

**System Validation Plan   
TEMPLATE**

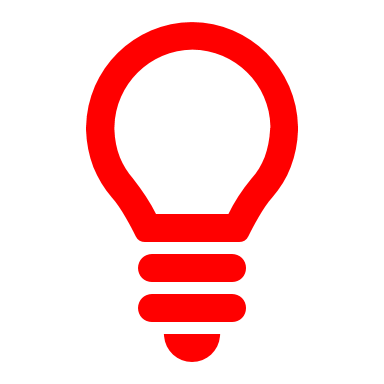
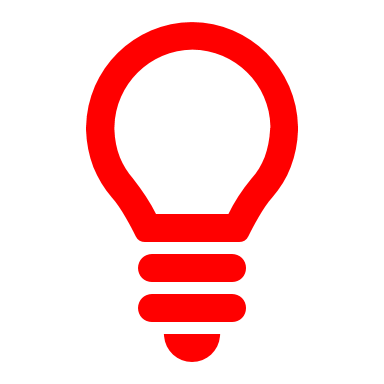
**TEMPLATE Version: *2.0***

**TEMPLATE Approval Date: *9/4/2019***

**Procedure for Using this Template to Create a Deliverable:**

1. Enter your name, firm, and date in the author field document control panel.
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Note that bracketed text in blue italics holds instructions on what content with which to replace the bracketed text. When you remove or highlight the entire bracketed portion and replace with text, the text should appear in the desired text format of the document. Also, the Document Title is a property/field of the document visible from the file system and will appear different from blue italics and can utilize the “update field” functionality.

1. Each section contains instructions preceded with a check box  for that section in blue italics.Additional helpful information and description of the required content for that section will be indicated as well next to the lightbulb icon. ****
2. Some sections also contain boilerplate text to use as a starting point. Review and modify the boilerplate content, if it exists, add additional content as necessary to fulfill the requirement of each section. Use the Styles *H1 – H5* for section headers, *Figure Caption* for captions below figures, and *Table Caption* for captions above tables so that the Table of Contents, List of Figures, and List of Tables can be automatically updated.
3. Define acronyms at the first usage in parentheses after the expanded term and add to the List of Acronyms.
4. Delete the template title page, these instructions pages, all blue instructions, and the detailed instruction notes and examples that are identified with the lightbulb **** throughout the document.
5. Update the filename and file location in the document control panel by right-clicking the field, then click “Update Field.”
6. Update the Headers and Footers to have the appropriate document title and version.
7. Delete the List of Tables or List of Figures if they do not contain any items.
8. Update the table of contents, List of Tables, and list of Figures by right-clicking and selecting “Update Field,” then “Update entire table.”
9. Have the document modified and reviewed as appropriate, and have each reviewer and modifier enter his/her name, organization, and date in the document control panel.
10. Submit the document for approval and go through the review/revision needed to obtain approval to finalize the document.
11. Repeat the review cycle and resubmit for approval as needed to obtain approval to finalize the document.
12. Enter the approver’s name, organization, and date in the *approved by* section of the document control panel.
13. Enter the approval date on the title page and in the footer throughout the document and update the revision history at the end of the document.
14. Remove the DRAFT watermark on the title page and the content pages by entering the Edit Header and Footer mode of the document and deleting the DRAFT image.
15. Print the document to PDF and review it outside of the Microsoft Word application.
16. Submit the Word and PDF versions of the document as final.

**Template Revision History**

| Version | Date | Name | Description |
| --- | --- | --- | --- |
| 1.0 | 2017 | Derek Vollmer | Original template for compliance with Rule 940 |
| 1.1 | 6/1/2018 | Clay Packard | Added content sections for a level 2 project for compliance with Agency for State Technology |
| 2.0 | 6/7/2018 | Josie Sanchez | Overhauled the template format to distinguish instructions, example, and boilerplate text for clarity and user friendliness |
| 2.0 | 07/10/2018 | Victor Blue | Edits to add user needs to goal for validation and revisions to Section 4.2 in case of failure to verify goal or user need |
| 2.0 | 07/20/2018 | Victor Blue | Edits per Steve Bahler’s email on Section 4.1 |
| 2.0 | 02/13/2019 | Victor Blue | Edits per latest draft System Engineering documents – ConOps, etc. |
| 2.0 | 03/07/2019 | Steve Bahler | Edits for clarity and format |
| 2.0 | 03/08/2019 | Victor Blue | Review of edits |
| 2.0 | 03/08/2019 | Steve Petty | Final editorial review |
| 2.0 | 07/18/2019 | Victor Blue | Edits per Districts |
| 2.0 | 07/18/2019 | Schelley Cassidy | Review and compile final |
| 2.0 | 07/23/2019 | Schelley Cassidy | Review and compile final |



