**SERIS**

Solar Energy Research Institute Singapore



Cloud Based Real-time Analytical Monitoring of Photovoltaic Systems

Project Plan (PP)

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# INTRODUCTION

## Purpose

The purpose of this document is to provide a Project Plan for the work to complete the development and implementation of cloud-based Real-time Analytical Monitoring (RAM) of Photovoltaic Systems and Weather Parameters.

## Audience

The intended readers of this Project Plan are the project team to:

1. Provide them with a plan for the activities that they are going to perform;

2. Specify the deliverables they are to produce and;

3. Indicate the required effort, budgets and timescales.

## Organization

## Reference

# APPROACH

The approach that will be applied to the development of the RAM will be to carry out the development phases outlined below.

## Project Initiation

To initiate the project, a formal project plan will be produced (this document). Subsequently, a QA plan will be produced. To complete the project initiation tasks, a project filing system will be set-up.

## Initial Requirements Analysis.

The project will undertake requirements analysis by:

1. liaising closely with SERIS to identify the user requirements;

2. producing a user requirements specification; and

3. conducting additional user interviews or requirement workshops to resolve any remaining requirements issues or gaps.

## Prototype Development

Based on the high-level user requirements specification, a prototype will be produced by using JAVA and the AWS services (IoT, Lambda, Dynamo DB, EC2) etc.; Not all functionalities will be included in the prototype and the main focus for prototyping is to demonstrate the POC of the cloud architecture and services which will be used in the project. SERIS will have to determine the acceptability of technology selections and AWS cloud services, to determine the technology feasibility and same has to be agreed to be included in the prototype survey report. As a result of the prototype demonstration, changes will be agreed to be included in the development only if it is necessary.

## Software Implementation

When the final prototype has been produced and requirements for the software have been agreed, the software will be implemented by:

1. specifying the detailed processes to be implemented;

2. coding the new software (cloud-based RAM web application);

4. undertaking system testing;

5. producing user and programmer documentation;

6. undertaking activities to achieve SERIS's acceptance of the completed system;

7. deployment of the accepted system on the AWS cloud; and

8. user training manual if required.

# WORK PLAN

The following work program has been identified to complete the development of the system according to the approach described in Section 2.

Activity 1 : Initial Planning.

Activity 2 : Requirements Identification.

Activity 3 : Requirement Analysis and Design

Activity 4 : Programming

Activity 5 : Testing

Activity 6 : User and Programmer Documentation.

Activity 7 : User Acceptance.

Activity 8 : Implementation

Activity 9 : Management and Administration.

Activities 1 through 8 contain the technical activities required to produce the system. Activity 9 provides the supporting management and administrative activities. The work to be performed in each activity is described in the following subsections.

## Activity 1 – Initial Planning.

After the preliminarily user meeting, a high-level user requirement specification will be produced for SERIS to verify the user requirements. The key project deliverables are broken down into manageable tasks. The project size and complexity will be estimated using use case points estimation technique.

## Activity 2 – Requirements Identification.

After gathering all the requirements, we will be doing the preliminary research and analysis on the requirements which are gathered and based on the outcome of this we create a URS (User Requirement Specification), UCMS (Use Case Model Survey) and User Interface Requirement Document.

As described in Section 2, the detailed requirements for the software to be developed will be determined by creating a prototype using the AWS cloud services. This work will result in the production of a High-Level Design and Prototype Survey Report.

## Activity 3 - Requirement Analysis and Design.

This activity will help in creating the UCMS document and capture all the use cases required for RAM. High Level Design will be created which will become guiding principle for Low Level Design and implementation.

## Activity 4 - Programming.

The software requirements are defined during the requirement workshop and prototyping activities and documented in the system specification. The application will be coded using an appropriate programming language to produce the required application. HLD or programmer manual will be used as guiding principle for programming the application. The following tasks will be performed.

### Define AWS services and Set-Up.

The system will use the AWS cloud services for receiving incoming data from different devices, processing the data and storing data into the respective databases. Linux EC2 instance with the Docker container shall be set up on the AWS cloud for the JAVA web application which will be installed into a Docker Image and deployed into EC2 instance, for the users to interact with the system. The necessary API for the web user interfaces will be implemented in JAVA application for consuming required data. The API design for web application will be documented in the programmer’s manual.

### Process Specification.

Processes that are required to be coded will be specified. These specifications will be documented in the programmer's manual or HLD produced in Activity 6.

