

APPROVED

Navy Modeling and Simulation Standard

Standard Title:

Best Practices Guide for Verification, Validation, and Accreditation of Legacy Modeling and Simulation

Signed

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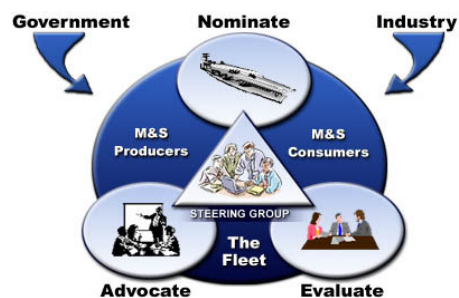


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EXECUTIVE SUMMARY

Modeling and Simulation (M&S) is used to analyze system effectiveness, support design tradeoffs, and provide an analytical basis for test scenario development and test result evaluation. The use of M&S provides significant risk reductions and increased test confidence at minimal cost.

The Verification, Validation, and Accreditation (VV&A) of models and simulations provides increased confidence in the application of M&S, reduces the risk that M&S use will lead to incorrect results, increases M&S usability for future applications, provides cost containment, provides a potential for better analysis, and satisfies policy requirements. Validation and Verification (V&V) techniques tailored to the specific application provide M&S credibility within the confines of the intended use. Furthermore, V&V results are documented in a standardized way and are made available to the user community. New accreditation efforts build on V&V results of earlier users and reduce the cost of V&V.

This document recommends and discusses VV&A processes that have proven to effectively support legacy M&S accreditation for design, development, test, and evaluation of Program Office systems. Models and simulations will be identified and accredited to support major program decisions, objectives, milestones, developmental tests, and operational tests.

1.0 PURPOSE

This document provides Program Managers (PMs) with guidelines on how to perform Modeling and Simulation (M&S) Verification, Validation, and Accreditation (VV&A) in support of their acquisition programs.

This document was developed in accordance with the Department of Defense (DoD), Department of the Navy (DoN), and Program Executive Office (PEO) instructions regarding VV&A.

1.1 Scope

This document is applicable to Program Offices. It applies to legacy M&S (including Hardware-in-the-Loop (HWIL)) sponsored, managed, or used to represent Program Office systems and system elements.

Legacy M&S are those models and simulations that were developed either in the past or for a different purpose. This document describes best practices that have proven effective in the accreditation of legacy M&S used in support of systems design, development, test and evaluation. The process described in this document is easily tailorable. Program Managers undertaking the VV&A of legacy M&S for the first time should consider modeling their VV&A processes on the best practices that are documented here. References to models and simulations or M&S throughout this document refer to legacy M&S unless otherwise specifically stated.

Sections 2.0 and 3.0 address a general accreditation approach and the accreditation guidelines for legacy M&S used by Program Offices. Section 4.0 provides information regarding the VV&A of new models and simulations. (Note: Although this process has been adopted for legacy M&S, it is easily adaptable for new M&S.) Section 5.0 addresses VV&A of HWIL systems. Section 6.0 provides information on data accreditation.

2.0 GENERAL ACCREDITATION APPROACH

2.1 Overview

The general VV&A process consists of three phases: designation, execution, and accreditation. The designation phase begins when the Accreditation Authority (AA) designates M&S or M&S functional requirements for VV&A and proceeds with the convening of an Accreditation Review Panel (ARP). The designation phase culminates with the approval of an Accreditation Plan, which specifies the intended use, M&S requirements, and acceptance criteria. The execution phase begins with the development of the Verification and Validation (V&V) Plan and continues through the development of the V&V Assessment Report. The accreditation phase begins with an ARP review of the V&V Assessment Report and ends when the AA makes an accreditation decision. If appropriate, the official M&S catalog entry is updated with the pertinent data from the VV&A decision made by the AA. Proprietary and/or competition-sensitive data may be included as part of an accreditation package. Such data should be handled in accordance with established PEO practices and procedures.

There are two key benefits of this process. It provides the AA with increased insight into the uses and capabilities of supporting M&S, and it assists the M&S Proponent (MSP) in ongoing efforts to improve quality. These benefits will help ensure appropriate use of M&S in the acquisition process by increasing the awareness of the requirements and capabilities of existing M&S. Areas that require increased capabilities will be identified, and existing M&S may be modified or new M&S may be developed.

A necessary precondition for the accreditation of M&S is sound Configuration Management (CM) practices in the development of the M&S. All developers of M&S should implement positive CM as early as practical in the development cycle.

2.2 Participants

The various participants and their roles in the VV&A process are discussed in Sections 2.2.1 through 2.2.4 below.

2.2.1 Accreditation Authority

The AA is the senior management or command level directly responsible to approve the use of an M&S capability for a particular application or set of applications. The AA will:

- a. Resource the VV&A effort
- b. Develop the accreditation process
- c. Establish the ARP
- d. Designate models and/or simulations for VV&A
- e. Approve the M&S Accreditation Plan
- f. Accredit the models and/or simulations

- g. Maintain and disseminate gathered VV&A information (for Operational Test (OT), the Program Office will maintain this information)

2.2.2 Accreditation Review Panel

The ARP is composed of AA representatives and Subject Matter Experts (SMEs) as needed, and each ARP will include a Program Office representative(s). The Program Office will reconvene the ARP for each M&S milestone effort and should allow tailoring of approaches and participants to the specific models and simulations under consideration. The AA or his designated representative chairs the ARP. The ARP will:

- a. Develop M&S Accreditation Plans with MSP assistance
- b. Establish Simulation Control Panels (SCPs)
- c. Approve the V&V Assessment Report
- d. Review V&V information
- e. Prepare the Accreditation Recommendation Letters

2.2.3 Simulation Control Panel

The SCP(s) should consist of technical SMEs from the relevant Program Office and supporting organizations. The SCP is not a permanent body. An SCP will be chartered for each model or simulation designated for accreditation. The SCP chairman is designated by and reports directly to the ARP chairman. The SCP will:

- a. Provide guidelines for V&V Plan development to the MSP
- b. Approve the V&V Plan
- c. Guide the gathering of V&V information
- d. Provide guidelines for the V&V Report to the MSP
- e. Approve the V&V Report
- f. Prepare the V&V Assessment Report and deliver to the ARP

2.2.4 M&S Proponent

An MSP is a developer, maintainer, modifier, or user of a model or simulation designated for VV&A. The MSP will:

- a. Provide a Point of Contact (POC) to the ARP Chairman
- b. Assist the ARP in drafting the M&S Accreditation Plan
- c. Develop a CM Plan for the M&S
- d. Develop a V&V Plan and deliver to the SCP
- e. Execute the V&V Plan upon approval by the SCP
- f. Develop the V&V Report and deliver to the SCP, along with supporting documentation
- g. Assist the SCP in determining model capabilities versus requirements
- h. Provide VV&A Status to the Program Office M&S Catalog

2.3 Products

The various documents produced during the VV&A process are discussed in Sections 3.3.1 through 3.3.11 below. Sample formats for these documents are found in Appendix B.

2.3.1 M&S VV&A Designation Letter

The M&S VV&A Designation letter, initiating the accreditation process, is sent by the AA to the MSP and ARP Chairman. It notifies the MSP of the AA's plan to conduct VV&A on the uniquely identified model or simulation and directs the MSP to support this effort. The Designation Letter also indicates the necessity for accreditation.

2.3.2 ARP Charter

The ARP Charter, developed by the AA, identifies the ARP's membership and reporting responsibilities. It also defines the organizational structure, roles, and responsibilities of the ARP.

2.3.3 M&S Accreditation Plan

The M&S Accreditation Plan, developed by the ARP with assistance from the MSP, contains a Plan of Action and Milestones (POA&M) specific to the designated model or simulation. The M&S Accreditation Plan primarily defines the acceptance criteria and specific intended use for accreditation.

2.3.4 SCP Charter

The SCP Charter, developed by the ARP, identifies the SCP's membership and reporting responsibilities. It also defines the organizational structure, roles, and responsibilities of the SCP.

