System Requirements Document for Validation and Verification System

Team 4

Chadha, Harshita

Karuppaiah. Boomika

Liao, Wenjun

Department of Computer Science

George Washington University

Professor Stephen Kaisler

Department of Computer Science

George Washington University

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1. Preface

This document serves as the Software Requirements Document(SRD) for the Verification and Validation(V&V) tool project. Its purpose is to provide a structured definition of requirements on the end-to-end process in an operational context.

The expected readership of the document is mentioned below:

1. **Software Developers:** Developers who will work on developing the V&V tool.
2. **Software Testers:** Software testers who will develop test cases for the V&V tool.
3. **Requirements Engineer:** Engineers who will collect requirements data and enter it in the V&V tool.
4. **Design Engineer:** Engineers who will prepare design documents and enter it in the V&V tool.
5. **Test Developer:** Engineers who will prepare test requirements and enter it in the V&V tool.
6. **Management:** Managers who will approve the requirements, design and test plan that has been entered in the V&V tool.
7. **Stakeholders:** Stakeholders who will refer to this document to get understanding of the features of the V&V tool.
8. **Maintenance Engineer:** Engineers who will refer to this document to maintain the V&V tool upon its completion.

Version Number	Description	Date
1.0	Initial Draft	09/22/2023
1.1	Final Software Requirements Document	10/02/2023

Table 1: Version History

The version history of the Software Requirements Document for the V&V tool is mentioned in Table 1.

2. Introduction

For the success of any project, verification and validation of the requirements is a crucial part. Detecting any missing information, conflicting or ambiguous requirements at the initial stages of the project will help save rework in the later stages and use of any additional funds that will be required to correct the workflow. The Verification and Validation tool will serve as a one-stop solution for keeping track of all requirements for all projects undertaken by the organization.

The V&V tool will take in Software Requirements Documents, Software Design Documents and System Test Plan of any given project and add it to the central database. The access to different views of the V&V tool will be decided by access roles assigned to users of the system. This shall ensure that the database of each project will only be accessible by the personnels who will be working on it to increase security.

3. Glossary

Term	Description
V&V	Verification and Validation
SRD	Software Requirement Document
SDD	Software Design Document
STP	System Test Plan
Creator User	Can upload SRD, SDD, and STP documents and use it to enter requirements, design and test plans into the V&V tool.
Reviewer User	Can review requirements, design and test plans and provide feedback.
Administrator User	Can add, delete and modify user roles.

4. User Requirements Definition

This section specifies an overview of the V&V system to be created for the client. These requirements can be modified and then made available for the end users with version upgrades based on their needs.

4.1. System Overview

The V&V tool helps the client's software engineering team to capture their development workflow systematically and in a centralized manner. A diagram providing a high-level view of these components and their interactions is shown below -
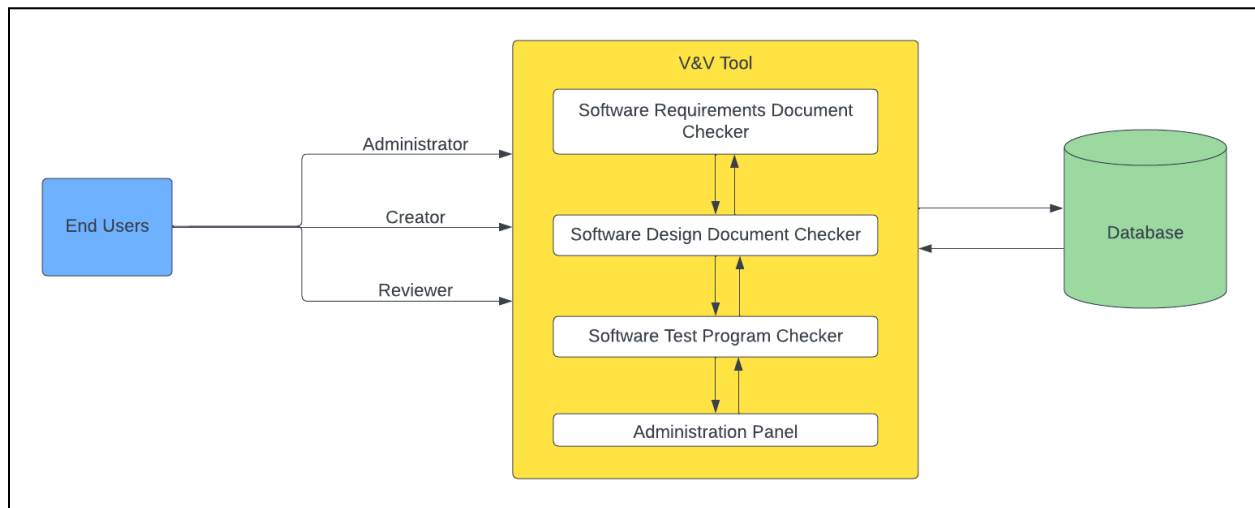

