LOTUS

LOW-COST INNOVATIVE TECHNOLOGY FOR WATER QUALITY MONITORING
AND WATER RESOURCES MANAGEMENT FOR URBAN AND RURAL WATER SYSTEMS IN INDIA

Deliverable D8.2

Scientific Quality Assurance Plan

Lead: IIT B

Date: 15.06.2020

- Public -

LOTUS is co-funded by the European Commission under the Horizon 2020 research and innovation programme under Grant Agreement N° 820881 and by the Indian Government, Ministry of Science and Technology.

Project Deliverable

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820881	LOTUS	LOw-cost innovative Technology for water quality monitoring and water resources management for Urban and rural water Systems in India

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D8.2 Scientific Quality Assurance Plan

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Abstract

The Scientific Quality Assurance Plan of LOTUS project will provide guidelines to project organisation members to achieve desired results with defined quality criteria by stakeholder. This doc intended to provide information about (i) test plan for all the components and system planned to develop, (i) the configuration management plan for both project doc and source code generated in LOTUS project, (iii) Change management plan if any changes in project requirement during project period (iv) Quality assurance plan for LOTUS deliverables for bot Docs and prototypes.

Keywords

Test Plan, Quality assurance plan, configuration management, change management plan

Disclaimer

LOTUS has been financed with support from the European Commission and the Indian Government, Ministry of Science and Technology.

The LOTUS Project

LOTUS is a project funded by DG Environment under the European Union Horizon 2020 Research and Innovation Programme and by the Indian Government. It brings together EU and Indian prominent organisations with the aim to co-create, co-design and co-develop innovative robust affordable low-cost sensing solutions for enhancing India's water and sanitation challenges in both rural and urban area.

The LOTUS solution is based on an innovative sensor and includes tailor-made decision support to exploit the capabilities of the sensor as well as a specific approach to co-creation. LOTUS aims to be co-designed and co-produced in India, and have a wide, diverse and lasting impact for the water sector in India due to intense collaborations with commercial and academic partners in India.

Based on the low-cost sensor platform, solutions for the early detection of water quality problems, decision support for countermeasures and optimal management of drinking and irrigation water systems, tailored on the functionalities of the new sensor, will be developed and integrated with the existing monitoring and control systems.

This sensor will be deployed in five different use cases: in a water-network, on ground-water, in irrigation, in an algae-based waste water treatment plant and in water tankers. The packaging of the sensor, as well as the online and offline software tools will be tailored for each of the use cases. These last will enable to test the sensors and improve them iteratively.

The project is based on co-creation, co-design and co-production between the different partners. Therefore, an important stakeholder engagement process will be implemented during the project lifetime and involve relevant stakeholders, including local authorities, water users and social communities, and will consider possible gender differences in the use and need of water. Broad outreach activities will take place both in India and in Europe, therefore contributing to LOTUS impact maximisation.

The further development and exploitation (beyond the project) of the novel sensor platform will be done in cooperation with the Indian partners. This will create a level playing field for European and Indian industries and SMEs working in the water quality area.

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Acronyms and Definitions

Acronyms	Defined as
SQA	Software Quality Assurance
CM	Configuration Management
CCB	Change Control Board
github	Soure code repository
RTM	Requirement Traceability Matrix
CT	component test
SIT	system integration test

1 Executive Summary

The Scientific Quality Assurance Plan of LOTUS project will provide guidelines to project organisation members to achieve desired results with defined quality criteria by stakeholder. This document is intended to provide information about (i) test plan for all the components and system planned to develop, (i) the configuration management plan for both project doc and source code generated in LOTUS project, (iii) Change management plan if any changes in project requirement during project period (iv) Quality assurance plan for LOTUS deliverables for both documents and prototypes. Overall, the proposed quality assurance plan is indented to ensure quality and reproducibility in the products and deliverables which are handed over to the stakeholders.