2.3.5 V&V Plan

The V&V Plan, developed by the MSP, details the V&V methodologies that will be utilized by the MSP to establish the suitability of the M&S for accreditation.

2.3.6 V&V Report

The V&V Report, generated by the MSP, contains selected planning, V&V execution, and accreditation information gathered during the execution of the approved V&V Plan.

2.3.7 Configuration Management Plan

The CM Plan, provided by the MSP, documents configuration control requirements for the designated model or simulation. It also details the methods and approach needed to meet the CM requirements.

2.3.8 V&V Assessment Report

The V&V Assessment Report, generated by the SCP, summarizes the overall V&V execution, and provides an assessment of the demonstrated functionality to support the specific intended use.

2.3.9 M&S Accreditation Recommendation Letter

The M&S Accreditation Recommendation Letter, sent from the ARP to the AA, contains the ARP's accreditation recommendation. It contains specific information on the model or simulation, such as version and intended use.

2.3.10 M&S Accreditation Decision Letter

The M&S Accreditation Decision Letter, sent from the AA to the ARP and MSP (as well as to the M&S Technical Agent for posting on the PEO VV&A web site), specifies approval or disapproval of the designated M&S accreditation recommendation.

2.3.11 M&S Catalog Entry

The M&S Catalog Entry provides information about a model or simulation, including its applicability, accreditation status, implementation, CM control mechanisms, distribution restrictions, current users, and functional description. The MSP provides VV&A status to the Program Office M&S Catalog. The ARP chair provides the Program Office Technical Agent with an electronic copy for inclusion in the PEO VV&A web site. The PEO maintains the comprehensive M&S Catalog. NAVSEA Dahlgren, N Department, maintains a VV&A M&S Catalog.

2.4 VV&A Process

The VV&A process shown in Figure 2-1 (following page) provides a framework for developing the necessary documentation to support accreditation decisions for Program Office systems. The documentation should consist of individual VV&A packages and Program Office M&S updates in the appropriate M&S catalog.

As depicted in the figure, the three phases of the VV&A process are the 1) designation phase, 2) execution phase, and 3) accreditation phase. Specific actions to be taken during each of these phases are discussed in Section 3.0.

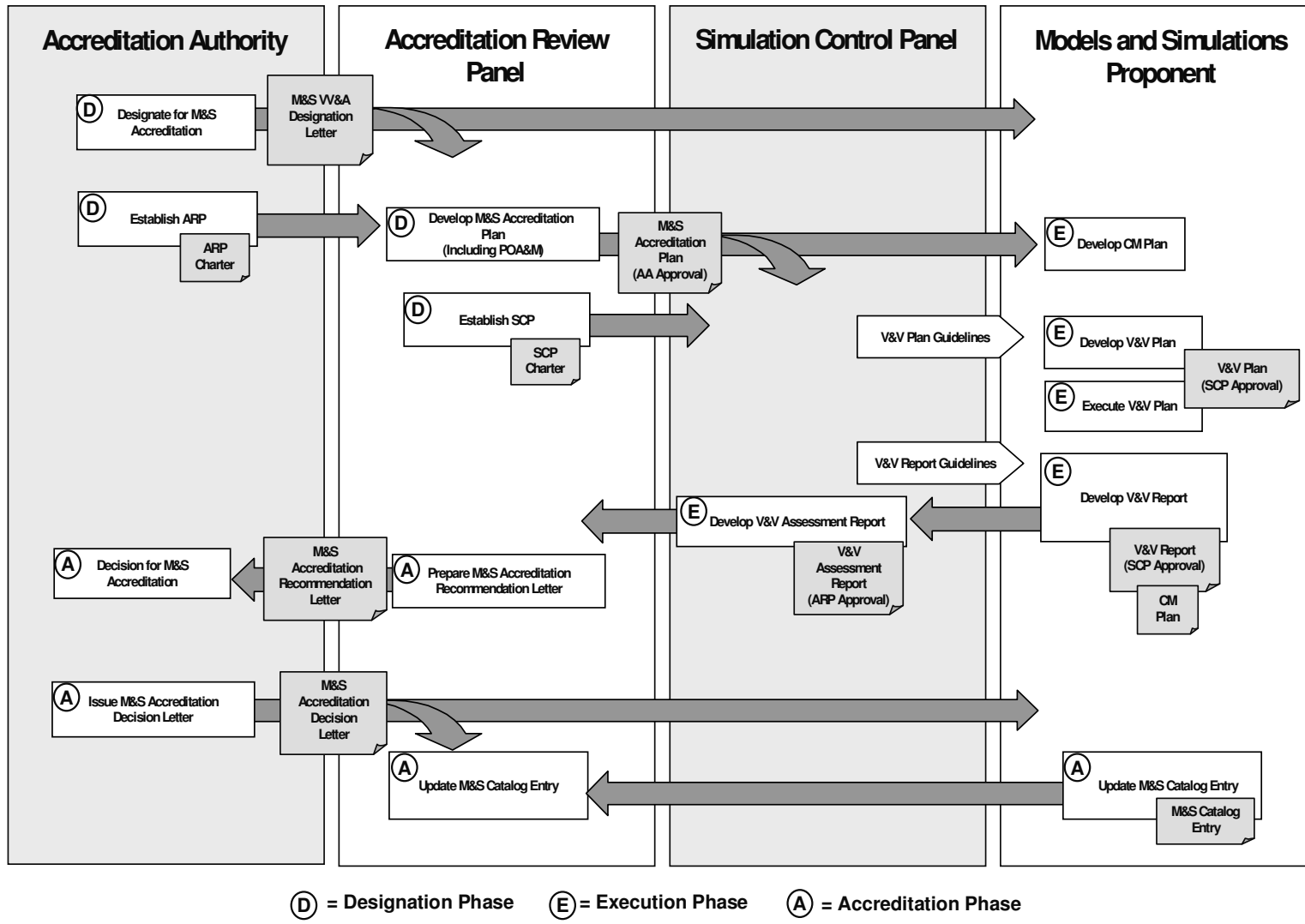


Figure 2-1. PEO M&S VV&A Process

3.0 ACCREDITATION GUIDELINES

3.1 Designation

The purpose of M&S VV&A designation is for the user and the owner/developer to agree that the model or simulation selected is capable of satisfying the specified need and that there are sufficient resources to complete accreditation. Each Program Office will have specific variations on designating M&S – these guidelines are intended to provide a basic understanding.

It should be noted that the PEO process for M&S VV&A includes three phases: designation, execution, and accreditation. Preceding these three phases is a designation process. The designation process and designation phase are separate activities. The designation process is that process that leads toward the selection and formal designation of M&S for accreditation. The designation phase is the initial activity that takes place after the selected model or simulation has been identified for accreditation.

3.1.1 General Guidelines

There are two common scenarios that could initiate the designation phase. They are (1) Program Office initiation and (2) external organization initiation. In Scenario 1, the Program Office determines the potential need for a model or simulation to be accredited. In Scenario 2, an external organization (government or commercial) identifies the need to accredit a model or simulation and requests accreditation from the Program Office.

For a request that originates from an external organization, the applicable Program Office should ensure that an *M&S Accreditation Designation Request Form* be completed and submitted to that Program Office. This form will provide the information that is necessary to process the designation request.

Models or simulations listed in a Systems Requirements Document (SRD) or in a Test and Evaluation Master Plan (TEMP) should be considered for designation.

Requesting organizations should attempt to establish accreditation at a lower level than the Program Office if their specific intended use supports a subordinate organization's delegated responsibility.

3.1.2 Designation Process

The PEO has developed a six-step process to achieve designation of M&S. The six steps are:

- Step 1: Identify Need
- Step 2: Identify Sponsor
- Step 3: Establish Requirements
- Step 4: Understand M&S Functionality

- Step 5: Develop Plan of Action and Milestones
- Step 6: Make Designation Decision

These six steps are discussed in further detail below.

Step 1: Identify Need

The purpose of this step is to define the specific intended use and to establish the necessity for accreditation. It is important to be as detailed as possible in defining the specific intended use. This is commonly an iterative process for the user. This supports later requirements definition and keeps the V&V activity focused upon the specific use.