Figure 1: High-level system overview

The tool is composed of three main input components - the SRD or software requirements document checker, the SDD or the Software Design Document Checker, and the STP or the Software Test Program checker. Each of these components works together to ensure the quality and compliance of the client's software development process.

4.2. System Components

As stated in section 4.1 above, the tool is composed mainly of three components and the purpose and scope of these components pertaining to the V7V tool are defined below -

4.2.1. SRD (Software Requirements Document) Checker: This component helps define the requirements for the given software project against a Concept of Operations or CONOPS as provided by the project's user. This component also helps add comments flag down problem areas within the requirements document and make iterative improvements.

4.2.2. SDD (Software Design Document) Checker: This component helps review the software design document and check against the previously approved software requirement document designed and approved using the first component of the V&V tool defined in section 4.2.1 above. Similar to the SRD checker, here there is functionality provided to add comments, flag down problem areas within the document, and make iterative improvements.

4.2.3. STP (Software Test Program) Checker: This component helps to track the Software Test Programs for the software project at hand and helps in verifying that they encompass all necessary test cases and scenarios.

4.3. Basic System Requirements

The following user requirements outline the fundamental functionalities of the V&V tool:

4.3.1. The V&V tool shall allow a user to log into the system using a username and a password.

4.3.2. A user of the V&V tool shall have one or more of the following three roles within the system - Administrator, Reviewer, and Creator. A user may hold more than one role simultaneously.

4.3.3. The view of the tool shall vary depending upon the role specified for a given user.

4.3.4. A tool user with the role of "Creator" shall be allowed to input new documents, revise existing documents, add new contributing creators to a document, and escalate review requests.

4.3.5. A tool user with the role of "Admin" shall be allowed to create new users, edit roles for users, and delete users from the system.

4.3.6. A tool user with the role of "Reviewer" shall be allowed to access submitted documents and supporting material, make suggestions and comments, send back documents, and escalate final approval requests.

4.3.7. The creator shall be able to input three types of documents within the tool in keeping with the three component system as defined in section 4.1 above namely the SRD, the SDD, and the STP.

4.3.8. For each of the three document types, the system shall allow for type-specific functionalities for creators and reviewers.

4.3.9. For an SRD document type, the system shall allow the creator to add requirements to the document along with nested components. The system shall also allow the creator to upload the basis CONOPS for the SRD. The created requirements shall then be cross-linked to paragraphs within the CONOPS to track requirements better.

4.3.10. For an SRD document type, the system shall allow the reviewer to view the cross-reference sections between the generated SRD and the CONOPS, flag problematic sections, add comments, and assess for the existence of completeness, coherence, correctness, and consistency.

4.3.11. For the SDD document type, the system shall allow the creator to input design components and specifications. The system shall also allow the creator to link the underlying pre-approved SRD with the SDD. The created design components shall then be cross-linked to requirements within the SRD to track progress better.

4.3.12. For an SDD document type, the system shall allow the reviewer to view the cross-reference sections between the generated SDD and the SRD, flag problematic sections, add comments, and assess for the existence of completeness, coherence, correctness, and consistency.