**System Validation Plan for [insert project name]**

**Version: [*insert version number*]**

**Approval date: [*insert approval date*]**

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**List of Acronyms and Abbreviations**

AASHTO American Association of State Highway and Transportation Officials

ConOps Concept of Operations

FDOT Florida Department of Transportation

IEEE Institute of Electrical and Electronics Engineers

ITS Intelligent Transportation Systems

PSEMP Project Systems Engineering Management Plan

RITSA Regional Intelligent Transportation Systems Architecture

TMC Transportation Management Center

TSM&O Transportation Systems Management and Operations

# Purpose of Document

* *Systems validation is a step in the systems engineering process required by the Florida Department of Transportation (FDOT) Systems Engineering and ITS Architecture Procedure 750-040-003. Systems validation is for new systems, major system updates, multijurisdictional, multimodal, software, and adaptive signal systems projects (i.e., high-risk projects). A System Validation Plan is essential to ensure that stakeholders’ needs identified in the Concept of Operations (ConOps) have been met by the project, the right assessments are properly carried out, and results at the end of the project are robust and clear.*
* *Update the following two paragraphs, as needed.*

This section identifies the type of validation activities to be performed for [Insert the official project name].

* *For instance, this activity may validate the entire system, a sub-system, the deployment at a site, or any other validation activity called for in the ConOps or the Project Systems Engineering Management Plan (PSEMP)*[[1]](#footnote-1).

The first section of the System Validation Plan document provides two elements: system identification and an overview of the document.

## Identification

Project Name: [Insert the official project name].  
Financial Project Identification: [Insert the financial project identification code].  
Federal Aid Project Number: [Insert the federal aid project number, if applicable].

* *If a system’s related ConOps documentation has been developed hierarchically, describe the position of this document relative to other ConOps documentation.*
* *When the work is dispersed over several agencies, project management may find it more efficient to assign the responsible agencies to submit their own System Validation Plans.*

## Document Overview

* *Summarize and expand on the purpose of the System Validation Plan document by reviewing and modifying the text below*

The purposes of this System Validation Plan document are:

* To communicate user needs and operational scenarios, as put forth in the ConOps, that the proposed system validation expects to evaluate.
* To ensure statistical methods and equipment needed to collect necessary data are defined early enough so that the needed data will be collected.
* To communicate the steps involved in validating the system as it has been built and verified.
* *Discuss how the document meets its purpose(s).*
* *Outline the remaining parts of the document.*

## Referenced Documentation

* Provide a List of References or Bibliography of the documents used in developing this System Validation Plan. Optionally, establish a centralized project repository to house and archive all project documentation and provide the location here: [Show file path in the document control panel].
* Cite the documentation that is relevant to the project.
* *Documentation that might be cited includes, but is not limited to, project authorizations, relevant technical documentation, sources of design and communications standards, significant correspondence, documentation concerning related projects, risk analysis reports, feasibility studies, any earlier project ConOps or systems engineering documents, regional or corridor ITS Strategic Plan, Regional Concept for Transportation Operations (RCTO), and/or Regional ITS Architecture (RITSA).*
* *This list almost always includes the Feasibility Study (if one was written), ConOps, and PSEMP. Reference of other documents, such as descriptions of external systems, standards, and manuals may need to be included, such as those of the FDOT Standards and Specifications, etc.* *If needed and not addressed in the FDOT Standards and Specifications, refer to standards of the American Association of State Highway and Transportation Officials (AASHTO), Institute of Electrical and Electronics Engineers (IEEE), Architecture Regional Intelligent Transportation Systems Architecture (RITSA), the FDOT Highway Safety Manual, etc.*
* *This section lists the publisher, document identification number, title, revision, date, and the web address of documentation referenced in this document. This section should also identify a contact for all documents not available through standard channels.*
* *Use a table as below (Table 1) or the Bibliography tool in Microsoft Word (example below the table). Do not do both. Microsoft Word requires entering the citation into References/Managed Sources. Enter the citation information and put the URL in the Publisher cell. Use the References/Style/APA. Then use the button in References/Bibliography to generate the list.*