The importance of M&S accreditation in general is well established, for reasons that are provided by documents cited in this guide as references. The requirement to accredit M&S also is well established with regard to acquisition testing and training (joint testing and exercises, operational testing), and with regard to external release from the Navy. The requirement to accredit is less well defined with regard to developmental test and evaluation (DT&E), system development, and contractor testing.

Step 2: Identify Sponsor

The purpose of this step is to establish the AA who will be responsible for funding and approving results. It is important that the AA be familiar with the overall VV&A process. The AA must understand the specific intended uses and the need for accreditation. The AA must be provided with a date for and the list of the data that will support an accreditation decision.

Step 3: Establish Requirements

The purpose of this step is to document the usage and initial functionality requirements to support the specific intended use. The Program Office M&S Manager must review the application user requirements documents or interview the application user to refine usage and functionality requirements. Usage requirements might include (1) availability / releaseability, (2) training, and (3) documents. Functionality requirements might include (1) interaction with other simulations, (2) inputs/outputs, (3) algorithms, and (4) data extraction/data recording.

Step 4: Understand M&S Capabilities

The purpose of this step is to document current M&S capabilities, and assess the specific intended use of the model or simulation by comparing those capabilities to the defined M&S requirements.

The M&S Manager (normally the AA) must provide M&S requirements to the MSP(s). The MSP(s) should provide the M&S Manager with a brief description of the M&S to include (1) usage history, (2) current functionality, (3) sources of data, (4) CM

documentation, (5) previous V&V, (6) existing V&V data that could support the specific intended use, and (7) availability/releaseability status.

The M&S Manager must trace the M&S capabilities to the M&S requirements with assistance from the MSP(s). The sponsor must then assess the extent to which the model or simulation satisfies the M&S requirements.

Step 5: Develop Plan of Action and Milestones

The purpose of this step is to develop an overall POA&M to quantify the programmatic issues. The M&S Manager must ensure that the MSP understands its responsibilities (i.e., documents, participation on panels) to support the overall VV&A process. The M&S manager must discuss and gain agreement with the MSP(s) on the expected V&V methods.

The M&S Manager should request a POA&M from the MSP(s) that states, at a minimum, (1) the date needed and the expected decision date, (2) the specific intended use and the M&S requirements, and (3) the V&V expectations. The M&S Manager should then add an estimate of non-MSP VV&A costs and schedule impacts (i.e., VV&A support, ARP/SCP members). If multiple models and/or simulations are available, the M&S Manager should recommend the most favorable based upon coverage of the M&S requirements and the costs.

Step 6: Make Designation Decision

The purpose of this step is for the AA to review information provided by the Program Office M&S Manager and decide which models and/or simulations are to be accredited. The Program Office M&S Manager should provide the AA with (1) technical and programmatic assessments, (2) selection rationale, and (3) a designation recommendation.

If multiple models and/or simulations were considered, the AA should provide a denial letter to the MSP for the models and simulations not selected. If the AA approves designation for a model or simulation, the M&S Manager should draft a Designation Letter for the AA's signature and then distribute the Designation Letter to the ARP and the MSP(s).

3.2 Designation Phase

During the designation phase, the AA establishes the ARP. The ARP establishes the SCP and documents information from the preceding designation process in an Accreditation Plan. This document will consist of a description of the M&S, overview of its intended use, M&S requirements and acceptability criteria, V&V techniques to be used, and the AA's POA&M for the accreditation effort.

The designation phase is completed when the Accreditation Plan receives AA approval.

3.3 Execution Phase

The execution phase of the VV&A process begins with the development of the V&V Plan. The plan should contain the specific qualitative and/or quantitative testing requirements to satisfy the acceptance criteria of the accreditation plan. The SCP provides V&V Plan guidelines to the MSP. These guidelines should consist of an outline, schedule for the execution phase, and clarification of any questions about the accreditation plan requirements. V&V Plans may vary greatly based upon previous V&V efforts, complexity of simulation functionality, length of usage, scope of intended use, and M&S application requirements.

Once the V&V Plan is approved by the SCP, the MSP is tasked with executing that plan. According to the length and complexity of the required V&V, the SCP may have one or more In-Progress Reviews to ensure that the schedule and product development is progressing according to schedule. Prior to completion of V&V testing, the SCP should provide the MSP with guidance for the V&V Report. This guidance should include an outline, inputs on desired formats of information, and distribution formats. When all required V&V efforts and documentation are complete, the MSP provides a final V&V Report to the SCP for evaluation and approval.

The V&V Report should summarize all V&V efforts in accordance with the requirements set forth in the V&V Plan. The SCP can decide to approve the V&V Report with or without modification. As the V&V Report is a critical document in the accreditation process, modification to the report might be necessary to clarify V&V results or to correct deficiencies. Once the V&V Report is approved, the SCP must prepare a V&V Assessment Report.

The V&V Assessment Report summarizes the overall V&V execution, provides an assessment of the demonstrated functionality's support of the specific intended use, and makes a recommendation to the ARP for action on the results. This recommendation could be any one of the following:

- a. The model or simulation can be used as is for the specific intended use
- b. The model or simulation can be used for the specific intended use with recommended modifications
- c. The model or simulation requires additional V&V to be considered suitable for accreditation
- d. The model or simulation should not be used for the specific intended use

The execution phase should use V&V techniques from among those defined in the DoD VV&A Recommended Practices Guide, unless other V&V techniques are authorized by the SCP. The DoD VV&A Recommended Practices Guide provides information and guidelines for use on 76 V&V techniques and 18 statistical techniques. These V&V techniques are grouped into four categories: informal, static, dynamic, and formal. The use of mathematical and logical formalism in each category increases from informal to formal. The complexity also increases as the category becomes more formal. Chapter 4

of the above reference should be thoroughly reviewed in order to gain a better understanding of the various V&V techniques available for use.

3.4 Accreditation Phase

Upon completion of the V&V Assessment Report, the ARP evaluates the report for consistency, correctness, and completeness. Once the ARP is satisfied that the V&V information provided meets the stated accreditation requirements, the ARP prepares an M&S Accreditation Recommendation Letter.

This recommendation provides all the M&S information required to support accreditation, such as version and intended use. The AA can approve the recommendation, deny the recommendation, or request additional information. Upon approval by the AA, an M&S Accreditation Decision Letter is sent to the MSP and the ARP. The SCP is dissolved at this time. If the recommendation is denied or if additional information is required, the AA should provide written notification to the ARP and MSP. The SCP may be retained if the ARP decides that further V&V is required for accreditation.

The accreditation remains in effect as long as the intended use or limitations/assumptions of the model or simulation do not change, or until revoked by the AA. If the functionality or the intended use of the model or simulation defined in the M&S Accreditation Decision Letter change, the AA must submit the model or simulation for re-accreditation.

The Program Office M&S Engineer is responsible for maintenance of the M&S Catalogs. The MSP should be tasked with providing updates to the catalog entry as the status of the model or simulation changes.

3.5 Governing Principles of Accreditation

One governing principal of the accreditation process is to leverage from the VV&A effort of the Program Office to the greatest degree possible. Accreditation of M&S may be required by organizations or groups that do not have contractual relationships with the MSP. Therefore the group seeking accreditation should strive to capture and use the VV&A efforts performed by the Program Office. The group seeking accreditation at a minimum should request information about existing VV&A from the applicable Program Office and may even invite representation from that Program Office to participate the ARP and/or SCP of the new accreditation effort.

Another governing principle of this process is to place authority in M&S matters consistent with the accountability for the proper use of M&S. M&S is accredited for a specific purpose or a specific use. This specific use or specific purpose drive M&S requirements, which have to be demonstrated by proper V&V techniques before the M&S can be accredited. M&S requirements should be levied on the MSP by the Accreditation Authority. M&S requirements may be imposed on the Program Office by another Program Office, a Mission Program Office, or an external agency or group.