4.3.13. For an STP document, the tool shall allow the input of suitable software test plans, provide a mechanism for maintaining version control, and shall allow cross-referencing with the SRD to ensure that the specified test programs cover all the underlying requirements.

4.3.14. For an STP document type, the system shall allow the reviewer to view the cross-reference sections between the created STP and the SRD and SDD, flag problematic sections, add comments, and assess for the existence of completeness, coherence, correctness, and consistency.

4.3.15. The tool shall be linked to a centralized database system that stores all the information pertaining to the system such as the users of the tool, the documents in the pipeline, and the components within a document, etc.

All the detailed functionalities of the three components are elaborated upon in detail in section 6 - System Requirements Specification- of this document.

5. System Architecture

5.1 Architecture Overview

The V&V tool has a central architecture that facilitates the input of three types of software development artifacts namely the SRD, the SDD, and the STP, and allows a systematic mechanism to iteratively review and approve them for a smooth development process. The key architectural components of the tool include the following -

5.1.1. The V&V tool shall have a central database that stores all the information that drives the document creation and review process. This database shall systematically store the user login information, each of the requirements, design elements, and testing modules associated with IDs and linked to each other via keys to ensure smooth traceability and consequent verification by the SME/ reviewer.

5.1.2. The V&V tool shall have intuitive user interfaces that allow users to log in, create documents, edit access roles, and review documents. The specific operations that can be performed by a user and their system view shall be decided by their specified role.

5.1.3. The V&V tool shall manage the document workflow through the creation, editing, and review stages.

5.2 Authentication Architecture

5.1.1. The V&V tool shall have a landing login page where the user must enter their credential before accessing the systems thereby ensuring that only the relevant users can access certain views of the tool.

5.2.2. The view of the system is dependent upon the role specified to the user by the administrator preventing accidental access and corruption of sensitive data,

5.3 Database Architecture

5.3.1. The V&V tool shall utilize a NoSQL database, to efficiently store diverse data types. This allows for increased flexibility and scalability, allowing the system to adapt to future needs.

5.3.2 The data shall be stored in JSON format tailored to accept different input forms such as texts, images and diagrams.

5.3.3 The V&V tool shall restrict direct access to the database for security measures.

5.3.4 The V&V tool shall interact with the database only through secure application programming interfaces(APIs).

6. System Requirements Specification

In order to facilitate successful communication between stakeholders and the development team throughout the project lifecycle, this section seeks to give a clear and comprehensive roadmap for the design, development, and validation of the V&V system. The following subsections offer a thorough explanation of the functional and non-functional needs of the V&V system, from user interactions through system behavior.

6.1. Login and user role-based views

In this section we define the scope of operation of the login page along with the different views of the tool according to user role. Furthermore, the functions of the system for each of these roles are defined in detail using wireframe illustrations.

6.1.1. The V&V tool shall allow a user to log in using valid credentials. The credentials shall be stored in the centralized database and matched with the entered values.

Figure 2: Login interface of the V&V tool

A wireframe diagram illustrating one interpretation of the login page is shown in figure 2. The user can enter their credentials and then based on the role specified by the system administrator they are presented with a given view of the V&V tool - provided their credentials match the ones entered.

6.1.2. The user shall have one or more of the following roles within the V&V tool - Administrator, Reviewer, Creator. A user can have more than one role assigned to them.

6.1.3. In case a user has more than one role assigned to them, the system shall open the view assigned to the role that comes first when the roles are arranged in alphabetical order. For instance, if a user is assigned the following roles - [Administrator, Creator], after login, the view that first appears would be the Administrator view.

6.1.4. In case a user has multiple roles assigned to them, the system shall allow them to switch between views after successful login.