Table 1: Referenced Documentation

| **Document Name** | **ID, Revision, Date, etc.** | **Link, or Contact Info to Obtain** |
| --- | --- | --- |
| *Systems Engineering and ITS Architecture Procedure 750-040-003* | 2019 | FDOT Forms Management/Procedures <https://fms.fdot.gov/> |
| *23 Code of Federal Regulations (CFR) Part 940, Intelligent Transportation System Architecture and Standards – Final Rule (latest edition).* | Federal regulation | http://www.gpo.gov/fdsys/granule/CFR-2008-title23-vol1/CFR-2008-title23-vol1-part940. |
| *Systems Engineering for Intelligent Transportation Systems.* | January 2007 | http://ops.fhwa.dot.gov/publications/seitsguide/ |

# References

FDOT. (2019). *Systems Engineering and ITS Architecture Procedure 750-040-003.* FDOT Forms Management/Procedures: https://fms.fdot.gov/.

FHWA. (Accessed 2015). *23 Code of Federal Regulations (CFR) Part 940, Intelligent Transportation System Architecture and Standards – Final Rule (latest edition).* http://www.gpo.gov/fdsys/granule/CFR-2008-title23-vol1/CFR-2008-title23-vol1-part940.

FHWA. (January 2007). *Systems Engineering for Intelligent Transportation Systems.* http://ops.fhwa.dot.gov/publications/seitsguide/.

# Scope of Project

* *Update the following paragraph, as needed.*

This section is a high-level description of the general nature of the proposed system to which the System Validation Plan applies. The aim of the System Validation Plan is to test that the system meets the goals and user needs presented in the ConOps.

## System Overview

* *Provide a brief description of the project and the purpose of the system being built based on the ConOps. Special emphasis is placed on the project’s complexities and challenges that must be addressed by the systems engineering efforts.*
* *The content for this section should be available from the ConOps or PSEMP. It can be copied in full or summarized and referenced, depending on the preparer’s perceived need for the material.* *If at this point, new elements are identified, the ConOps and PSEMP should be updated accordingly.*

## Stakeholders

* *Identify the stakeholders and users, which will include project sponsors, the system owner, user agencies, maintenance and support entities, evaluation and certification entities, and the operating centers or sites that will run the system.*
* *The content for this section should be available from the ConOps or PSEMP. It can be copied in full or summarized and referenced, depending on the preparer’s perceived need for the material.* *If at this point, new stakeholders are identified, the ConOps and PSEMP should be updated accordingly.*
* *Identify the organizational structures and provide all stakeholders with a brief description of their role in the System Validation Plan to be played by each stakeholder.*
* *Organizational structure may include ad hoc and existing management workgroups, and multidisciplinary technical teams that should be formed to provide the support that is critical to reaching successful system deployment.*
* *The content for this section should be available from the ConOps or PSEMP. It can be copied in full or summarized and referenced, depending on the preparer’s perceived need for the material.* *If at this point, new stakeholders are identified, the ConOps and PSEMP should be updated accordingly.*

## Support Environment

* *Describe the physical environment and location(s) of where the System Validation will be conducted and where any field data will be collected.*
* *If applicable, explain how the TMC and other agents will apply oversight of the data collection and the system parameters under testing.*
* *How parameters of interest will be accessed is of vital importance to the System Validation Plan.*

# Conducting the System Validation

* *Update the following two paragraphs, as needed.*

This section provides details on how the validation is to be accomplished. It defines: who does it; when and where it is to be done; the responsibilities of each participant before, during, and after each validation event or activity; the [hardware](https://www.fhwa.dot.gov/cadiv/segb/glossary/h.cfm#text_Hardware) and software to be used and other systems, if any; and the documents to be prepared as a record of the activity.

