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Operations Support

**VERIFICATION, VALIDATION
AND ACCREDITATION (VV&A)**

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(Maj Gen James A. Jacobson)

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This publication implements Air Force Policy Directive (AFPD) 16-10, *Modeling and Simulation*, by establishing procedures and responsibilities for the Verification, Validation, and Accreditation (VV&A) of Air Force- owned or -managed models and simulations. This publication applies to the Regular Air Force, Air Force Reserve, and Air National Guard. Ensure all records created as a result of processes prescribed in this publication are maintained in accordance with Air Force Instruction 33-322, *Records Management and Information Governance Program*, and disposed of in accordance with the Air Force Records Disposition Schedule located in the Air Force Records Information Management System. Refer recommended changes and questions about this publication to the Office of Primary Responsibility (OPR) using the AF Form 847, *Recommendation for Change of Publication*; route AF Forms 847 from the field through the appropriate functional chain of command to the Directorate of Operations, Operational Training Division (AF/A3TI) workflow (usaf.pentagon.af-a3.mbx.a3ti-workflow@mail.mil). This publication may be supplemented at any level, but all direct supplements must be routed to the OPR of this publication for coordination prior to certification and approval. The authorities to waive wing or unit level requirements in this publication are identified with a Tier (“T-0, T-1, T-2, T-3”) number following the compliance statement. See AFI 33-360, *Publications and Forms Management*, for a description of the authorities associated with the Tier numbers. Submit requests for waivers through the chain of command to the appropriate Tier waiver approval authority, or alternately, to the requestor’s commander for non-tiered compliance items. Consider the National Guard Bureau as a Major Command (MAJCOM) for the purpose of this instruction’s Tier authorities. Process waivers to mandates involving the acquisition program execution chain in accordance

with the acquisition chain of authority as specified in AFI 63-101/20-101, *Integrated Life Cycle Management*.

SUMMARY OF CHANGES

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Section A—General

1. Applicability. This instruction applies to all Air Force (owned or managed) models and simulations that qualify as federation elements, common-use, general-use, or joint modeling & Simulation as defined in the DoD online Modeling & Simulation Glossary.

2. Background. Before decision makers vest their confidence in Modeling & Simulation (M&S) results used to make decisions involving large costs or human lives, such confidence must be justified. Processes for VV&A investigate, document, and authenticate M&S content and quality. Verification and validation (V&V) will be a continuous process throughout a model's life cycle. Air Force model V&V plans will emphasize an incremental "building block" approach where individual users, model managers, and developers will sponsor their different V&V activities to support accreditation needs. These V&V results are maintained in locations available to all model users, such as the DoD online M&S Catalog. This approach, over time, produces an in-depth examination of the model, with the model's entire user community sharing V&V costs. Accreditation is the final step that allows use of a validated and verified model for a particular application or period of time.

2.1. A systematic V&V plan is an integral part of Air Force M&S development, enhancement, maintenance, or upgrade activity. V&V is also be an integral component of M&S configuration management actions.

2.2. Air Force models, simulations, and associated data used to support DoD processes, products, and decisions shall undergo V&V throughout their lifecycles. **(T-0).**

2.3. Air Force M&S applications will be accredited for their intended purpose when supporting major DoD decision-making organizations or processes, joint training, and joint exercises. All executed V&V activities will support the model acceptance and accreditation requirements defined by the accreditation authority. **(T-0).**

2.4. Air Force agencies using M&S owned by other DoD components will adhere to the terms and conditions specified in any memorandum of agreement releasing the model for Air Force use. Unless otherwise specified, the Air Force using agency is responsible for accomplishing model V&V activities according to model owner, MAJCOM, or Air Force guidance, whichever is the most appropriate for the intended model use if not already part of an existing VV&A approval. A memorandum is not required if the other component does not have release restrictions imposed on the model.

2.5. The Air Force agency that is responsible for a contractor or Federally Funded Research and Development Center developed model or simulation (either new major model development or enhancements) ensures that V&V requirements are accomplished.

2.6. Model managers and developers ensure compliance with the appropriate V&V requirements when an M&S configuration changes.

2.7. If applicable, include assessments of the representations of concepts, tactics, forces, processes, and doctrine from all protagonists' perspectives into V&V activities. The authoritative source for threat models and data is the Defense Intelligence Enterprise (DIE). The Defense Intelligence Agency, Missile and Space Intelligence Center, National Air and Space Intelligence Center, National Ground Intelligence Center, and the Office of Naval Intelligence are primary participants in the DIE for authoritative threat models and data.

2.8. The VV&A of a federation of M&S complies with VV&A policy for each individual M&S, but also considers overall system compliance, compatibility, and interoperability requirements. The VV&A of a federation of systems ensures credible results of the integrated system as a whole.

2.9. Data used in models and simulations will be verified, validated, and certified for use in specific applications.

2.10. Manage M&S developed as an integral part of a weapon system according to both the policies prescribed for that weapon system and the VV&A and requirements portions of this instruction to ensure the integrity of such M&S.

2.11. Models developed and maintained by a designated authoritative source that are adopted for use by other systems do not require any additional VV&A if the model's implementation meets the authoritative source's accreditation constraints.