2 Test Plan

2.1 Definition

This project will use a combination of verification and validation activities to confirm the compliance of the project deliverables with the requirements specifications. Verification refers to the testing of actual project prototypes in Lab-scale facility and to the simulation of individual components /systems placed under simulated real conditions, before validating the prototypes in the real conditions. After successful verification, the performance of the system is studied in real condition, and this phase is called validation. During the verification and validation phase, if any deviation from the original requirements is observed, then it is considered a finding. Corrective actions are then defined and followed to ensure the deliverable quality. Findings may be classified either as defects or as change request. The defects are expected to be fixed with the specified procedures while change request are managed through a change control board.

2.2 Verification Plan

The documents and source that are related to the LOTUS project will be prepared as per defined standard, and expert members of LOTUS project will review all the deliverables such as documents, hardware, source code and demo of prototypes. The review process for lotus deliverable (both doc and prototype) are presented in Figure 1 and Table 1. The plan for verification will be described in the test plan of each work modules. For example, the deliverables having any prototype will have an individual test plan. This test plan is expected to capture the following aspects for prototype (i) test scenario, (ii) test condition, and (ii) test cases. The test cases will be described in terms of step by step action and of required test data, and it will be executable with the goal to make sure that all the modules are working fine. The test cases will be prepared for each unit, integration, and system. Unit means individual components (e.g. sensor chips, PCBs...); Integration means assembling the units together into a prototype (e.g. assembled sensor probe); System means the prototype into its end-to-end architecture (e.g. the prototype deployed in a pipe with connexion to decision support tools) The people responsible for leading the Verification activities are the members of the Project Management Team (Scientific Coordinator and Deputy Scientific Coordinator, Scientific Lead and Deputy Scientific Lead).

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Table 1: Verification process for LOTUS deliverables

Activity	Responsible	Work Products	Procedure/Reference
Self review	Author	Documents and source code	No review comments recorded, as the author himself does the review and make the changes
Peer reviews	Authors, peer-reviewers	Deliverable documents Source code	Peer Review is recorded with comments, and the comments will be corrected by author
Self-review Verification Testing • Component test (CT): Test case will be prepared for each component. • System integration test (SIT): When integrating all the independent components, validation of how the system behaves through test cases)	Developers(CT), Tester(CT,SIT)	Test Scenario, Test Case	No review comments recorded, as the author himself does the review and make the changes
Peer reviews (for both CT and SIT)	Authors, Peer-reviewers	Documented Test Scenario , Test Case with properly recorded test results	The test result is recorded with comments, and the failed test cases will be fixed by the developer, and it will go through repeated peer reviews

2.3Validation Plan

Similar to verification, for validation, test scenario and Test cases will be prepared and executed based on the functionalities of the product given in the specifications. Each release of the build product will be validated against the test case. The test execution will be split in categories as needed, for instance

unit testing, integration testing, system testing, and regression testing. Regression testing will be tested in 3 phases to make sure that fixing defects have not damaged the product as a whole. The organisation responsible for leading the validation activities is named in the Project Plan [1]. The different types of Validation activities for this project are listed in Table 2.

Table 2: Validation process for LOTUS deliverables.

Activity	Responsible	Work Products	Procedure Reference
Unit testing	Developer	Unit test case	Test Case
Component testing	Tester	Component test case	Test Case
System integration testing	Tester	SIT test case	Test Case
Regression testing	Tester	Regression test case	Test Case

