Department of Commerce $ National Oceanic & Atmospheric Administration $ National Weather Service

NATIONAL WEATHER SERVICE INSTRUCTION 80-305
NOVEMBER 11, 2019

Office of Planning & Programming for Service Delivery

Systems Engineering

TEST AND EVALUATION

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Type of Issuance: Routine

SUMMARY OF REVISIONS: This instruction supersedes NWS Instruction 80-305, dated April 8, 2009. Changes were made to:

- Update the names of certification and approval officials to reflect the personnel changes;
- Update the Development Test & Evaluation (DT&E) and Operational Test & Evaluation (OT&E) descriptions;
- Include the System Integration Test (SIT), System Acceptance Test (SAT), and System Test (ST) descriptions.
- Update Section 3 for the Test & Evaluation Master Plan (TEMP) discussion including templates for plans and reports.
- Update the Test & Evaluation Figure 1 and removed all OSIP labels and added SIT and SAT/ST testing.
- Remove the previous Appendix C because definitions are already discussed in Section 1.

SUMMARY: This instruction specifies the test and evaluation master plan template for all authorized projects. Each program should establish and manage its test effort to ensure timely, efficient, and comprehensive data that support evaluation processes, and through effectively managed processes, lead to systematic improvement. Each program test and evaluation process must ensure, to the maximum extent possible, that the end item fulfills the established requirements and is operationally acceptable. To support this goal, this instruction specifies a template for the TEMP, and summarizes the DT&E, SIT, SAT for new systems and the ST for deployed and maintained systems, and the OT&E. This instruction relates to NWS Instruction 80-301 *Systems Engineering Process and Life Cycle*.

Signed 10/28/2019
Kevin Cooley Date
Director
Office of Planning & Programming for Service Delivery

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Test and Evaluation

1. Introduction

Test and Evaluation (T&E) supports system engineering processes for both the Design and Development and the Operations Validation NWS life cycle stages. Testing is a process of objective and repeatable use-based review of a system, subsystem, or component that is the basis for evaluation and judgment. The purpose of evaluation is to review, analyze, and assess data obtained from testing and other means to aid in making systematic decisions. The purpose of T&E is to verify technical performance, operational effectiveness, operational suitability, sustainability, system security, and to provide essential information to support decisions.

The Test and Evaluation Master Plan (TEMP) describes an acquisition program's planned T&E activities over a program's life-cycle and identifies evaluation criteria for the testers. The TEMP establishes the overall testing philosophy and strategy to be followed from development through operational testing, provides an integrated test program schedule and a description of the overall test and management process, and describes provides guidance regarding documentation and issue reporting requirements. The TEMP serves as the parent document for the subsequent development, integration, system, and operational test plans.

Developmental Test and Evaluation (DT&E) verifies system development against approved system requirements and is included in the Design and Development stage of the NWS systems engineering lifecycle model. DT&E focuses on the unit and component verification during the development phase to assess development progress and maturity in preparation of for integration testing. The DT&E is managed by project management and is performed without introducing operational complexity by controlling the testing within the development environment defined by the system developers. While the DT&E is typically informal, the level of formality and documentation should be established in the TEMP and may or may not include a DT&E plan. The outputs of the DT&E are hardware components and software modules ready for system integration.

System Integration Test (SIT) focuses on verification of multiple system components integrated as a whole system within a controlled environment, typically at the design and development organization's facility. The SIT is included in the Design and Development stage of the NWS systems engineering lifecycle model. Testing during the SIT is to simulate as close to an operational environment without involving actual operational sites. The SIT is an informal test managed by project management (PM) and conducted by designated system integrators.

System Acceptance Test (SAT) focuses on the validation of technical requirements after the DT&E and SIT have been successfully completed. The SAT is a formal test managed by the PM and conducted by the PM designated developers and/or integrators for new systems not already fielded. Documentation should consist of test plans, procedures, and test reports. The SAT is performed and traced to the functional requirements specification via the Requirements Traceability Matrix (RTM).

For systems that are already fielded and maintained by National Weather Service (NWS), the System Test (ST), instead of the SAT, is managed and conducted by the Office of Programming and Planning for Service Delivery (OPPSD)/Systems Engineering Integration Testing (SEIT) branch. The ST is performed and traced to release notes documented by a Request for Change (RC). Documentation will consist of test plans, procedures, and test reports.