3.5.1 Accreditation Authority Policy

Models and simulations supporting PEO systems fall under three classifications.

Single Accreditation Authority. The first class of M&S accreditation applies to M&S that is developed by the Program Offices and is used by the Program Offices to support the design, development, and test of their products. While the Mission Program Offices, or other groups, have a clear interest in the effectiveness of M&S used in this role, the sole AA for this type of M&S is the Program Office that develops and uses it.

Hierarchical Accreditation Authority. The second class of M&S accreditation is used when another organization provides M&S requirements to a Program Office. The Program Office then reviews the requirements and determines if M&S under its control satisfies the M&S requirements, or with minor modifications will satisfy the requirements. The Program Office determines the AA and designates the appropriate M&S for accreditation. After the Program Office completes the accreditation cycle, the AA passes the accreditation decision to the original organization which provided the M&S requirements. The original organization then conducts its own review of the VV&A material and determines whether the M&S will be accredited for their use.

The M&S requirements could come from within the PEO, e.g., from another Product Program Office or from a Mission Program Office. The M&S requirements could also be from an organization outside the PEO such as BMDO, JNTF, or COTF. In all these instances, the Program Office that has direct oversight of the M&S performs its accreditation first and passed the accreditation decision to another group for their accreditation assessment.

Cooperative or Coordinated Accreditation. The third class of M&S accreditation applies when two or more Program Offices cooperate in accrediting M&S which share or exchange data. In this case, each Program Office controls a part of the total M&S; but each needs other pieces to generate the entire M&S picture. In this class of accreditation, the individual M&S will be combined or linked together to create a larger more robust simulation. A key feature of this accreditation class is that no Program Office can claim superiority, or jurisdiction, over any of the other Program Offices. For example, this class of accreditation can apply to M&S from Product Program Offices being linked together in HLA federations.

4.0 NEW MODELS

The new simulation development process consists of six phases. The associated VV&A process is normally treated as two separate processes, the V&V process, conducted by the MSP and SCP, and the accreditation assessment, conducted by the ARP and AA.

4.1 New M&S Development Process

The new M&S development process consists of six phases. These phases are:

- a. Define M&S Requirements
- b. Plan M&S Development
- c. Develop Conceptual Model
- d. Develop Design
- e. Implement and Test Design
- f. Prepare Simulation for Use

4.2 V&V Process for New M&S

The V&V process for new M&S consists of six steps. These steps are:

- a. Verify Requirements
- b. Develop V&V Plan
- c. Validate Conceptual Model
- d. Verify Design
- e. Verify Implementation
- f. Validate Results

4.3 Accreditation Process for New M&S

The Accreditation Process for new M&S consists of four steps. These steps are:

- a. Develop Accreditation Plan
- b. Collect and Evaluate Accreditation Information
- c. Conduct Accreditation Assessment
- d. Make Decision

5.0 HARDWARE-IN-THE-LOOP

5.1 Overview

An HWIL system is an integration of simulations, stimulators, hardware, and operational components. This system provides a capability to exercise and evaluate the operational components, which could be tactical hardware (such as phased-array radar), or a computer program (such as missile guidance software). The remaining portion, the “loop” in HWIL, is the additional simulations, stimulators, and non-tactical hardware that provide the operational component with the necessary stimulus.

M&S VV&A within the PEO has focused primarily upon the model, simulation, and stimulator. However, the scope is expanding to encompass the total HWIL system. Although the methods used to develop confidence in computer simulations and hardware components are different, they both fall under the current DoD M&S accreditation process.

An HWIL system contains the individual complexity of each included model and simulation, the complexity of each tactical component, and the complexity associated with integration. The individual components of the HWIL system must first perform as expected before the system can be evaluated. For this reason, proper employment of an HWIL system requires a significant understanding of each component’s functions and limitations.

While the single-model VV&A process is generally applicable for HWIL systems, the inherent complexity of any given HWIL may require a tailoring of the process. Each HWIL VV&A effort must be assessed to determine the need for procedural adaptations. To assist with this determination, the PEO has developed an HWIL-specific approach to VV&A.

5.2 VV&A Approach for an HWIL System

The PEO has developed a five-step approach for VV&A of an HWIL System. The five steps are listed below:

- Step 1: Develop an overarching HWIL System Accreditation Plan
- Step 2: Perform V&V of individual M&S components
- Step 3: Perform configuration management of the HWIL system in addition to individual component configuration management
- Step 4: Establish a single SCP to oversee all V&V execution
- Step 5: Incorporate HWIL System Accreditation Status into the Test Readiness Review Process

Each of these five steps will be discussed separately in detail.

Step 1: Develop an overarching HWIL System Accreditation Plan

In addition to any existing Accreditation Plans for individual components, an Accreditation Plan for the HWIL system should be developed. The Accreditation Plan documents the system description, M&S requirements, acceptance criteria, V&V expectations, and integrated POA&M for the HWIL VV&A effort. In this regard, the HWIL VV&A process is similar to the single-model process. The tasks associated with the Designation Process and Designation Phase, which culminates with the approval of an Accreditation Plan, still must be performed.

The Accreditation Plan should trace the M&S requirements to HWIL system-level capabilities. The description of the HWIL system should include at least the following:

- a. Description of major functions of the HWIL system
- b. Diagram of the fielded operational system
- c. Diagram of the HWIL system differentiating among models and simulations, non-tactical hardware, and operational components
- d. Description of each component's role in the HWIL system
- e. List of components with a brief description of each component's function(s), and a brief description of interfaces between non-tactical and operational components

The acceptance criteria should define the qualitative and/or quantitative metrics to prove the capabilities of the entire HWIL system to the M&S Application Sponsor (normally the AA). The V&V expectations should provide guidance to the SCP and MSP on the type of V&V methods and amount of V&V data desired by the ARP. The integrated POA&M should define the component and system V&V events.

If components of the HWIL system are owned by organizations other than the M&S Application Sponsor, those organizations are responsible for accrediting their M&S component to support the HWIL Accreditation Plan. The organization would develop its own acceptance criteria, and provide a certification letter with supporting V&V data to the ARP. The certification letter would state the organization's assertion that the M&S is suitable for the sponsor's need. Such certification does not equate to nor replace the need for accreditation, and as with other M&S, accreditation can only come from the AA.

Step 2: Perform V&V of Individual M&S Components

Individual M&S components contribute to the overall functionality of the HWIL system. Therefore, each M&S component must undergo V&V for the functionality it contributes to the overall HWIL system. This V&V must be completed prior to completion of the HWIL system V&V, so that its capabilities and limitations are properly characterized in the HWIL system V&V Report.

Step 3: Perform Configuration Management of HWIL System in Addition to Individual Component Configuration Management

The HWIL system CM Plan defines the process to ensure the correct versions and configuration of the components are provided for the application usage. This would include, at a minimum, a documented Version Description and Change Control process.

Step 4: Establish a Single Simulation Control Panel to Oversee all V&V Execution

Given the potentially broad technical breadth and M&S types employed in an HWIL system, multiple SCPs might be desired to address all the technical needs of the ARP. This would put undue burden on the ARP, and could force it to be involved with more technical detail than it should. There should be a single HWIL system SCP responsible to the ARP for oversight of all V&V execution activities. This SCP would be responsible for providing a single V&V Assessment Report to the ARP for the total HWIL system. This will minimize the V&V management responsibilities for the ARP, yet still ensure an integrated report.

Step 5: Incorporate HWIL System Accreditation Status into the Test Readiness Review Process

Testers that utilize M&S for testing events should assess the need for accreditation and incorporate appropriate processes in their Test documents and Readiness Review. This will document the Test Director's M&S accreditation decision and rationale to support the usage of test results generated by models or simulations. In the case of operational testing, the Oversight Office M&S VV&A instruction requires the Oversight Office's accreditation 90 days prior to testing.

6.0 DATA ACCREDITATION

Data are symbolic representations of factual information to be used as a basis for reasoning, discussion, comprehension, communication, prediction, or calculation. However, although “factual” implies truth, “data” merely denotes information: the truth or falsity of data depends solely on the application. Data represent or “model” aspects of reality as defined in a specification. As is the case with any model, data can never be absolutely correct for all purposes.