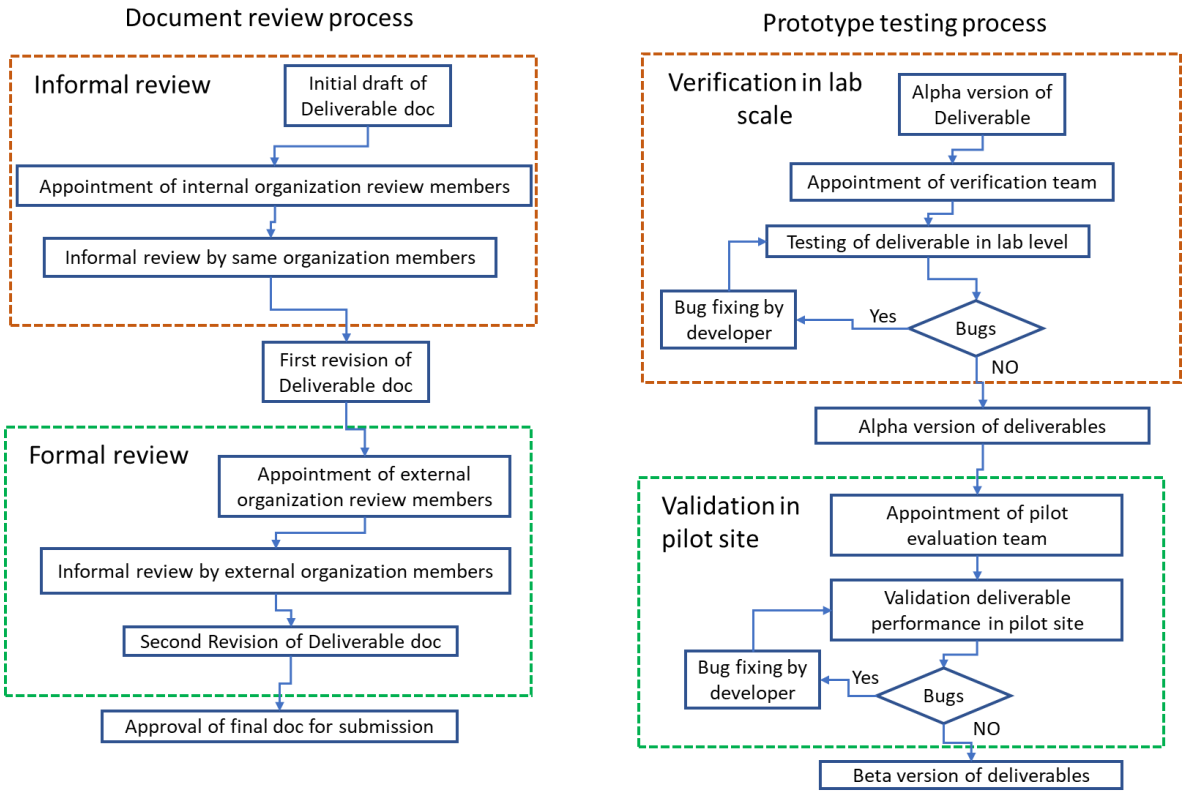


Figure 1: Review process for LOTUS deliverables

3 Configuration Management (CM) Plan

This section constitutes the Configuration Management (CM) Plan for the project.

The CM plan describes what are all the project related activities done and responsibilities of resources information as well defined in this section.CM plan starts right from the requirement identification, development, testing, and change request, how the process is defined for change requirement, and base line document for each phase should be placed in the share path.

3.1 Configuration Items and CM Library Structure

Configuration Items will be uniquely identified in the CM Repository by their full file name (including the path from the root directory).

This project uses GitHub as code repository and Share point/LOTUS cloud as document repository (see details below). The configuration items managed during this project will include:

- source files (.c, .h, .cpp, .m, .py, .js, html);
- macro files (.xls)
- technical documentation (.txt, .pdf, .xls, .htm, .doc, .vsd, …);
- project management documentation (.doc, .mpp, .xls, .ppt, .htm, .html…);
- patent search records and other images (.pdf, .tif, .jpg)
- archive files (.zip)
- etc.

The project related documents will be placed on share path, the source file will be placed in the GitHub, and access will be given to project development team

Other documents related to development like Architecture document, High level Design (HLD), Low Level Design (LLD), Mock up, prototype, will be placed in the share point and version will be managed respective author/developer.

Testing related document such as test plan, test scenario, test cases, execution tracker, closure documents will also be placed in the share point with version management.

Access to development materials will be for all the developers, as each developer will make the changes in their file, and will make it available to the next release, so all the developer should have the access but they should under go proper process to update the file before start their task,

The CM Repository for LOTUS Project will reside on:

This part has been removed as is relevant for the internal use of the consortium only.

3.2 Naming Convention for Documents

The document number in LOTUS project has to be assigned as per below given number procedure.

A X.Y document name M.N.VVV

A stands type of document namely **D** - Deliverable to EU/DST, **P** - Project internal document for project organisation which are deliverable to EU or DST

X – Work package Number 1, 2, 3, 4 - 8

Y - Running number of the respective document in each work package, 1, 2, 3, 4….