Both SAT and ST will require successful completion of the DT&E and the SIT without any critical failures. SAT or ST are mostly conducted within a controlled simulated operational environment. The SAT or the ST are included in the Design and Development stage of the NWS systems engineering lifecycle model. The SAT and ST detailed processes are discussed in NWSI 80-306 *System Acceptance Test Process*.

Operational Test and Evaluation (OT&E) focuses on operational effectiveness and suitability, introducing realistic and actual operational considerations that may influence concepts of operation, requirements, design, and system use. The OT&E requires successful completion of SAT or ST without any critical failures. OT&E includes testing in which varying degrees of the operational environment are introduced. It may include early operational assessment, initial operational test and evaluation, and follow-on operational test and evaluation. Representatives from the user and maintenance communities participate in operational testing. Tests performed as part of OT&E trace to operational requirements and test results provide information to support decisions on commissioning and/or national deployment of the system. The OT&E is managed and conducted by the SEIT branch and is included in the Operations Validation stage of the NWS systems engineering lifecycle model. The detailed OT&E process is discussed in NWSI 80-307 *Operational Test & Evaluation Process*.

Security Test and Evaluation (ST&E) confirms that the system security requirements have been appropriately addressed within system design, development, integration and implementation and that the system is in compliance with NWS IT security policies. ST&E activities may occur during the OT&E under the authority of the designated ISSO. The ST&E is included in the Operations Validation stage of the NWS systems engineering lifecycle model.

2. Purpose and Scope

This instruction specifies the framework and functions that can be used for test and evaluation. Each program should establish and manage its test effort to ensure timely, efficient, and comprehensive data that support evaluation processes, and through effectively managed processes, lead to systematic improvement. The context, framework, and schedule for test and evaluation, in relation to the overall NWS systems engineering lifecycle model, is shown in Appendix A, Figure 1.

3. Program Product Standards

This section defines the standard template for a TEMP which is the guiding plan for a test and evaluation program. The activities required to complete the TEMP will result in planning an appropriate test program to evaluate a system. Specific definitions supporting the information presented here are included in Appendix B.

3.1 System Introduction

Provide a summary of system objectives, measures of effectiveness and suitability, a system description, and an identification of critical technical parameters.

3.2 Test and Evaluation Master Schedule and Management

Provide an integrated test program schedule and description of the overall test and management process. This section should reference applicable test policies.

3.3 DT&E Plan

Provide an overview of the DT&E plan. Reference the Requirements Specification and trace testing to system specifications. For complex projects and programs, the DT&E Plan may be a separate document that is referenced in this section. The DT&E Plan will include the following:

- Background
- Purpose and objectives
- System under test description
- Test cases
- Use cases
- Assumptions and limitations of the test and system under test
- Applicable policies
- Test management
- Entrance criteria
- Success criteria
- Test schedule

An example of the planned DT&E Test Report outline is provided in Appendix B, Table 2.

3.4 SIT Plan

Provide an overview of the SIT plan. For complex projects and programs, the SIT Plan may be a separate document that is referenced in this section. The SIT Plan can include the same sections as listed for the DT&E in Section 3.3.

3.5 SAT/ST Plan

Provide an overview of the SAT/ST plan. Reference the Requirements Specification and trace testing to system requirements. For complex projects and programs, the SAT/ST Plan may be a separate document that is referenced in this section. The SAT/ST Plan will include the following:

- Introduction
- Purpose and test objectives
- Background/system description
- Prerequisites, assumptions, and limitations of system under test
- Test Strategy
- Test Management/Test Review Group
- Test schedule, facilities, resources
- Test conduct and planned activities
- Test reporting and analysis
- Conclusion

An example of the planned SAT/ST Test Report outline is provided in Appendix B, Table 3.