Another very important part of this section defines how anomalies are to be handled. That is, what to do when something fails, does not match the documented needs, or does not satisfactorily address the original problem.

## Basis of System Validation Plan in ConOps

* *Provide a list of all the ConOps’ goals and user needs that the Validation Plan is to evaluate.*
* *The ConOps should have defined goals and user needs related to mobility, safety, environment, agency efficiency, and others as needed, for each operational mode.*
* *The ConOps should also have defined performance measures along with statistical tests, simulations, or experimental designs that define project success, as needed.*
* *The ConOps is an important source document for the System Validation Plan and should be referenced for its goal and user-needs structure. Performance measures and statistical tests of significance should be delineated. Any controlled experiments should be listed and defined as well.*
* *The content for this section should be available from the ConOps. It can be copied in full or summarized and referenced, depending on the preparer’s perceived need for the material.* *If at this point, new material is identified, the ConOps and PSEMP should be updated accordingly.*

## Responsibilities

* *Provide a description of the participating organizations and their roles and responsibilities for validation.*
* *This may include, for example, the operators, an event recorder, witnesses, and/or engineering support. Some agencies prefer to not have contractors around during validation; others want access to them in case questions or problems arise.*
* *Provide the names of the key personnel involved in the validation effort, stating their responsibilities, authority, and the following information:*
* *Name, title, current organization*
* *Description of the required tasks to be performed*
* *Geographical location of the work to be performed*
* *Time or dates required*
* *Skills required, and specialties needed*

## Locations

* *Identify the location of the activities (i.e., the place, or places, where the progress must be observed).*

## Schedules

* *Provide a schedule of validation activities with start and completion events for each activity, including a sequencing of the events and activities that make up the validation schedule.*
* *Events (e.g., kickoff meeting, system validation approval) are the start and endpoints of activities (e.g., emergency operations validation, crash reduction validation, etc.). Events do not take time in the schedule, while activities do take time. The schedule presentation can be a table, a critical-path chart, or any other form that assists in understanding the scheduled activities and events.*

## Conduct of Activities

* *Provide a description of how the activities will be conducted. Details on conducting the activities will include:*
* *Notification of participants*
* *Management roles and all roles of the participants - TMC operators and others*
* *Procedures for approving last-minute changes to the scenarios*
* *System configuration(s) including hardware and software*
* *Supporting documents – checklists, setup procedures*
* *Handling of anomalies – equipment, communications or software failure, unplanned traffic interruption, solutions taken, resolution, retesting*
* *Deliverables as part of the system test, to include the quantity and full identification*

# Validation Event Identification

* *Update the following paragraph, as needed.*

This section of the System Validation Plan identifies the specific scenarios, organizational structures for grouping validation activities and events, and other activities to be performed.

* *Stakeholders may set up events to exercise the final system during or as set up for normal operations, incident conditions, power failure, etc., to see if the system meets goals, user needs, and performance criteria in the ConOps. The actual grouping of goals and user needs into a validation event is up to the stakeholders. The events should be related and easily combined into a reasonable set of actions to take. Events could be:*
  + *clustered around a typical operator’s use of the system*
  + *structured around the operational needs defined in the ConOps*
  + *based on particular performance criteria or measures*
  + *other organizational methods*

## Validation Activities

* *Summarize the validation activities in Table 2:*

Table 2: Validation Activities

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Goal/User Need ID Number** | **User Need** | **Measure of Effectiveness/**  **Data Need** | **Pass/Fail Criteria** | **System Configuration** | **Date** | **Results** |
| UN001 |  |  |  |  |  |  |
| UN002 |  |  |  |  |  |  |
| UNxxx |  |  |  |  |  |  |

* *Fill out Table 2 to describe the Validation Activities. As needed, under a separate subheading in this plan (e.g., 4.1.1, 4.1.2, etc.), add details to explain the information in the table:*