M.N – represent running version of the document and if its 0.1 means initial draft of the document ready for review and it can change like 0.2… to 0.9 then 1.0 the first official release and further changes can vary from 1.1, 1.2, … then … 2.0-second official release

VVV is type of electronic document type such as .**doc/*.pdf/*.xls/*.ppt etc.**

Example D1.1 State-of the-art water quality solutions ecosystem 1.0.doc

Above document name signifies ”Deliverable 1 to EU/DST in WP 1 and f; first official release”.

The list of deliverables planned to EU/DST is given in [1]

P2.1 Specification of IITG sensor test bench 1.0.doc

Above document name signifies for “Project internal document 1 for project organisation in work package 2; and first official release”.

All the project documents are placed in share point with the proper version. Whenever the document is uploaded in the share point, automatically the new version is updated with the ascending order of running number with author/ reviewer/ approver remarks, so that we can identify the latest updates in the documents.

3.3 Software Repository Management

The source code(s) for each of the work packages is stored in respective repositories in GitHub, and the screenshot of the GitHub repository structure is given below

The access for both SharePoint and GitHub repositories will be given to all project team members based on role and responsibility.

Each SharePoint check-in and GitHub commit-push shall have a comment with version number and a short summary of modification made. Each check-in of the document will have the comment in the following format: revision index\date\reason for change\actual change done

GitHub commit message: [<Type>] <Scope/ModuleName> <Short summary(<= 72characters)> <Description(Optional)> <References(Optional)>

Type:

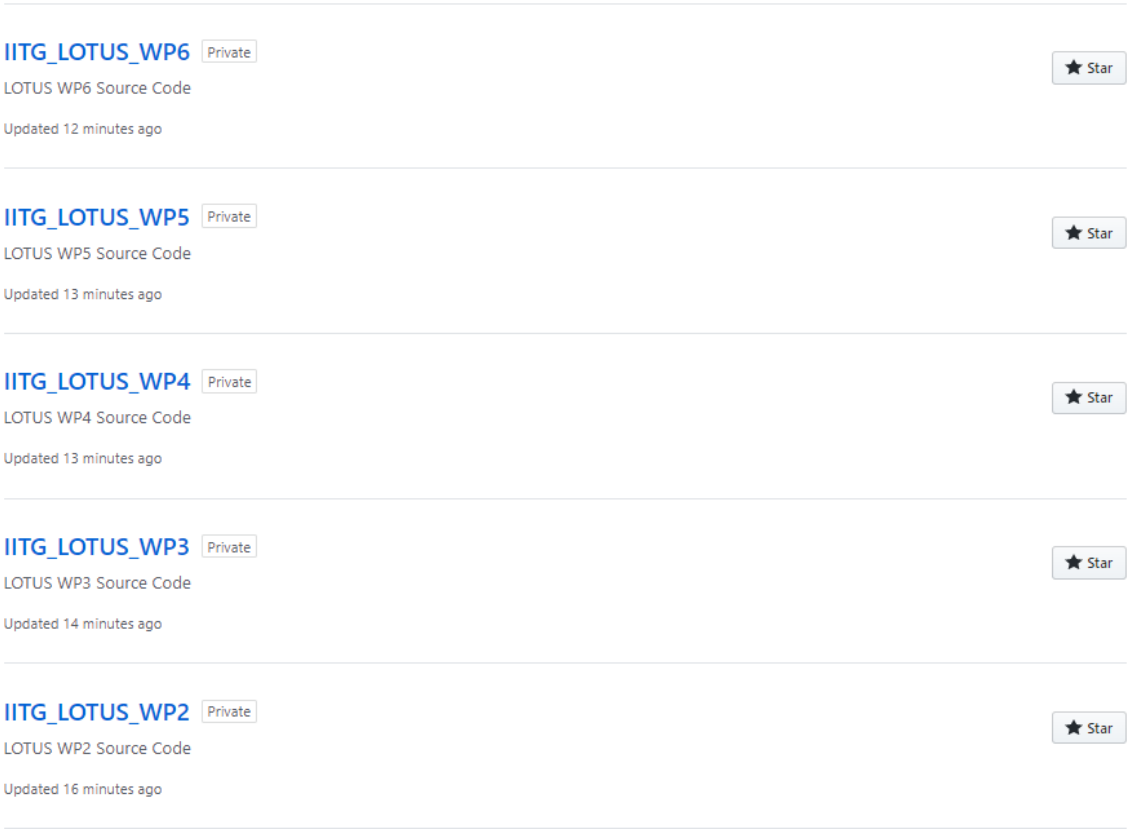
FEATURE, FIX (bug fix), STYLE(updates related to styling), REFACTOR (refactoring specific section of codebase), TEST (updates related to testing), DOCS (updates related to documentation), PERF(updates related to performance improvement)