3.6 OT&E Plan

Provide an overview of the OT&E Plan. Reference the Concept of Operations / Operational Requirements Document (ConOps/ORD) and trace testing to operational requirements. For complex projects and programs, the OT&E Plan may be a separate document that is referenced in this section. The OT&E Plan will include the following:

- Introduction
- Purpose and test objectives
- Background/system description
- Prerequisites, assumptions, and limitations of system under test
- Test Strategy
- Test Management/Test Review Group
- Test schedule, facilities/OT&E sites, resources
- Test conduct and planned activities
- Test reporting and analysis
- Conclusion

An example of the planned OT&E Test Report outline is provided in Appendix B, Table 4.

3.7 T&E Resource Summary

Identify the necessary physical resources and activity responsibilities. The following items may be included: test articles, test sites, test instrumentation, test support equipment, test targets and

other expendables, operational force test support, simulations, models, test data, test-beds, information security safeguards, special requirements, funding, and training.

3.8 Appendices

Appendices may contain additional information used in supporting test program planning.

Appendix A - Test & Evaluation Framework

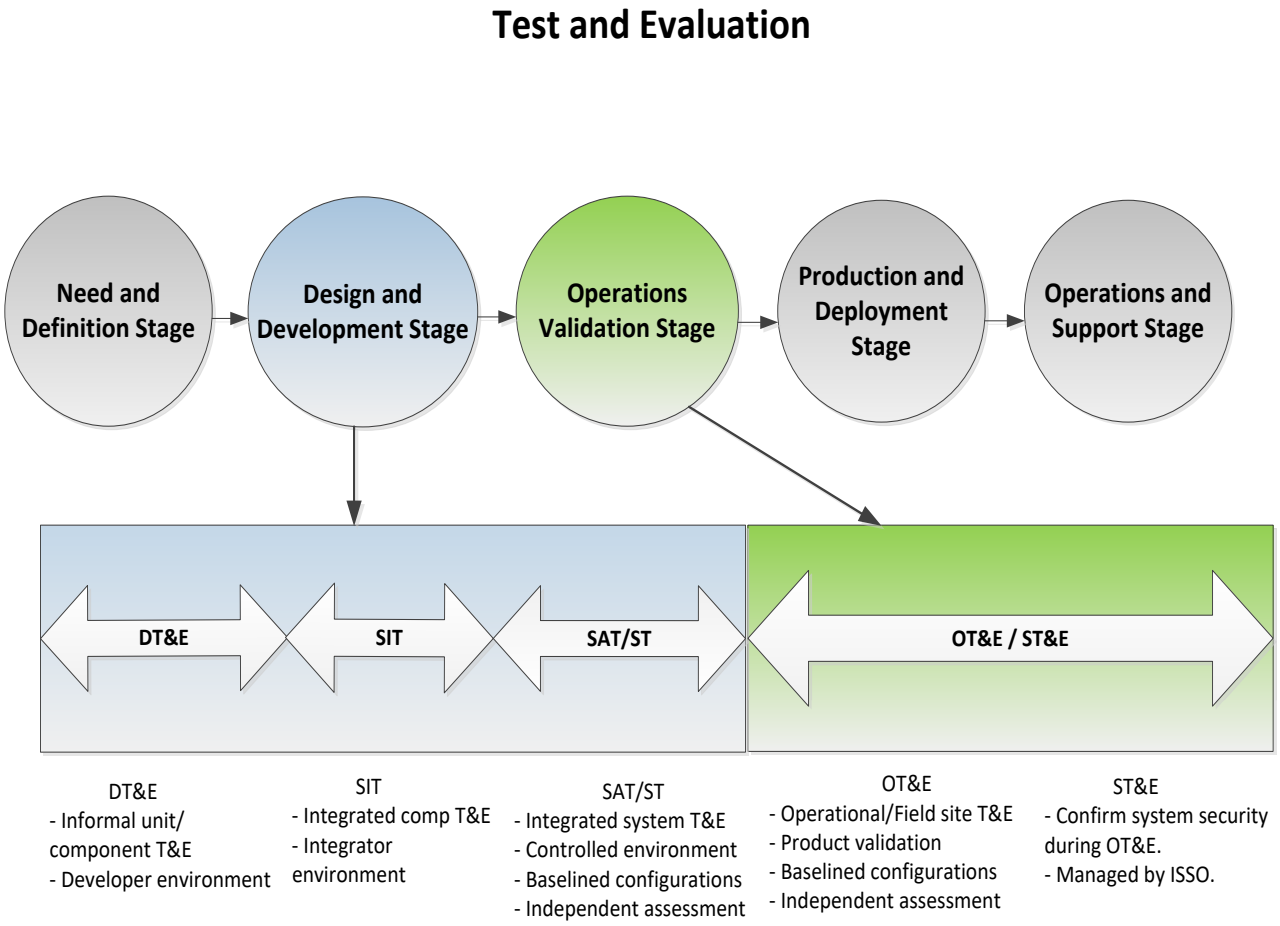

Figure 1 - Test and Evaluation

Appendix B - Test Report Outlines

Table 1 - Example of DT&E Report Outline

Section	Section Title	Content
1	Component / Subsystem / System Description	A brief description of the system component to be tested. *Component* is used broadly in this context to include physical, logical, and process elements of the system.
2	Test Objectives	A brief statement of test objectives traceable to requirements.
3	Test and Use Cases	Test and use cases designed to objectively develop information to support test objectives.
4	Test Tools and Resources	A summary of all tools and resources required to execute the tests including identification of test sites.
5	Test Procedure	Reference the appropriate procedures executed, and identify the sequence steps used during the test.
6	Test Constraints/Limitations	Describe any test constraints or limitations (i.e., test platform).
7	Test Results, Schedule, and Success Criteria	A report of all test results, including those not anticipated during the procedure.
8	Test Anomalies	A description of anomalies identified during the test and (if any) workarounds.
9	Recommendations	A list of recommendations based on the test outcomes.
10	Conclusions	A list of conclusions drawn from the test outcomes and success criteria.

Table 2 - Example of SAT/ST Report Outline

