Power System Engineer						
3	Programmer1						
4	Programmer2						
5	Programmer3						
6	Networking Engineer						

10th December 2018

Upveda Technology Pvt. Ltd.

PILOTING AND TRAINING

The system has been piloted in five major distribution centers of Nepal (Minbhawan, Dhalkevar, Chandranigapur, Shivapur, Duhabi). Two operators from each substation was trained for 1 day on the operation of Online Data System for NEA's Distribution System. The training has been provided for the following:

1. Addition of Feeder Information
2. Data Entry of Log Sheet in Prespecified Excel Format
3. Direct Entry of Feeder data in forms
4. Data Entry on Arrange Shutdown and Tripping Details
5. Data Entry on Daily Energy Data
6. Searching and Filtering Data to get reports on different datas Energy, Power, Power factor etc
7. Data Exporting in Excel format of Daily Logsheet
8. Data Exporting in Excel Format for Shutdown and Tripping Information
9. Printing Line Graph and Bar Graph