### Software Coding.

The software will be coded by using JAVA, Angular or React, JavaScript Graph Libraries, AWS Lambda for processing incoming data, NPM/Yarn, AWS Elastic Load Balancing if required, Eclipse as tool, rest-based APIs services, AWS Dynamo DB for static contents of RAM. During coding, the programmer will apply the programming standards specified in the project's QA plan, to ensure the consistency and quality of the software produced.

## Activity 5 - Testing.

To exercise quality control over the software produced, various testing procedures will be carried out. The following tasks will be performed. Refer MPP and QP for more detailed activity.

### Test Planning.

The testing work to be performed will be formally planned, resulting in the production of a system test plan document. This document will define the tests to be performed to demonstrate all the circumstances in which the software is required to operate, as specified in the system specification. Any standards and guidelines that are required for carrying out the tests will also specified in the plan.

### System Testing

The runs of the software, defined in the system test plan, will be undertaken, checked and documented in the system testing work file or defect tracker. Any errors detected during testing will be corrected and the appropriate tests will be re-run to demonstrate that the software is operating correctly.

## Activity 6 - User and Programmer Documentation.

Under this activity, the user's manual and the programmer's manual or HLD for the RAM Application (Real time analytical monitoring Application) will be produced.

### User's Manual.

This document will describe the functions of the application.

### Programmer's Manual.

This manual will provide the information required by the programmers tasked with maintaining the software (that cannot be found in the system specification or user's manual). It will include wireframes, continuous integration tool, low level descriptions of the navigation between screens, and code listings.

## Activity 7 - User Acceptance.

The next stage in the development of the system will be for the users to test the system in User Acceptance phase. This trial will form the basis of the process by which the user will accept the system. The following tasks will be performed.

### Planning.

The Project Manager will liaise with SERIS to arrange the User Acceptance and ensure that appropriate user staff are available to conduct the test. The Manager will also agree with the user, the duration of the trial and the method by which the users should report errors, observations and suggestions.

### Installation.

The software will be installed on AWS cloud, and a subset of the system tests will be re-run to ensure that the software functions correctly.

### User Training.

The users will receive training in the basic use of the software. No need to provide end user with training manual.

### Trial.

The user in SERIS will use the system during the suggested trial period. The Project Leader will provide continuous support to the users during the trial period. All errors detected, observations and suggestions will be reported in the form agreed at the planning stage (refer to Section 3.7.1).

### Final Changes.

At the end of the trial, a meeting will be held at which the user and the project team will review the reports from the trial (errors, observations and suggestions), and agree the changes to be made to the software. The project team will then implement the agreed changes.

## Activity 8 - Implementation.

When the final changes have been successfully completed by the project team (refer to Section 3.7.5), a formal acceptance meeting will be held at which the project will demonstrate that the "agreed final changes" have been made. If this has been satisfied by the users, then SERIS will be requested to accept the system. Otherwise, further modifications will be made until the "agreed final changes" are acceptably implemented. The system will be deemed accepted when written confirmation of acceptance is received from the user.

## Activity 9 - Management and Administration.

This activity covers the project planning, management and administration activities required to support the technical project tasks. The following tasks are to be involved.

### Production of Project Plan.

This activity involves the detailed planning of the project, resulting in the production of this document (ref MGMT/PLAN/PP/WORK IN PROGRESS). It consists of work breakdowns, staff effort estimates, resource requirements, time schedules, milestones and deliverables.

### Set-up Filing System.

The project filing system for management and technical files will be set- up in accordance with the pre-defined standards.

### Production of Project Quality Plan.

A project quality plan (ref MGMT/QUALITY/QP/WORK IN PROGRESS) will be produced to specify how the project will assure the quality of its deliverables, and its main mechanism by which the project is monitored and managed for quality assurance. In particulars, the plan will specify the standards and procedures that will be applied to the project's technical and management activities, and will detail the reviews to be performed and the acceptance procedure for each deliverable.

### General Management and Administration.

This activity covers all aspects of the general management and administration of the project to be performed. The following tasks will be involved.

1. detailed planning of activities;
2. progress reporting;
3. production of meeting minutes;
4. project tracking; and
5. the maintenance of the project filing system.

# STAFF EFFORT ESTIMATES.

## Staff Effort Estimates and Progress

Estimates of the staff effort required to undertake the activities described in Section 3 are given in attached [Microsoft Project file](RAM.mpp).