The overall usefulness of any M&S application is limited as much by the quality of data as by the quality of the model or simulation involved. Whether a model or simulation is used for analysis, training, or acquisition, the data involved in its preparation and execution need to be subjected to the same kind of scrutiny as the model or simulation itself.

6.1 Types of Data Used in Models and Simulations

There are four basic types of data that support the design, development, execution and evaluation of a model or simulation: 1) reference data, 2) hard-wired data, 3) instance data, and 4) validation data.

Reference data are descriptive information (metadata) about all the data used by the model, simulation, or federation. Reference data include data characteristics (e.g., resolution, fidelity, accuracy, completeness, relevancy, currency, appropriateness). They also include specifications to which the data were developed or are provided, and factors describing data quality.

Hard-wired data are data values implemented as part of the code (e.g., constants, set parameters). Hard-wired data include the data values incorporated in the algorithms used to mathematically articulate the actions/reactions/interactions of the “players” in the mission space. Although data such as “constants” are included in this category, the resolution/fidelity assumptions of a simulation may require additional “facts” to be treated in this way.

Instance data are data values comprising the baseline set of conditions (and allowable dynamic updates) under which the simulation is initiated and executed; input data (e.g., kill rates, firing ranges, flight altitudes, movement rates); and output data. Instance data are stored and accessed separately from the code. Instance data are usually found at the intersections of rows and columns in a relational database and are the “facts” used to initialize a simulation before start and to update the simulation dynamically over simulation execution.

Validation data are actual measurements from the real world or “best guess” information provided by SMEs that are used to validate that the results of the simulation are “correct enough” for the simulation to be useful. Note that validation data do not directly support the model or simulation itself, but are involved in VV&A activities. They are the real

world facts used for comparison to validate the results of a simulation. Validation data come from empirical sources (such as test ranges, live exercise results, and historical records); from outputs of other previously validated simulations; or from the knowledge of SMEs.

A fifth type of data, called exchange data, provides all the data needed by the individual models and simulations (i.e., federates) that comprise the federation. Exchange data are the metadata that identify what is to be exchanged in a federation. They are identified using the Object Model Template (OMT) and captured in Federation Object Models (FOMs).

6.2 Data Quality

Data quality issues concern data producers, data centers, and M&S developers and users, who all share responsibility for the quality of data used in modeling and simulation. Data quality is established during production. Data producers generate data to meet a specification based on the need to represent some aspect of a defined reality. They conduct tests to validate their production techniques and assessments to verify the quality and accuracy of the resulting data.

Data quality is a measure of how well data serve the purpose for which they were produced. All data are produced for a purpose, and their quality is directly tied to whether they meet the requirements of that purpose.

Determination of data quality is a data producer function. Data quality assessments are conducted during production against the producer's specifications. Data quality assessment is inherently complex and cannot be represented by a simple numeric value. Rather, it is indicated by the sum of numerous bits of information about the data that are captured during the data production process and made available to the data user as metadata.

Although data quality addresses the appropriateness of the data for a specified use, there is no reason the data cannot be put to a different use as long as the data user understands the requirements of the original purpose and has some confidence that the data can meet the requirements of the current application. However, even when data are consistent and accurate, they may not be suitable for use in a specific model or appropriate for a specific application. They may be incompatible with other data being used in the simulation, they may be based on assumptions inconsistent with simulation specifications, or they may represent a level of fidelity that is inappropriate for the application.

The results of the data quality assessment are provided to the data users who must determine the appropriateness of the data for their particular application. Although the quality of the data is determined by the data producer, only the user of the data can determine whether the data are of the appropriate quality for the new intended purpose. The credibility of the application depends on the credibility of the data no less than the credibility of the model or simulation itself.

6.3 Data Verification and Validation

Data V&V activities are performed to ensure that data are appropriate for use in a particular simulation for a specific application. Data verification activities are conducted to ensure the data selected are the most appropriate for the application and are properly prepared for the model. Data validation activities are conducted to ensure the data provide an accurate representation of the real world to be simulated.

In simulation, it is virtually impossible to separately evaluate the model being executed from the data used. It is the interaction of data and code that produces simulation results, making both responsible for simulation credibility.

This interdependent relationship between a simulation and its associated data dictates that data V&V activities be considered part of the overall M&S VV&A process. However, because of the specialized nature of data V&V, and particularly because of the large varieties of data subject areas, SMEs, in particular the data producers themselves, are frequently called upon to assist in the data V&V process. Regardless of who are designated to conduct data V&V activities, they should work closely with the M&S developers and those performing M&S V&V activities.

REFERENCES

DoD Directives, Standards, and Plans:

1. DoD Directive 5000.59, "DoD Modeling and Simulation (M&S) Management," 4 January 1994.
2. DoD 5000.59-M, "DoD Glossary of M&S Terms," December 1997.
3. DoD 5000.59-P, "Modeling and Simulation (M&S) Master Plan," October 1995.
4. DoDINST 5000.61, "DoD Modeling and Simulation (M&S) Verification, Validation, and Accreditation (VV&A)," 29 April 1996.
5. Draft "Introduction to VV&A Standards and Practices for DoD M&S," 30 September 1995.
6. Department of Defense "Verification, Validation, and Accreditation (VV&A) Recommended Practices Guide," November 1996.

DoN Directives, Standards, and Plans:

7. SECNAVINST 5200.38, "Department of the Navy Modeling and Simulation Program," 18 October 1994.
8. SECNAVINST 5200.40, "VV&A of Models and Simulations," 19 April 1999.
9. "Navy Modeling and Simulation Master Plan," 21 February 1997.
10. COMOPTEVFORINST 5000.1, "Use of Modeling and Simulation (M&S) in Operational Testing," 5 September 1995.
11. COMOPTEVFOR letter 3980 Ser 00T/312, "Accreditation of Modeling and Simulation in Support of Operational Test and Evaluation," 29 April 1998.
12. COMOPTEVFOR Policy and Information Notice 99-01, "COMOPTEVFOR Modeling and Simulation Accreditation Documentation," 13 May 1999.

Program Office Directives, Standards, and Plans:

13. PEOINST 5200.1, "Modeling and Simulation," 18 May 1999.
14. PEOINST 5200.3, "Verification, Validation, and Accreditation (VV&A) of Modeling and Simulation (M&S)," 4 February 2000.
15. "Modeling and Simulation Accreditation Process Plan for the Navy Area Theater Ballistic Missile Defense Program, Revision 1," 14 June 2000.
16. "Modeling and Simulation Accreditation Process Plan for the Navy Theater Wide Theater Ballistic Missile Defense Program, Version 1.0," 20 August 2000.
17. "STANDARD Missile Simulation Management Plan," ADS-99-015, The Johns Hopkins University Applied Physics Laboratory, March 1999.

DEFINITIONS

Accreditation. The official determination that a model or simulation is acceptable for use for a specific purpose.

Accreditation Authority (AA). An individual occupying a position with the appropriate rank, grade, responsibility and/or authority to accredit a model, simulation, or federation of models and/or simulations for a particular purpose or purposes. For design, development, and developmental testing, this authority resides with the Program Managers. For operational testing, this authority resides with the Commander, Operational Test and Evaluation Force.

Accreditation Review Panel (ARP). The PEO Program Office organization responsible for managing the gathering and review of V&V information and presenting an Accreditation Recommendation to the Program Office on all program controlled M&S. It is composed of Program Office representatives and subject matter experts as appropriate. The ARP establishes the SCP.

Core M&S. Those models or simulations used by a program that are identified by the Program manager as critical to the design, development, test, or evaluation of the system or are required to provide critical support to major milestone decisions.

Key M&S. Those models or simulations used by a program that are not identified as “core” but are determined to be instrumental in supporting system design, development, test, evaluation, or major milestone decisions.

Legacy M&S. Any M&S that was developed either in the past or for a different purpose.

Model. A physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process.