Section	Section Title	Content
1	Introduction	A brief introduction of the system and high level overall planning for the SAT/ST.
2	Purpose	A brief statement of the purpose of the SAT/ST and of the report.
3	Test objectives and success criteria	A discussion of all test objectives and their corresponding success criteria, including the status of the objectives that were met (Pass) with corresponding test results and those that were not (Fail).
4	Test Results	A discussion of all test results validated for the duration of the SAT/ST.
5	Test Trouble Reports	A list of all adjudicated problems/issues found during the SAT/ST including which have been resolved and which are still outstanding.
6	Conclusions	A list of conclusions drawn from the test outcomes and success criteria.
7	Recommendations	A list of recommendations based on the test outcomes.

Table 3 - Example of OT&E Report Outline

Section	Section Title	Content
1	Introduction	A brief introduction of the system and high level overall planning for the OT&E.
2	Purpose	A brief statement of the purpose of the OT&E and of the report.
3	Test objectives and success criteria	A discussion of all test objectives and their corresponding success criteria, including the status (Pass or Fail) of the objectives that were met with corresponding test results and those that were not.
4	Test Results	A discussion of all test results validated for the duration of the OT&E.
5	Test Trouble Reports	A list of all adjudicated problems/issues found during the OT&E including which have been resolved and which are still outstanding.
6	Conclusions	A list of conclusions drawn from the test outcomes and success criteria.
7	Recommendations	A list of recommendations based on the test outcomes.

Appendix C - References

1. NWS Instruction 80 3, Systems Engineering
2. NWS Instruction 80-301, *Systems Engineering Process and Life Cycle*
3. NWS Instruction 80-303, *Systems Engineering for New Development*.
4. NWS Instruction 80-304, *Software Development*.
5. NWS Instruction 80-305, *Test & Evaluation*
6. NWS Instruction 80-306, *System Acceptance Test Process*
7. NWS Instruction 80-307, *Operational Test & Evaluation Process*
8. NWS Policy Directive 60-7, *Information Technology Security Policy.*
9. NWS Instruction 80-201, *System Commissioning Process*.
10. DOD, Systems Management College, Defense Acquisition University, *Systems Engineering Fundamentals*, 2001.
11. IEEE 1012-1998 *Standard for Software Verification and Validation*, 1998.
12. DOC IT Security Program Policy and Minimum Implementation Standards, Section 6.3.3, *Security Test and Evaluation (ST&E)*, Revised June 30, 2005