This capability can be availed by selecting a valid option from the drop-down menu in the view as illustrated in the wireframe below.
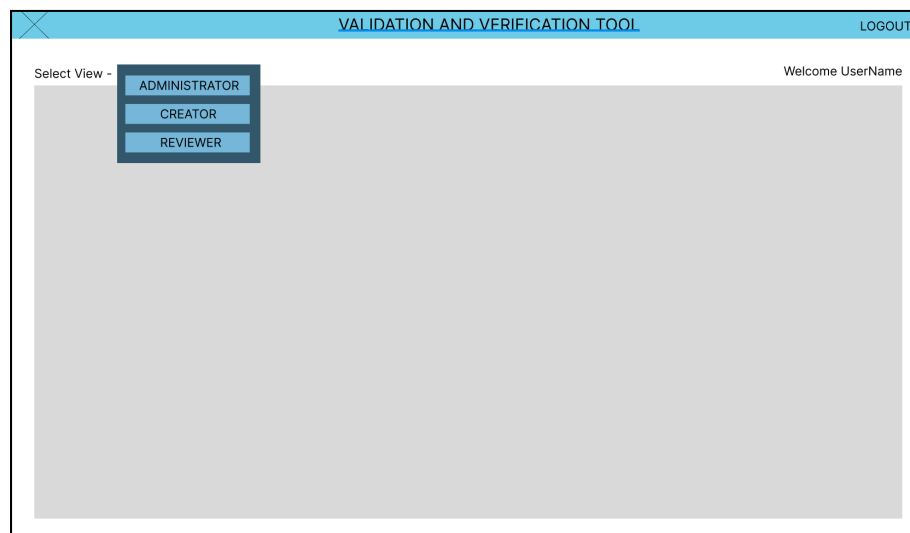

Figure 3: Role-based view of the V&V tool

The system will only display the options that the user has access to. For example, if a user is assigned the following roles - [Administrator, Creator], then the drop-down menu in the view selector will display only two options, namely Administrator and Creator. There is also an option to change the view type if the user has more than one role assigned.

6.1.5. The system shall allow a user with the role of Administrator to add or delete a user from the tool database. The system shall allow the administrator to change the roles assigned to users within the database.
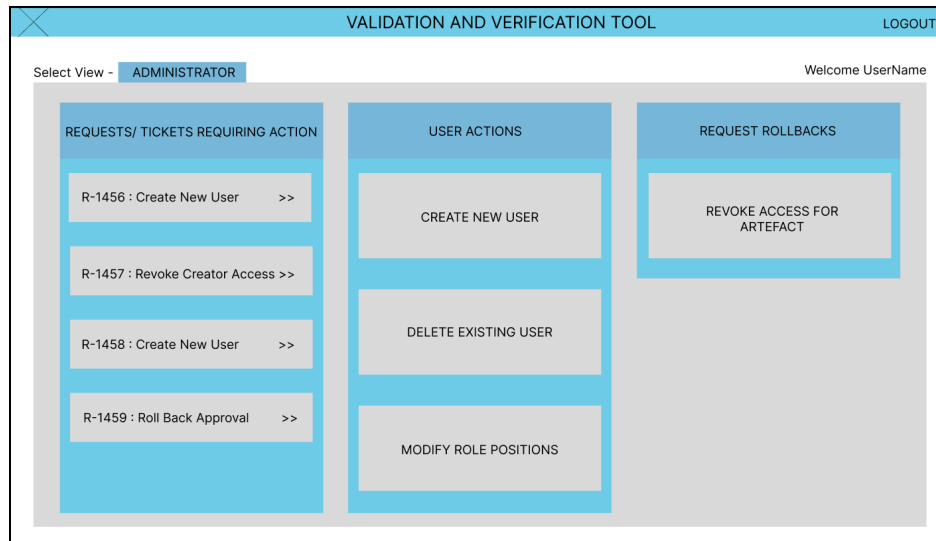

Figure 4: Administrator view of the V&V tool

The wireframe diagram in figure 3 above illustrates the Administrator user's view of the tool when first logging in. There is a section that shows all the requests opened by non-administrator users to request role additions or changes. Furthermore, there are options to act on these requests and add a new user to the database or to change user roles.

6.1.6. The system shall allow the administrator user to roll back approval of documentation on request of the reviewer. This is illustrated in the wireframe diagram in figure 3.