Scope/ModuleName: The module or library or functionality that's affected/changed in this commit

Short summary: <= 72 characters, describing the commit reason and changes

Description: Summary of – answering What, Why and How code changed?

References: Reference to Issue/bug (in issue/bug tracking system), Feature (in feature tracking system) or to change in requirements.



Developer's Instructions:

<table>
<tr><td colspan="2">The following procedures shall be followed when working on LOTUS codes. These guidelines aim to raise the product quality by securing successful builds and enable successful integration.
Naming Conventions for code:
(NB: Platform can be e.g. sensor monitoring module)

<Platform Name>_<Component/Module Name>_<Function Name>
E.g.: WP2_Sensor_DataAcquisition (refer figure below)</td></tr>
<tr><td>Check-in (e.g. software upload) Procedure</td><td>COMPILE LOCALLY BEFORE COMMIT!
Compile locally the individual model source code before committing

TEST BEFORE COMMIT!
Test the source code – Unit testing as well as Integration testing.

COMMIT WITH A COMMENT!
The comment shall contain a short description of what has been changed.

PUSH TO REMOTE!
Push the source code to respective remote repository.

CREATE PULL REQUEST (PR) IN GIT

Create a pull request to merge the code to Main Develop branch

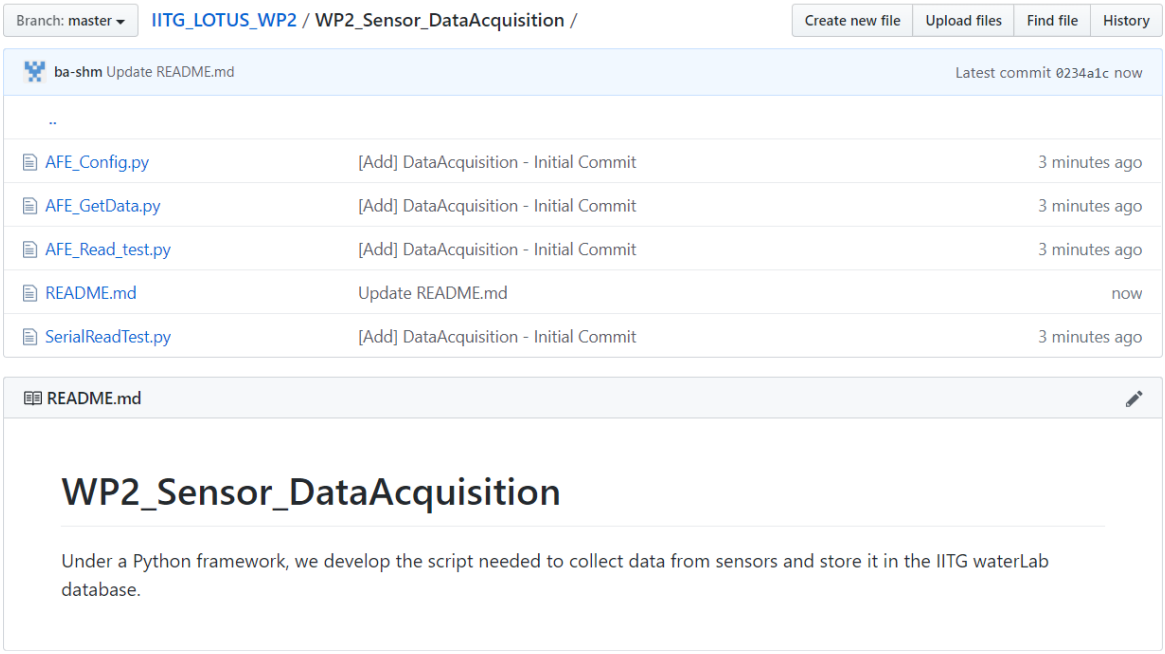
GET THE PR APPROVAL FROM REVIEWER

Get the PR approval, and merge the code to main branch</td></tr>
<tr><td>Check-in Schedule</td><td>Schedule can be any of the following