Modeling and Simulation (M&S). The use of models and simulations, including emulators, prototypes, simulators, and stimulators, either statically or over time, to develop data as a basis for making managerial or technical decisions. The terms “modeling” and “simulation” are often interchangeable. References to M&S in this document include hardware-in-the-loop (HWIL) and software-in-the-loop (SWIL).

M&S Application Sponsor. The organization that uses the results/products from a specific application of a model or simulation.

M&S Proponent. A developer, maintainer, modifier, user, or sponsor of M&S applied to PEO programs. The MSP provides the required V&V information, conducts V&V activities, and supports the ARP and SCP as tasked.

Simulation. A method for implementing a model over time.

Simulation Control Panel (SCP). A technical review panel established by the ARP to guide the gathering of V&V information. It provides the independent oversight of the execution of the V&V Plan and reviews the V&V effort of the MSP.

Validation. The process of determining the degree to which a model or simulation is an accurate representation of the real world from the perspective of the intended uses of the model or simulation.

Verification. The process of determining that a model or simulation accurately represents the developer's conceptual description and specification.

ACRONYMS AND ABBREVIATIONS

AA	Accreditation Authority
ARP	Accreditation Review Panel
CM	Configuration Management
COMOPTEVFOR	Commander, Operational Test and Evaluation Force
DAB	Defense Acquisition Board
DoD	Department of Defense
DoF	Degrees of Freedom
DoN	Department of the Navy
DT	Developmental Test
DT&E	Developmental Test and Evaluation
FOM	Federation Object Models
HWIL	Hardware-in-the-Loop
Inst	Instruction
JROC	Joint Requirements Oversight Council
M&S	Modeling and Simulation
MSP	Modeling and Simulation Proponent
OMT	Object Model Template
OT	Operational Test
OT&E	Operational Test and Evaluation
PEO	Program Executive Office
PM	Program Manager
POA&M	Plan of Action and Milestones
POC	Point of Contact
SCP	Simulation Control Panel
SME	Subject Matter Expert
SOM	Simulation Object Models
SRD	System Requirements Document
SWIL	Software-in-the-Loop
TEMP	Test and Evaluation Master Plan
V&V	Verification and Validation
VV&A	Verification, Validation, and Accreditation

APPENDIX A: PEO INSTRUCTION 5200.3

Insert Copy of Document Here

APPENDIX B: SAMPLE PRODUCT FORMATS

Sample M&S VV&A Designation Letter

From: Program Executive OfficeTo: Johns Hopkins
University/Applied Physics Laboratory
11100 Johns Hopkins Road
Laurel, MD 2723-6099

Subj: DESIGNATION OF NAVY MODELS FOR VERIFICATION
VALIDATION AND ACCREDITATION

Ref: (a) Department of Defense (DoD) 5000.2-R; Mandatory
Procedures for MDAPs and MAIS Acquisition Programs;
(Change 4); dtd 11 May 99
(b) DOD DIRECTIVE 5000.59; DoD Modeling and Simulation
(M&S) Management; (Change 1); dtd 20 Jan 98
(c) DODINST 5000.61, DoD Modeling and Simulation (M&S)
Verification, Validation, and Accreditation (VV&A),
dtd 29 Apr 96
(d) SECNAVINST 5200.40 Verification, Validation and
Accreditation (VV&A) of Models and Simulations, dtd
19 April 1999
(e) Modeling and Simulation Accreditation Plan for the
Navy Area Theater Ballistic Missile Defense Program,
dtd 18 December 1996

1. References (a), (b) and (c) establish procedures and guidance for Major Defense Acquisition Programs (MDAPs) use of and validation, verification and accreditation (VV&A) of modeling and simulation (M&S). Reference (d) provides additional VV&A direction for all Navy components. Reference (e) complies with the overarching instructions and specifies the requirements for VV&A of the Navy Program M&S.

2. The JHU/APL FIRMTRACK model is designated for accreditation. JHU/APL is hereby directed to support the Accreditation Review Panel (ARP) in the W&A effort. Funding for this task is under contract N00024-98-D-8124; task BKK01, AD-18724; task planning sheet APL0100453. Schedule for this task is in accordance with Navy schedule. The FIRMTRACK model is to be accredited for the specific purposes of Navy Area TBMD system performance prediction, development testing (DT), operational testing (OT) and DAB Milestone III. The Accreditation Authority (AA) for DT is the Program Office. The AA for OT is Oversight Office. The AA for Milestone III is another Program Office.

Subj: DESIGNATION OF NAVY MODELS FOR VERIFICATION
VALIDATION AND ACCREDITATION

3. Additional information on the Program Office VV&A Processes and procedures will be provided at a later date. The PEO pointof contact is the Program Office, at (703) 602-9320 extension 242.

By direction

Copy to:
JHU/APL
Lockheed Martin
NSWCDD XX5

Blind Copy to:
PMS XX
PMS XXXCCC400B1
PMS XXXCC
PMS XXXDD
PMS XXXCCDDYY
PMS XXXEEE
PMS XXXFFF
PMS XXXMMM
PMS XXX000OJJ
PMS XXXLLL
PMS ZZZ

Sample ARP Charter

3900
Ser XXXB

From: Technical Director (PMS XXXB)

Subj: CHARTER FOR ACCREDITATION REVIEW PANEL

1. Purpose. The purpose of this letter is to establish the Modeling and Simulation (M&S) Accreditation Review Panel (ARP), define its placement within the AEGIS organizational structure, and define its roles and responsibilities.
2. Implementation. The Program Office Manager (PMS XXXYYE) has established the need for a Verification, Validation, and Accreditation (VV&A) Board which will be established as the ARP. ARP membership will consist of personnel from the Program Office, Program Executive Office, NAVSEA, Navy, and Subject Matter Experts. The ARP will report directly to the Technical Director (PMS XXXB) who will serve as the Accreditation Authority (AA) for all M&S accreditation decisions.
3. Definition. The ARP will be responsible for ensuring the implementation of all AEGIS VV&A activities, as directed by the Technical Director. The ARP will be responsible for compliance with overarching M&S VV&A instructions from DoD, SECNAV, and PEO. The ARP will ensure that sufficient verification or validation has been performed to make an informed recommendation for accrediting applicable M&S for specific project uses.
4. Responsibilities.
 - a. The AA shall:
 - (1) Establish the ARP, designate the chairman, and approve membership.
 - (2) Approve M&S accreditation recommendations for usage by the Program Office.
 - (3) Resource VV&A activities
 - b. The ARP shall:
 - (1) Oversee the execution of VV&A activities
 - (2) Assess M&S accreditation requests

- (3) Make recommendations to the AA
- (4) Report all resource requirements for VV&A activities to the AA prior to execution of tasking
- (5) Charter and oversee Simulation Control Panels (SCPs) as required
- (6) Maintain VV&A information
- (7) Maintain the M&S Catalog

c. All organizations shall cooperate with and support the M&S ARP in discharging its responsibilities.

d. The M&S Manager is responsible for maintaining this charter.

5. Membership. Membership in the ARP is at the discretion of the AA. Member organizations are in two groups, voting and non-voting. A support contractor shall not be allowed to vote in place of a government organization representative.

a. Voting members are:

- (1) PMS XXXB3YYY (ARP Chair)
- (2) PMS XXXB3ZZZ (ARP Co-Chair)
- (3) PMS XXX400B3P
- (4) PEO
- (5) NSWCDD

b. Non-voting members are:

- (1) NSWCDD VV&A support (secretary)
- 2) PMS XXXN
- (3) PMS XIC
- (4) PMS XHU
- (5) COMOPTEVFOR
- (6) JHU/APL
- (7) LM/NE&SS

c. Additional voting and not-voting members may be appointed by the ARP Chair.

6. Accreditation. VV&A may be performed for the purposes of supporting system design, system development, system requirements verification, system performance verification and prediction, DT, OT, and the Milestone III DAB decision. After accreditation by the AA, the M&S Accreditation Report and Accreditation Notification Letter will be forwarded to the

Mission Program Office, Program Office, Oversight Office, and any other Program Office, as appropriate, for determination if the M&S meets their needs.