1. *A reference number from the ConOps is needed for each User Need (UNxxx).*
2. *A description of the User Need is required.*
3. *The Measure of Effectiveness to use and data needed to test the User Need. A User Need may have more than one Measure of Effectiveness.*
4. *A statement of the Pass/Fail criteria is required.*
5. *A description of the system configuration (i.e., a list of the hardware and software items needed and how they should be used (e.g., detectors and SunGuide). Often, the same configuration may be used for several events/scenarios. A list of any other important assumptions and constraints necessary to conduct the test.*
6. *The last two columns are reserved for documenting the System Validation Test Results.*

* *There is a clear distinction between verification and validation in systems engineering. During another phase of systems engineering, a Requirements Traceability and Verification Matrix (RTVM) is undertaken, which has some similarity to Table 2 but uses User Needs as a reference source for detailed requirements that will be tested. Requirements tests would verify whether the field equipment works to specifications, for example. However, the validation tests per Table 1 of this document aim to measure whether a specific User Need was met, and not a requirement based on it.*
* *For example, a User Need to “improve travel time reliability on highway “X” from “A” to “B” might have a requirement for traffic detectors that measure traffic speed and travel times. The verification test would be listed and checked in the RTVM. There might be other requirements for detectors in the RTVM, as well, such as mounting height and offsets, cybersecurity, weather protection, and so forth. A verification test would follow upon installation that the operator can verify detector outputs as installed.*
* *Validation also includes overall project goals that may not be listed in the ConOps as User Needs, such as “the system will reduce the incident delay by five percent.” The goal might then be phrased as a User Need, “the system will reduce the incident delay by five percent.” To evaluate this measure, a statistically significant test may need to be designed and data gathered before and after the implementation. Simulation or other methods may be needed to get valid results. The System Validation Plan should detail the tests needed to validate whether the system attains its goals and User Needs, as they were delineated in the ConOps.*

## System Validation Test Results Summary

* *Compile the completed test results (that were summarized in Table 1) into either:* 
  + *An Appendix to the System Validation Plan, or*
  + *A System Validation Results Summary report for larger projects.*
* *The results will delineate the validation findings with special emphasis on the validation failures and the activities that were undertaken or might be undertaken to remedy them.*
* *The following outlines elements to be included in System Validation Results:*
  + *Completed Validation Plan Results Table (Table 1) annotated with results*
  + *Description of each anomaly, if any, from the expected result called for in the Validation Plan*
  + *Any back-up data or records related to the tests*
* *Special attention is to be paid to any situation where a failure or deviation from the expected system performance occurred. If the system does not meet a goal or user need, it may not necessarily be rectifiable. If the failure cannot be resolved through equipment and software checks, procedure modifications, re-testing, and so forth, then be sure to document the tests and results. Include comments to add to the ConOps, such as an explanation of the outcome.*
* *If the System Validation Results Summary is done as a separate report, it should include:*
  + *FDOT title page*
  + *Project identification as in the System Validation Plan, Section 1.1*
  + *Purpose of the document, as in the System Validation Plan but focusing on results*
  + *Identification of configuration(s) under test (per Section 4.5 of the System Validation Plan)*
  + *Validation Plan results (discussed above)*

## Agency System Validation Results Report

* *Assemble the Final Project System Validation Results Report. If multiple reports were made, bring all the agency reports together.*
* *If applicable, arrange test results according to the agency hierarchy, as discussed in Section 1.1.*
* *As stated in Section 1.1, when a project is complex and several agencies are involved, it may be practical for each agency to conduct its own tests. Then, each agency will submit an agency System Validation Results Summary following the model presented in Section 4.2.*

# Glossary

* *Include a clear and concise compilation of the definitions and terms used in the System Validation Plan document, especially those that may be unfamiliar to readers.*
* *A glossary should be maintained and updated during the System Validation Plan’s development processes. To avoid unnecessary work due to misinterpretations, all definitions should be reviewed and agreed upon by all involved parties.*

# Appendices

* *Insert information in appendices to the document when appropriate.*
* *Appendices can facilitate the System Validation Plan’s ease of use and maintenance. Each appendix should be referenced in the main body of the document where the information applied. Appendices may be bound as separate documents for easier handling.*

1. For the relationship between ConOps and System Validation, see discussion of V-Diagram in FHWA’s *Systems Engineering for Intelligent Transportation Systems,* <https://ops.fhwa.dot.gov/publications/seitsguide/section3.htm>. [↑](#footnote-ref-1)