6.1.7. The system shall allow all the Creator users to upload documents of one of three types namely - Software Requirements document, Software Design Document, and Software Testing Program.
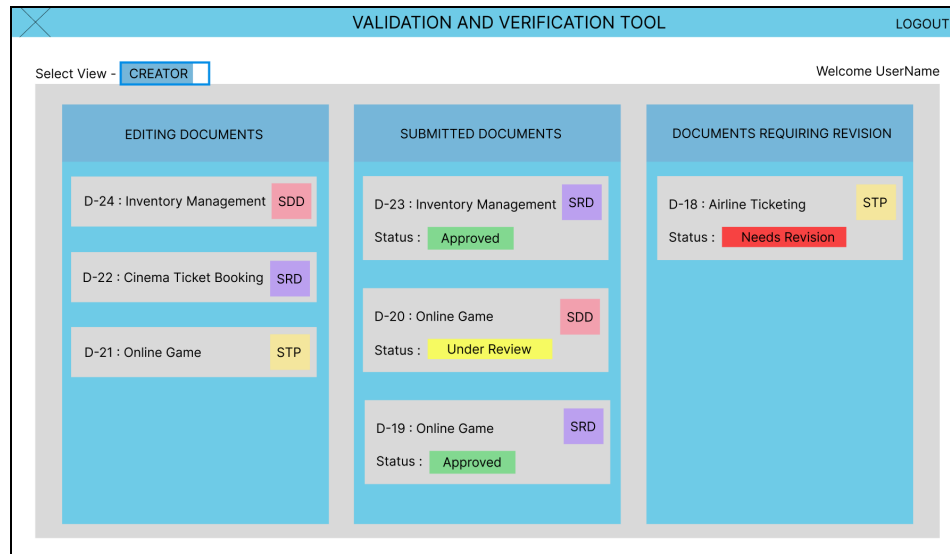
Figure 5: Creator view of the V&V tool

The wireframe in figure 4 above illustrates the Creator User's view of the system and the first section on the left entitled Create New Document allows the user to upload one of these three types of documents. A small colored flag next to the document name identifies the type of document.

6.1.8. The system shall allow a Creator user to save an in progress document and return to it later.

The wireframe in figure 4 illustrates the list of ongoing documents the creator user in our example is working on.

6.1.9. The system shall allow the Creator-type user to view all submitted documents and their status of review. The wireframe diagram in figure 4 above illustrates this.

6.1.10. If a document is sent back to the Creator user for revision, the system shall display it under the "Documents Requiring Revision" section. This is illustrated in the wireframe figure 4.

6.1.11. For a user with the role of Reviewer, the system view shall be composed of three sections - pending requests, approved and escalated requests, and sent-back requests.
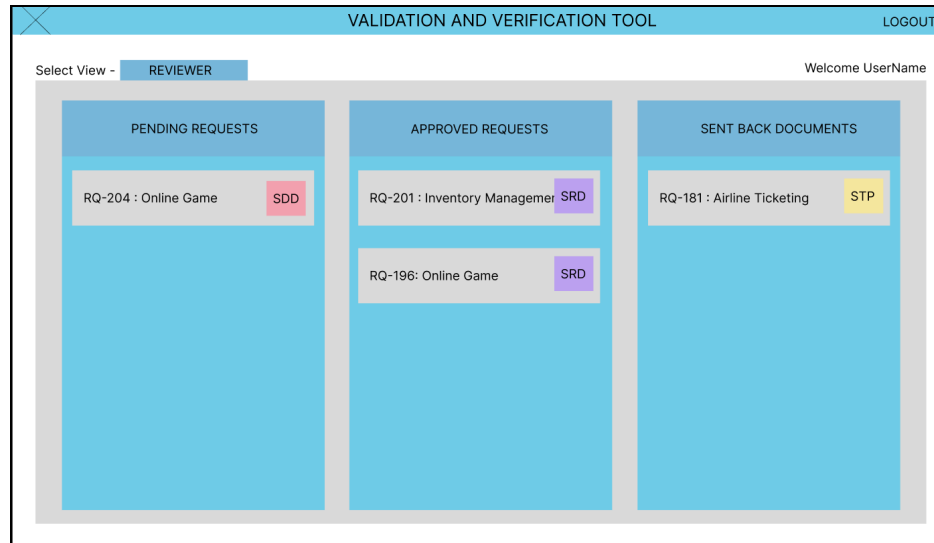
Figure 6: Reviewer view of the V&V tool

This is shown in the wireframe in figure 5 above.