7. Points of Contact. The ARP Chair is PMS XXXB3T4 available at (703) 602-7090. The ARP Co-Chair and alternate POC PMS XXXB3ZZZ available at (703) 602-9320 x242 or (540) 653-1278.

Distribution:
PMS XXXB3ZZZ
PMS XXXB3Y
PMS XXXN
PMS XZC
PMS XRF
PMS XB12
PEO
NSWCDD
Oversight Office
JHU/APL
LM/NE&SS
Logicon

Blind Copy to:
PMS XZC
PMS XRF
PMS XRG
PMS XXXB
PMS XXXB1
PMS XXXB3
PMS XXXB3X
PMS XXXB3A
PMS XXXB3B
PMS XXXB3C
PMS XXXB3D
PMS XXXB3E
PMS XXXB3L
PMS XXXB3T
PMS XXXB4
PMS XXXB42
Oversight Office (Code 70)

Sample M&S Accreditation Plan Outline

Executive Summary

1.0 Application Description and M&S Approach

- 1.1 Purpose of Document
- 1.2 Overall Program Description
- 1.3 Program M&S Methodology
- 1.4 Verification, Validation, and Accreditation Overview

2.0 Model Description

- 2.1 Model Description
- 2.2 Model Sponsor
- 2.3 Model Configuration Manager
- 2.4 Specific use for Accreditation
- 2.5 Operating Environment
- 2.6 Key Sources of Data

3.0 M&S Requirements and Acceptability Criteria

- 3.1 M&S Requirements Overview
- 3.2 M&S Requirement 1-N
 - 3.2.1 Acceptability Criteria

4.0 Model Capabilities and Limitations

- 4.1 Model Capability Overview
- 4.2 Model Objects and Functions Represented
- 4.3 Model Limitations

5.0 Planned Verification and Validation Approach

- 5.1 Planned Verification Approach
- 5.2 Planned Validation Approach
- 5.3 Data Accreditation Summary

6.0 Other Accreditation Information

- 6.1 Model Development and Use History
- 6.2 Configuration Management
- 6.3 Model Documentation Available

7.0 Schedules

- 7.1 Verification, Validation, and Accreditation Schedule
- 7.2 Verification and Validation Schedule

References

Appendix A: Accreditation Review Panel Charter

Appendix B: Designation Letter

Appendix C: Simulation Control Panel Charter

Sample SCP Charter

3900
Ser XXXB

From: Technical Director (PMS XXXB)

Subj: CHARTER FOR SIMULATION CONTROL PANEL (SCP)

Ref: (a) CHARTER FOR ACCREDITATION REVIEW PANEL (ARP),
dtd 27 Mar 00

1. Purpose. To charter the Simulation Control Panel (SCP), define its placement within the organizational structure, and define its roles and responsibilities in support of the policies established in reference (a).
2. Implementation. The Modeling and Simulation Manager (PMS XXXB3M&S) has established the need to accredit models and simulations that support the Program Office. The Accreditation Review Panel (ARP) was established in reference (a), with the responsibility of executing this task. The ARP requires the establishment of a SCP to provide technical support leading to an accreditation decision. The SCP Chair will be designated by the ARP Chair. The SCP will consist of technical personnel from the Systems Engineering Department (PMS XXXB3T), NAVSEA, Oversight Office, other supporting organizations, and contractors. The SCP will report directly to the ARP Chair.
3. Definition. The SCP will be responsible for ensuring that Verification and Validation (V&V) activities are in compliance with accreditation criteria established in Accreditation Plans for M&S designated for accreditation PMS XXXB3. The SCP will serve as technical advisor to the ARP on the applicability and acceptability of V&V results to support accreditation decisions.
4. Responsibilities.
 - a. The responsibilities of the are specified in ref (a).
 - b. The SCP shall:
 - (1) Serve as the technical review agent of the ARP.

(2) Monitor ongoing V&V activities and keep the ARP Chair informed of V&V progress.

(3) Provide guidelines to the Modeling and Simulation Proponent (MSP) for V&V Plan development.

(4) Approve the V&V Plan generated by MSP.

(5) Provide guidelines to the MSP for the V&V Report.

(6) Approve the V&V Report generated by the MSP.

(7) Provide a V&V Assessment Report to the ARP.

(8) Respond to specific tasking from the ARP.

c. The SCP Chair shall:

(1) Coordinate the review of the MSP-generated V&V plan.

(2) Coordinate the review of the MSP-generated V&V data.

(3) Conduct SCP meetings to assess the status of the V&V effort.

(4) Coordinate the review of the MSP-generated V&V Report.

(5) Coordinate the development of the V&V Assessment Report.

(6) Delegate tasking from the ARP to specific SCP members.

(7) Conduct other SCP business as required.

d. The SCP shall cooperate with, and obtain support from, Program Office organizations in discharging its responsibilities.

e. The ARP Chair is responsible for updating and maintaining this charter.

Distribution:

NSWCDD
PMS XXXB3T
PMS XXXN
PMS XFC
PMS XOO
Oversight Office
JHU/APL
LM/NE&SS
SEG
EG&G
PEO

Blind Copy to:

PMS XXXB
PMS XXXB1
PMS XXXB3
PMS XXXB3X
PMS XXXB3A
PMS XXXB3B
PMS XXXB3C
PMS XXX3D
PMS XXXB3E
PMS XXXB3L
PMS XXXB3T
PMS XXXB4
PMS XXXB42
PMS XFC
PMS XFF
PMS XFG
Oversight Office (Code 70)

Sample V&V Plan Outline

Executive Summary

1.0 Model Description

- 1.1 Model Description (Include name of model, version, scope and overview of model, model sponsor, and proposed use)
- 1.2 Model Configuration Manager (Include name of model configuration manager and any configuration management tools used)

2.0 M&S Requirements and Acceptability Criteria

- 2.1 M&S Requirement 1-N and Acceptability Criteria (For each M&S requirement, give a description of the requirement and the associated acceptability criteria)

3.0 Verification and Validation Approach

- 3.1 Detailed Requirement 1
 - 3.1.1 Acceptability Criteria (Discuss acceptability criteria)
 - 3.1.2 V&V Techniques (Discuss the verification and validation techniques applied)
- 3.2 Detailed Requirement N
 - 3.2.1 Acceptability Criteria
 - 3.2.2 V&V Techniques

4.0 M&S Verification and Validation History (Describe any past V&V efforts here. Include any documents or papers used during previous V&V efforts)

5.0 Schedule Integrating all V&V Activities

References

Sample V&V Report Outline

Executive Summary

1.0 Differences From V&V Plan

- 1.1 Verification Differences (List of differences in the executed verification activity from the planned verification)
- 1.2 Validation Differences (List of differences in the executed validation activity from the planned validation)
- 1.3 Data VV&A Differences (List of differences in the executed Data VV&A activity from the planned Data VV&A)

2.0 V&V Results

2.1 Verification Results (Repeat this section for Verification Areas 2 through N)

- 2.1.1 Verification Area 1 Description
- 2.1.2 Model Section(s) Verified
- 2.1.3 Verification Approach Taken
- 2.1.4 Schedule of Activities, Resources Used
- 2.1.5 Verification Agent
- 2.1.6 Verification Results

2.2 Validation Results (Repeat this section for Validation Areas 2 through N)

- 2.2.1 Validation Area 1 Description
- 2.2.2 Model Section(s) Validated
- 2.2.3 Validation Approach Taken
- 2.2.4 Schedule of Activities, Resources Used
- 2.2.5 Validation Agent
- 2.2.6 Validation Results

2.3 Data VV&A Results (Repeat this section for Data VV&A Areas 2 through N)

- 2.3.1 Data VV&A Area 1 Description
- 2.3.2 Model Section(s) needing Data VV&A
- 2.3.3 Data VV&A Approach Taken
- 2.3.4 Schedule of Activities, Resources Used
- 2.3.5 Data VV&A Agent
- 2.3.6 Data VV&A Results