## Use-Case Point Estimation

### Calculate weighted number of Actors

|  |  |  |  |
| --- | --- | --- | --- |
| **Actors** | **Complexity** | **Weighting Factor** | **Contribution** |
| System Admin System User | Complex | 3 | 6 |
| Device Lambda Syncer | Average | 2 | 6 |
| AWS Dynamo  Kenisis  IoT  S3 | Sample | 1 | 4 |
|  | | **Total Weight(Actors)** | **16** |

### Calculate weighted number of Use Cases

|  |  |  |  |
| --- | --- | --- | --- |
| **Use Cases** | **Use Case Type** | **Weighting Factor** | **Contribution** |
| Transform raw data to structured  Data | Complex | 15 | 15 |
| Maintain users  Maintain devices info | Average | 10 | 20 |
| Maintain personas  Maintain device group(s)  Maintain stations  Authenticate Users  View station history information  View real-time station information  View/select user  View/select station  View/select persona  View/select device group  Select device(s)  Store structured data  Send real-time data  Display real-time data  Download history data  Send stream data  Pass raw data  Store raw data  Synchronize data with browsers | Simple | 5 | 95 |
|  | **Total Weight (Use Cases)** | | **130** |

### Use Case based Estimation on Technical Complexity Factors

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Factor Number** | **Factor Description** | **Weighting Factor** | **Grading**  **(0-5)** | **Weighted**  **Grading** |
| T1 | Distributed system | 2 | 4 | 8 |
| T2 | High response or throughput performance requirements | 1 | 3 | 3 |
| T3 | End-user efficiency | 1 | 2 | 2 |
| T4 | Complex internal processing | 1 | 2 | 2 |
| T5 | Reusability requirements | 1 | 5 | 5 |
| T6 | Ease of Installation | 0.5 | 0 | 0 |
| T7 | Ease of Use | 0.5 | 2 | 1 |
| T8 | Portability requirements | 2 | 3 | 6 |
| T9 | Ease of Change | 1 | 3 | 3 |
| T10 | Concurrency requirements | 1 | 4 | 4 |
| T11 | Special security requirements | 1 | 1 | 1 |
| T12 | Provision of direct access for third parties | 1 | 5 | 5 |
| T13 | Special user training facilities requirement | 1 | 1 | 2 |
|  | **Technical Factor (TCF)**  **=0.6+0.01\*SUM(T1-T13)** | | | **1.02** |

### Use Case based Estimation on Environmental Factors

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Factor Number** | **Factor Description** | **Weighting Factor** | **Grading**  **(0-5)** | | **Weighted grading** |
| F1 | Development team familiarity with OO development process | 1.5 | 4 | | 6 |
| F2 | Development team application domain experience | 0.5 | 1 | | 0.5 |
| F3 | Object-oriented experience | 1 | 4 | | 4 |
| F4 | Lead analyst capability | 0.5 | 3 | | 1.5 |
| F5 | Development team motivation | 1 | 3 | | 3 |
| F6 | Requirement stability | 2 | 3 | | 6 |
| F7 | Part-time team membership | -1 | 3 | | -3 |
| F8 | Difficulty of implementation language | -1 | 1 | | -1 |
|  | **Environmental Factor (EF)**  **=1.4-0.03\*SUM(F1-F8)** | | | | 0.89 |
|  |  |  | |  |  |

Unadjusted Use Case Point = Total Weight + Total Weight

(UUCP) (Actors) (Use Case)

= 16 + 130

= 146

Use Case Point (UCP) = UUCP \* TCF \* EF

= 146 \* 1.02 \* 0.89

= 132.5388

Effort (man-days) = Use Case Point (UCP) \* 17

= 132.5388 \* 17

= 2253.1596 (man-hours)

= 281.64495 (man-days)

= 56.32899 (man-days/person)

# TIMESCALES AND MILESTONES.

The timescales for the activities described in Section 3 using the staff effort specified in Section 4 are given in Figure 5.2. From these timescales, major milestones have been identified, as shown in Figure 5.1.