6.1.12. The system shall allow the reviewer to access, edit, and add to the documents listed under the pending reviews section and submit their evaluation once done.

6.1.13. The system shall allow the Reviewer user editing access to sent-back documentation for additional feedback as well. After a document has been initially rejected and rolled back for updates, the reviewer might add to their comments which will then be displayed to the creator user of the document with time stamps and a new comment label.

6.1.14. The system shall allow a creator user to view only access to the approved requests with the ability to send administrator requests to roll back approval if needed.

6.2. Software Requirements Document

In this section we define in detail the capabilities of the tool when it comes to the review of Software Requirements Document type.

6.2.1. The system shall allow a creator user to identify requirement sections in the SRD document.

Figure 7: Creator view of the requirements creation component of the V&V tool

The wireframe diagram in figure 6 above shows the creator's view while entering the software requirements using the V&V tool.

6.2.2. The system shall ensure that each SRD has an assigned project name and project manager information attached to it.

6.2.3. The system shall allow a creator user to define objects and functionalities within a requirement and identify nested requirements up to three levels.

6.2.3. The system shall allow the creator user to add comments to aid the reviewer's understanding of the sections of the SRD.
This is shown in the wireframe in figure 6 above.

6.2.5. The system should allow the creator user to upload the CONOPS that forms the basis of the software project and identify and mark different paragraphs within the CONOPS document.

6.2.6. The system shall allow the creator user to link the requirements to the specific section of the CONOPS from which they are identified and defined.

6.2.7. The system should add the identified requirements, associated comments, and linked CONOPS section for each component to the V&V tool's database.

6.2.8. The system shall allow the creator user to add other contributing creators to the document provided they have a creator role assigned to them. The system should otherwise allow them to raise a new creator user addition request with the admin.

6.2.9. The system shall allow the creator users to submit a finished artifact and generate an SRD report from the entered details.

6.2.10. The system shall allow the creator users to view the reviewer's comments on sent-back documents and edit relevant sections for iterative improvement.

6.2.11. The system shall allow the creator viewers access to the version history of the document.

6.2.12. The system shall allow the creator users to send communication messages to the reviewer of the sent-back documents, in case clarification is needed.

6.2.13. The system shall allow the reviewer user to view a submitted SRD report along with the underlying CONOPS.

6.2.14. The system shall allow the reviewer user to flag sections if there are findings in the created SRD. There shall be five main categories of findings enlisted in the table shown below -

Table : Finding Categories

CATEGORY	FLAG	DESCRIPTION
Critical		The requirement is flawed and needs major restatement and correction before design can proceed.
Non-critical		The requirement is flawed but can be corrected with minor effort.
Weakness		The requirement is ambiguous, incomplete, or incoherent.

Missing		A requirement implied by other requirements is missing.
Clarification		Additional explanation is required.