(i) On an everyday basis

(ii) Once bugs/errors are corrected

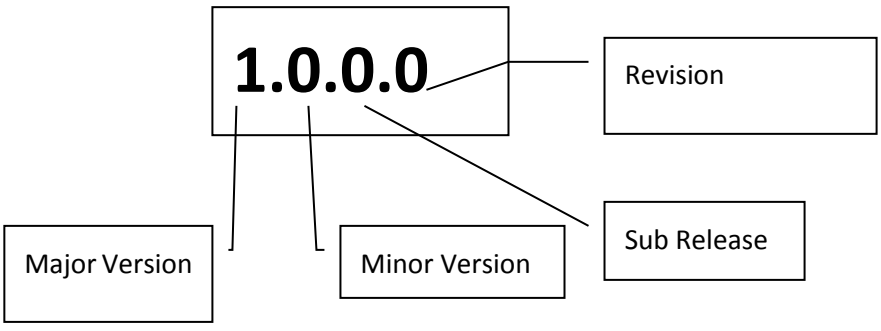
(iii) Once the planned functionality is implemented and tested</td></tr>
</table>



3.4 Build Process and Numbering

The build is done at the end of the development phase for every deliverable scheduled for release with an appropriate build date and number. Deliverable means here any piece of software, hardware or document required by the project. The build is tested thoroughly for its functionality before every release according to Test Plan.

Build number identifies individual deliverable builds and reflects where in the branch structure the build is done. Build numbers are related to the deliverable versions' numbers. Product version reflects the release procedure of the product and system build as below.



We would be following the format 'x1.x2.x3.x4' (since we have already started with 1.0.0.0) where

x1 = major version (would be incremented on a major change)

x2 = minor version (would be incremented when we add new tools)

x3 = sub release (would be incremented on medium to small changes/enhancements)

x4 = revision (would be incremented for patches)

3.5 Development Platforms and Tools

The following development platforms are currently used in the project and are assumed to be baselined as needed by the supporting organisation identified below

Table 3: Overview of the list of platforms planned to use in LOTUS project

Tool	Version/ build	Required equipment	Support person
FIWARE	7.8.1	Cloud subscription	NEC
ABB's Symphony Plus S+ Operations		Industrial PC	ABB
Jain irrigation Platform		Industrial PC	Jain irrigation ltd
Windows 10 pro, Ubunto…, Mac…	1909/18363	Industrial PC	Microsoft

The following development tools are expected to be used in the project, and will be baselined as needed during the execution of this project:

Table 4: Overview of the list of tools planned to use in LOTUS project

Tool	Version	Required equipment	Support person	Work packages to use
Microsoft Visual Studio Enterprise Edition	6.0	Standard issue PC	Microsoft	WP2, WP4, WP5, WP6
Microsoft Code	1.4	Standard issue PC	Microsoft	WP2, WP4, WP5, WP6

Microsoft Office	2019	Standard issue PC	Microsoft	All WPs
Microsoft Visio	2019	Standard issue PC	Microsoft	All WPs
MySQL	8.0	Industrial PC	Microsoft	WP2, WP4, WP5, WP6
Microsoft Visual C++	V6.0	Standard issue PC	Microsoft	WP3, WP4, WP5, WP6
Matlab with optimization toolbox	9.7 / R2019a	Standard issue PC	Math works	WP2, WP4, WP5, WP6
Microsoft Visual Studio C#.Net	2008, .Net Frame Work 3.5	Standard issue PC	Microsoft	WP3, WP4, WP5, WP6
EPANET	2.00.12.01 or later	Standard issue PC	EPA USA	WP4, WP5, WP6
Python	3.7 or later	Standard issue PC	LOTUS team	WP2, WP3, WP4, WP5, WP6
MongoDB	4.0 or later	Standard issue PC	LOTUS team	WP2, WP3, WP4, WP5, WP6

See the Training, Budget, and Resource sections in the Project Plan [1] for relevant requirements to support Configuration Management activities on this project

3.6 Configuration Management Procedure

The features of SharePoint and GitHub will be used for version and configuration control. This project will follow the procedures described in the Configuration Management Procedure. The CM status will be monitored by the Project Management team and reported on a weekly basis or as needed by the person assigned CM responsibilities for the project.