3.0 V&V Summary (Contains summary of V&V activities performed, the integrated schedule of performance, and a summary of resources used)

ATTACHMENT:

Verification and Validation Plan

Sample CM Plan Outline

1.0 Scope

- 1.1 Purpose of Document
- 1.2 System Overview

2.0 Reference Documents

3.0 Configuration Management Environment

- 3.1 Configured Items
 - 3.1.1 Hardware and Firmware Items
 - 3.1.2 Software Items
 - 3.1.3 Other Materials
 - 3.1.4 Non-Disclosure
- 3.2 Personnel Assignments

4.0 Configuration Control Processes

- 4.1 General Information
- 4.2 Configuration Management
 - 4.2.1 Configuration Control Manager
 - 4.2.2 Configuration Control Board
- 4.3 Configuration Status Accounting Processes
 - 4.3.1 Version Level Definition
 - 4.3.2 Version Archives
 - 4.3.3 Documentation Distribution and Control
- 4.4 Verification of Correction of Deficiencies
 - 4.4.1 Configuration Audits
 - 4.4.2 Testing of Changes

Sample V&V Assessment Report Outline

1.0 Summary

- 1.1 Application Description
- 1.2 M&S Approach
- 1.3 Model Description

2.0 Application M&S Requirements and Acceptability Criteria

- 2.1 Major M&S Requirement Areas (overview)
- 2.2 Major Requirement Area 1 Description with Acceptability Criteria (Repeat this section for Requirement Areas 2 through N)

3.0 Model Capability

- 3.1 Major Model Capability Areas (overview)
- 3.2 List of Model Objects and Functions Represented
- 3.3 Comparison of Model Capability Areas to Application Requirements Areas (Will model be used in each application requirements areas?)
- 3.4 Major Model Limitations of Each Object and Function

4.0 V&V Report Summary

- 4.1 Verification Report Summary
 - 4.1.1 Verification Approach Overview
 - 4.1.2 List of Verification Activities Accomplished for Each Required Area (For each verified model section, provide the verification method, the verification agent, and verification result)
- 4.2 Validation Report Summary
 - 4.2.1 Validation Approach Overview
 - 4.2.2 List of Validation Activities Accomplished for Each Required Area (For each validated model section, provide the validation method, the validation agent, application requirement, and model capability and accuracy)
- 4.3 Data Verification, Validation, and Accreditation Report Summary
 - 4.3.1 Data VV&A Approach Overview
 - 4.3.2 List of Data VV&A Activities Accomplished for Each Required Area (For each data base section for which Data VV&A is needed, provide the Data VV&A method, the VV&A agent, and the Data VV&A result)

5.0 Comparison Analysis of Requirements Versus Capabilities

- 5.1 Major Model Section Name and Short Description
- 5.2 Application Requirements for this Section
- 5.3 Model Capability/Accuracy Results of Activity
- 5.4 Comparison of Requirements to Model Capability (Include analysis of differences and implications for application in terms of risk, cost, schedule)

6.0 Comparison Analysis Summary

- 6.1 Prioritized List of Model Sections that Do Not Meet Application Requirements
 - 6.1.1 Prioritized in Terms of Risk to the Application
 - 6.1.2 Recommendations for Reducing Risk with Cost and Schedule Implications of Risk-Reduction Action
- 6.2 List of Model Sections that Meet or Exceed Application Requirements (Includes any implications for application for exceeding application requirements)

7.0 Other Accreditation Information

- 7.1 Model or Simulation Development and Use History
- 7.2 Implications of Operational Environment Requirements
- 7.3 Description of Configuration Management System and Process Being Applied to this Model or Simulation Including Listing of Configuration Control Board Members and Chair
- 7.4 Model or Simulation Documentation Available Including Breadth (types of documentation), Depth (detail of documentation), Accuracy and Currency
- 7.5 Other Known Capabilities/Limitations of the Model or Simulation and its Data Base

8.0 Recommendations

- 8.1 Recommendation Summary (Statement of model or simulation usability for application. It can be one of the following alternatives. It may also be a combination of b and c)
 - a. The Model or Simulation Can be Used as Described in the M&S Accreditation Plan
 - b. The Model or Simulation Can be Used as Described in the M&S Accreditation Plan with Limitations
 - c. The Model or Simulation Can be Used as Described in the M&S Accreditation Plan with Recommended Modifications
 - d. The Model or Simulation Requires Additional V&V to be Considered Suitable for Accreditation
 - e. The Model or Simulation Should Not be Used for this Application as Described in the M&S Accreditation Plan

Sample M&S Accreditation Recommendation Letter

Date

From: Chairman, Accreditation Review Panel

To: Accreditation Authority

Subj: M&S ACCREDITATION FOR (*name of model*)

Ref: (a) V&V Assessment Report for (*name of model*)

1. The (*name of model*) has been reviewed on (*date*) and accreditation is recommended for specific use in the (*program name*) program subject to the following restrictions: *List restrictions, if applicable.*

2. This accreditation recommendation applies to Version XXX of the (*name of model*). Major changes to the model's configuration and/or a change of specific use not addressed in reference (a) will be documented and a request for re-accreditation will be submitted through the (*accreditation authority's*) Program Office.

Signature
ARP Chairman

Sample M&S Accreditation Decision Letter

Date

From: [accreditation authority]

To: [modeling and simulation proponent]
[accreditation review panel]

Subj: ACCREDITATION OF [name of model] FOR USE IN THE BLOCK I PROGRAM

Ref: (a) [reference approved M&S Accreditation Plan].
(b) PMS XFG M&S Accreditation Recommendation Letter for [name of model]

Encl: (1) V&V Assessment Report for [name of model]

1. DECISION

- *Reference approved accreditation plan and any applicable documents*
- *Brief description of the system program and the test phase being supported by M&S*
- *Brief description of the model or simulation [title, version, and location] being recommended for accreditation and the intended usage*
- *Statement of approval/disapproval of M&S accreditation, which can be one of the following alternatives*
 - a. *The model or simulation is adequate and credible for the intended use with limitations.*
 - b. *The model or simulation can be used for the specific intended use with recommended modifications.*
 - c. *The model or simulation requires additional V&V to be considered suitable for accreditation.*
 - d. *The model or simulation is inadequate and unacceptable for the intended use*

2. DISCUSSION

- *Brief summary of the accreditation assessment results, as compared to acceptance criteria. Other supporting data for the model assessment*
- *Key M&S limitations and risks involved. Reference the V&V Assessment Report for detailed discussions*

3. ADDITIONAL GUIDANCE

- *Include any reservations or limitations to a full accreditation. Recommendations of modifications or additional V&V if any*
- *Statement of using strict configuration control of M&S used during the execution*
- *Future actions*
- *Other recommendations*

Signature
Accreditation Authority

M&S CATALOG ENTRY FORM
=== Required PEO Information ===

Acronym: (e.g., MEDUSA)

Name: (e.g. Multi-target Effectiveness Determined Under Simulation for AEGIS)

Contact Information:

POC: PMS XXXB3M&S, (540) 653-1278

Sponsor: Program Office (PMS XXX)

Developer: (e.g. Lockheed Martin/GES)

Description: (2 lines or less)

Purpose: (2 lines or less)

Capabilities & Limitations: (2 paragraphs or less)

Program Events Supported:

(e.g., Navy, etc)

Accreditation History: (Latest 2 or 3, specify AA)

(-Specific Use - Accreditation Authority -- Date)

(-Specific Use - Accreditation Authority -- Date)

Threat Representations:

(- Source -- Validation Authority -- Date)

Interoperability Status:

HWIL Interfaces: (N/A; Yes -- Systems // Elements)

C2 Interfaces: (N/A; Yes -- Systems // Message Types)

DIS Compliant: (N/A; Yes -- # of PDU Types)

HLA Compliant: (N/A; Yes -- # of Output Types)

Architecture:

Platforms: (e.g., SGI, SUN)

Languages: (e.g., C)

NOTES: *Adobe, read only, to prevent unauthorized changes
Entire entry should fit on a single page
Font no smaller than 10 Point*