6.2.15. The system shall allow the reviewer user of an SRD document to add comments to flagged sections for further clarification.
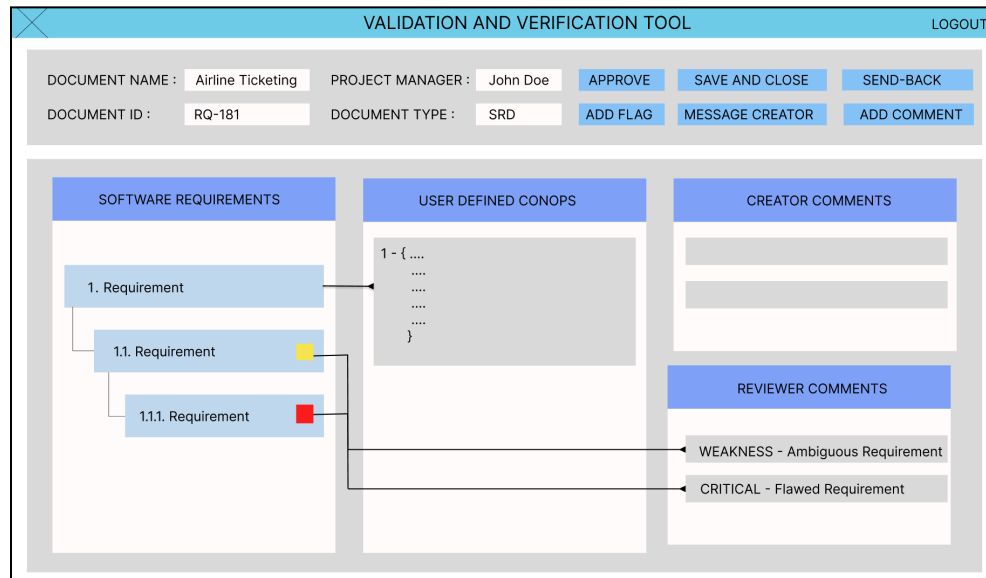

Figure 8: Reviewer view of the requirements document component of the V&V tool

This is shown in the wireframe in figure 7 above.

6.2.16. The system shall allow the reviewer user to communicate with the creator user of a document regarding findings in case of sent-back documents.

6.2.17. The system shall allow the reviewer user to approve a document and subsequently generate a review report. The system shall escalate this report to the next level reviewer or the project manager for final approval.

6.3. Software Design Document

6.3.1 The system shall allow the creator user to define Systems, Subsystems, and Modules from the Software Design Document within the V&V tool.
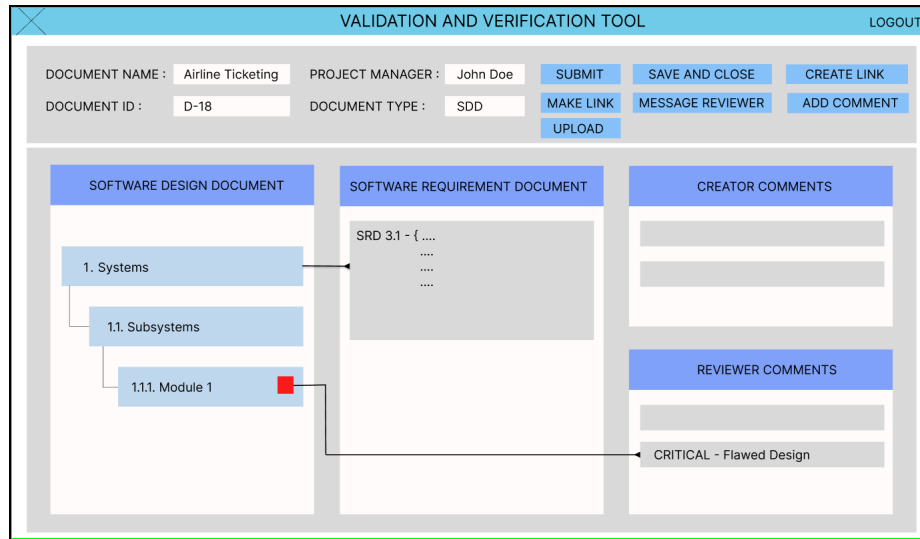
Figure 9: Reviewer view of the requirements document component of the V&V tool

6.3.2 The system shall allow the creator user to specify dependencies between different modules and components.

6.3.3 The system shall allow the creator user to upload relevant diagrams, charts and supporting documentation from the Software Design Document.

6.3.4 The system shall allow the creator user to add comments and explanations to aid the reviewer's understanding of the design sections.

6.3.5 The system shall allow the creator user to enter details to link modules/components/interfaces with their corresponding requirement in the Software Requirement Document.

6.3.6 The system shall allow the reviewer to flag sections if there are findings in the modules/components/interfaces. The findings shall be the same as those defined for the Software Requirements Document (Critical, Non-critical, Weakness, Missing, Clarification).

This is shown in the wireframe in figure 9 above.