All project team members are required to perform configuration management activities as defined in this Quality Plan and the Configuration Management Procedure and Change Management Procedure, in their areas of responsibility.

3.7 CM Tools, Resources, and Organisation

The "Configuration Manager" (the organisation responsible for project Configuration Management activities) is named in the Project Plan [1].

Table 5: List of configuration management tools planned to use in LOTUS project

Tool	Version	Required equipment	Support person
github	-	Online repositories	Balakumara Vignesh M bvigneshm@iitg.ac.in /IITG
Sharepoint office 365	2007	Standard issue PC	Senthilmurugan Subbiah senthilmurugan@iitg.ac.in /IITG

Table 6: Roles and access limitation in CM repository:

Roles	Accessibility	
	SharePoint/Own Cloud	GitHub
Steering Committee	Read access	-
Development Project Manager	Read\Write	-
CM Manager/ Build Manager	Read\Write\Delete and Grant access	Read\Write\Delete and Grant access
QA /QE	Read\Write	-
Development Engineer	Read\Write	Read\Write
Test Engineer	Read\Write	-

4 Change Management Plan

Change Requests are used to track changes to baselines, which are introduced from outside of the specification for the project, and to track changes due to defects identified.

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4.1 Change Management Procedure

A change is identified by a Change Request entry that describes the change requested and the desired result; to whom it was issued; and what versions/revisions results from the change.

Any project member can submit a Change Request.

The Change Control Board (see the Project Plan [1] for CCB membership) will classify, manage, and must accept a Change Request before work on it is initiated. The CCB must also accept all resulting changes before a new baseline is created.

The requirement change form will be used for entering the change request. The Change requests which are approved by the Change Control Board (CCB) for inclusion in the project will be logged in Requirement Traceability Matrix (RTM) for tracking of changes in deliverables as documented in the Change Management Procedure.

4.2 Change Management Tools and Resources

Tool	Version	Required equipment	Support person
Requirement Traceability Matrix	NA	Microsoft office XP	INNO/IITG

5 Quality Assurance (QA) Plan

5.1 Standards and Procedures

The project will comply with the below mentioned policies

1. Complete all the prepared test case without the status should be passed or deferred.
2. There could be no severe 1 and 2 open defects
3. Complete 3 rounds of regression testing.
4. Test case should be prepared by the requirement
5. All the prepared testing artefacts should be reviewed based on the check list.

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5.2 Quality Audits and Reviews

The review process is already defined in the section 3.1 in the same document, please refer the same.

Audits are conducted by the person who is not being part of the software development organisation and he conducts an independent examination of each part, it starts from the software product, software process whether it complies with the specified standard. Audit includes documentary products such as various sorts of plan, contracts, specifications, designs, procedures, standards, and reports, but also non-documentary products such as data, and test data.

The Non-compliance will be tracked and the same will be monitored until the NC for closure. Audits will be conducted as per the schedule by the organisation before normal audit internal audit will be conducted and NC will be incorporated.

5.2.1 Causal Analysis

Causal Analysis and resolution for the defects from the reviews and verification and validation activities will be performed at the end of every logical phase during the lifecycle of the project

5.3 Security Plan

During this project, the security issues of concern from a Quality perspective are source control (configuration and version) management and change management. These items are addressed in this document. All other confidentiality and data integrity/security issues are addressed in the Project Plan [1].

Issues of data security in the end product must be addressed by the productisation efforts, which will follow the completion of this project. And security issues with regards to the tool will be handled during product development.

6 References

[1] LOTUS Project Grant Agreement, 2019.