|  |  |  |
| --- | --- | --- |
| **Project Milestones** | | **Approx. Date** |
| **Increment 0** | | |
| 1.1 | Issue Work Breakdown Structure | 7/3/18 |
| 1.2 | Issue Use Case Modelling Survey Report | 13/4/18 |
| 1.3 | Issue Prototype Study Report | 24/4/18 |
| 1.4 | Issue Risk Tracker | 7/3/18 |
| 1.5 | Issue Project Plan Doc | 30/3/18 |
| 1.6 | Issue User Requirement Specification Doc | 22/3/18 |
| 1.7 | Issue User Interface Specification Doc | 28/3/18 |
| 1.8 | Issue High Level Design Doc | 19/3/18 |
| 1.9 | Issue Quality Plan Doc | 8/3/18 |
| 1.10 | Produce Prototype | 23/4/18 |
| **Increment 1** | | |
| 2.1 | Setup Cloud Environment | 11/5/18 |
| 2.3 | Issue Design Report | 15/6/18 |
| 2.4 | Complete Source Control Plan and Setup | 13/6/18 |
| 2.5 | Complete Coding | 20/7/18 |
| 2.6 | Issue System Test Plan | 24/7/18 |
| 2.7 | Complete System Testing | 27/7/18 |
| 2.8 | Issue SIT Document | 2/8/18 |
| 2.9 | Complete Integration Test | 7/8/18 |
| 2.10 | Issue User Acceptance Test Plan | 14/8/18 |
| 2.11 | Issue End User Training Manual and User Guide | 12/8/18 |
| 2.12 | Complete User Acceptance Testing | 22/8/18 |
| 2.13 | Issue User Acceptance Test Document | 27/8/18 |
| **Increment 2** | | |
| 3.1 | Issue Design Report | 12/10/18 |
| 3.2 | Complete Coding | 27/11/18 |
| 3.3 | Issue System Test Plan | 29/11/18 |
| 3.4 | Complete System Testing | 4/12/18 |
| 3.5 | Issue SIT Document | 10/12/18 |
| 3.6 | Complete Integration Test | 13/12/18 |
| 3.7 | Issue User Acceptance Test Plan | 20/12/18 |
| 3.8 | Issue End User Training Manual and User Guide | 24/12/18 |
| 3.9 | Complete User Acceptance Testing | 23/12/18 |
| 3.10 | Issue User Acceptance Test Document | 1/1/19 |
| 3.11 | Training Users | 10/1/19 |
| 3.12 | Project Hand-over | 16/1/19 |

# DELIVERABLES

As a result of undertaking the work described in this plan, the following deliverables will be produced by the project.

|  |  |
| --- | --- |
| **Project Deliverables** | |
| **Increment 0** | |
| 1.1 | Project Plan |
| 1.2 | Quality Plan |
| 1.3 | User Requirement Specification |
| 1.4 | Use Case Modelling Survey Report |
| 1.5 | User Interface Specification |
| 1.6 | Prototype Study Report |
| 1.7 | High Level Design Specification |
| **Increment 1** | |
| 2.1 | Use Case Model Survey Report (Requirement) |
| 2.2 | Design Model Report |
| 2.3 | Source and Executable Code |
| 2.4 | System Test Plan |
| 2.5 | SIT Document |
| 2.6 | User Acceptance Test Plan |
| 2.7 | User Acceptance Test Document |
| 2.8 | End User Training Manual and User Guide |
| **Increment 2** | |
| 3.1 | Use Case Model Survey Report (Analysis) |
| 3.2 | Design Model Report |
| 3.3 | Source and Executable Code |
| 3.4 | System Test Plan |
| 3.5 | SIT Document |
| 3.6 | User Acceptance Test Plan |
| 3.7 | User Acceptance Test Document |
| 3.8 | End User Training Manual and User Guide |
| 3.9 | Deployment Process Guide |

# PROJECT STRUCTURE AND STAFFING

## Project Manager : Kaung Myat Bo

He will be responsible for the project on a month to month basis be reviewing progress against the plan and instituting appropriate action. In addition, he will provide advice to the Project Leader on the structure and content of the deliverable project documents and will be responsible for the production of the required planning documents.

## Project Leader : Treza Bawn Win

These three people will be responsible for undertaking the majority of the work described in Section 3. The tasks to be undertaken by his/her are defined as below:

1. production of Project Plan;

2. production of User Requirement Specification;

3. prototyping development;

4. production of System Specification;

5. database define and set-up;

6. production of Algorithm Specification;

7. software coding;

8. testing and installation;

9. user training and user trial support;

10. production of user's manual and programmer's manual/HLD;

11. implementation of RAM enhancements; and

12. general project administration activities.

# RESOURCES

The supporting resources required to enable the project team to undertake the activities specified in Section 3 are described as below:

## Accommodation

The development work will be undertaken in the project team's usual office at ISS. No additional office space is required.

## Computer Hardware and Software.

Mac and Windows machines.

AWS Cloud Environment.

|  |  |  |
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| Approval Record | | |
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| **Document Ref:** |  | |
| **Approved by** | **Date** | |
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| Theory and formulae are correct and properly applied. | |  |
| Illustrations are relevant, readable and logically placed. | |  |
| There are no typographical errors. | |  |
| Units are consistent throughout. | |  |
| The security classification is correct. | |  |
| There are no obvious omissions. | |  |
| The document complies with the Client's requirements, however specified. | |  |
| Responsibility is accepted for all opinions, conclusions and recommendations. | |  |
| The document does not run counter to company policy. | |  |
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