6.3.7 The system shall allow the reviewer user to add comments to flagged sections for further clarification.

6.3.8 The system shall allow the reviewer user to approve the Software Design Document and generate a review report.

6.3.9 The system shall escalate the report to the next level reviewer or the project manager for the final approval upon reviewer approval.

6.4. Software Test Plan Document

6.4.1 The system shall allow the creator user to add test plans from a Software Test Plan Document (STP).
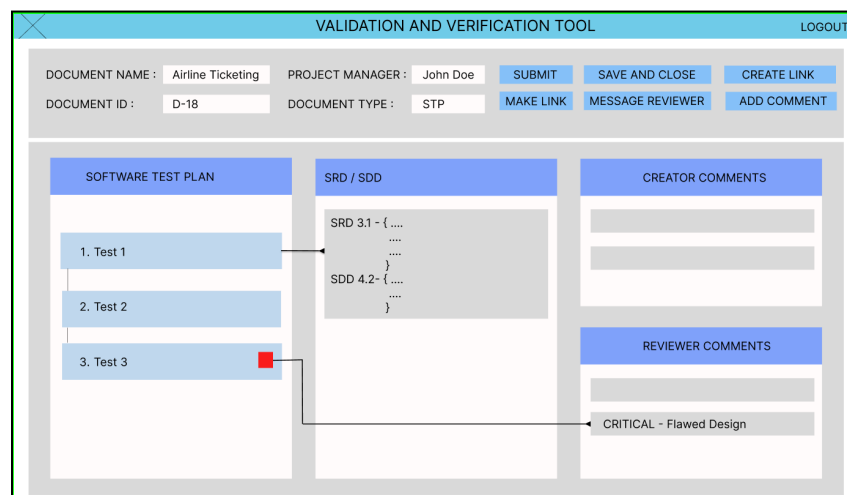

Figure 10: Reviewer view of the requirements document component of the V&V tool

6.4.2 The system shall allow the creator user to define test objectives, test scenarios, test cases, and test data for Unit Testing/ Subsystem Testing/ End-to-End Testing from the Software Test Plan Document and enter it into the user interface.

6.4.3 The system shall allow the creator user to add comments and explanations to aid the reviewer's understanding of the test plan sections.

6.4.5 The system shall allow the creator users to submit the entered test plans for review.

6.4.6 The system shall allow the creator users to view and address the reviewer's comments on the Software Test Plan for iterative improvement.

6.4.7 The system shall allow the reviewer user to view the submitted requirements from Software Test Plan along with all the test objectives, scenarios, cases, and data defined.

6.4.8 The system shall allow the reviewer user to flag sections if there are findings in the Software Test Plan Document. The findings categories shall be the same as those defined for the Software Requirements Document (Critical, Non-critical, Weakness, Missing, Clarification).

6.4.9 The system shall allow the reviewer user to add comments to flagged sections for further clarification.

6.4.10 The system shall allow the reviewer user to communicate with the creator user regarding findings in the Software Test Plan.

6.4.11 The system shall allow the reviewer user to approve the Software Test Plan and generate a review report. The system shall escalate this report to the next level reviewer or the project manager for final approval.

7. System Evolution

7.1 Continuous Improvement:

7.1.1 The V&V tool is designed for continuous evolution, incorporating feedback from users, developers, and stakeholders.

7.1.2 Regular updates and enhancements are planned to address emerging needs and technological advancements.

7.2 Versioning and Change Management:

7.2.1 The system will implement version control for documents and software components, ensuring traceability of changes over time.

7.2.2 Changes to documents will be tracked through version numbers and timestamps, allowing users to review the evolution of requirements and designs.

7.3 Adaptability to New Requirements:

7.3.1 The architecture is built with flexibility in mind, enabling seamless integration of new document types and functionalities.

7.3.2 The system will support customization, allowing organizations to adapt the tool according to their evolving validation and verification requirements.

7.4 Integration of Advanced Technologies:

7.4.1 The V&V tool will explore integration with advanced technologies such as machine learning and natural language processing. These technologies will enhance document analysis, identify patterns, and provide intelligent suggestions, streamlining the validation and verification process.