2.12. Test and Evaluation (T&E) M&S is a foundational element of Integrated Life Cycle Management. Effective use of M&S for T&E over the life cycle of a system can substantially reduce program risk and has benefits for Program Managers, Systems Engineers, decision-makers, and system users. The purpose of T&E modeling and simulation is to provide an increase in confidence level, provide a decrease in field test time and costs, increase amount of data collected for pre-test predictions and post-test validation, support test control and promote safety, and simulate non-testable events and scenarios.

Section B—Roles and Responsibilities for V&V Management

3. HQ USAF Responsibilities.

3.1. AF/A3 is the approval authority for M&S VV&A policy. AF/A3 will coordinate with AF/A9 for Decision Support VV&A and with SAF/AQ for Life Cycle Management VV&A.

3.1.1. The Director of Weather (AF/A3W) as the designated Air and Space Natural Environment (ASNE) Modeling and Simulation Executive Agent (MSEA) will determine resources, roles, and responsibilities for ASNE related VV&A.

3.2. The Deputy Chief of Staff for Intelligence, Surveillance and Reconnaissance (AF/A2), will assign V&V manager responsibilities for threat models or simulations owned by the Air Force.

3.3. Director for Studies, Analyses and Assessments (AF/A9) will manage decision support M&S and analysis policy and their implementation. In compliance with overall DoD and AF M&S policy, AF/A9 will develop VV&A requirements for M&S used in decision support and all strategy, planning, programming, budgeting, and execution process supporting analyses.

3.4. Assistant Secretary of the Air Force (Acquisition, Technology and Logistics) (SAF/AQ) is responsible for Life Cycle Management and Acquisition M&S policy. SAF/AQ will support early acquisition VV&A of models and simulations used in support of acquisition programs. SAF/AQ will integrate with AF/A2 (or appropriate DIE organization) to ensure appropriate use of intelligence data sources and threat models, or simulations in weapon system acquisitions.

3.5. Director for Test and Evaluation (AF/TE) advises Air Force leadership on the use of M&S in T&E and develops policy and guidance for its use. AF/TE will support and oversee VV&A in accordance with AFI 99-103, *Capabilities-Based Test and Evaluation*, and consistent with the T&E V&V checklist in the DoD VV&A Recommended Practices Guide (RPG).

3.6. Deputy Chiefs of Staff serve as the final accreditation authority for representations in common-use and general-use models, simulations, and associated data, of the DoD Component's forces, processes, characteristics, and performance capabilities within their area of responsibility. In addition, HAF 2-Letters shall:

3.6.1. Be responsive to HAF requests to ensure Air Force forces, processes, characteristics, and performance capabilities are appropriately represented in DoD forums and exercises.

3.6.2. When operating as approved by Office of the Under Secretary of Defense for Research and Engineering as a designated MSEA (e.g., ASNE):

3.6.2.1. Provide domain information and expertise in support of VV&A activities, upon request.

3.6.2.2. Ensure data quality information is available and accessible to support Office of the Secretary of Defense and other DoD Component's VV&A activities.

3.6.2.3. Establish and provide reference implementations for use as referent and validation referent data within their areas of responsibility.

3.6.3. Assign responsibilities to ensure that:

3.6.3.1. There is verification and validation of models, simulations, and associated data, developed or modified on behalf of the Air Force, throughout their lifecycles.

3.6.3.2. As appropriate, the Air Force only uses models, simulations, and associated data accredited for a specific intended use.

3.6.3.3. Resources are planned, programmed, and budgeted by individual organizations implementing verification, validation, or accreditation processes to support DoD processes, products, and decisions.

3.6.4. Ensure resources are provided and developed for necessary planning, programming, and budgeting activities.

3.6.5. Maintain specifications, standards, and other related standardization documents for VV&A.

3.6.6. Encourage participation in technical committees of government and nongovernment standards bodies and forums developing VV&A standards and in the review and adoption of government and non-government standards for VV&A.

3.6.7. For T&E applications requiring M&S, coordinate with AF/TE and appropriate Operational Test Organizations on the VV&A.

4. MAJCOM Commander Responsibilities.

- 4.1. Establish a V&V manager for each command-owned model or simulation (per [paragraph 6.6](#) below). A V&V manager may be responsible for more than one model or simulation. Unless otherwise designated, consider the program office for a system implementing models the owner of that model or simulation.
- 4.2. Ensure Air Force organizations designated as a MSEA have both Air Force and DoD responsibility for V&V of the respective DoD application.
- 4.3. Employ models from authoritative sources to the maximum extent possible where technically and fiscally feasible.
- 4.4. Be prepared to provide personnel that can serve on Technical Review Working Group (TRWG) teams as subject matter, problem domain, or technical experts (including model development, operation, and maintenance).
- 4.5. Establish, as necessary, supplemental guidance and procedures that identify and manage the VV&A requirements for command operated models that do not qualify as common-use, general-use, or joint-use M&S as defined in the DoD M&S Glossary. This includes the "threshold" criteria that require "prototype" computer code be treated as a model for V&V purposes.

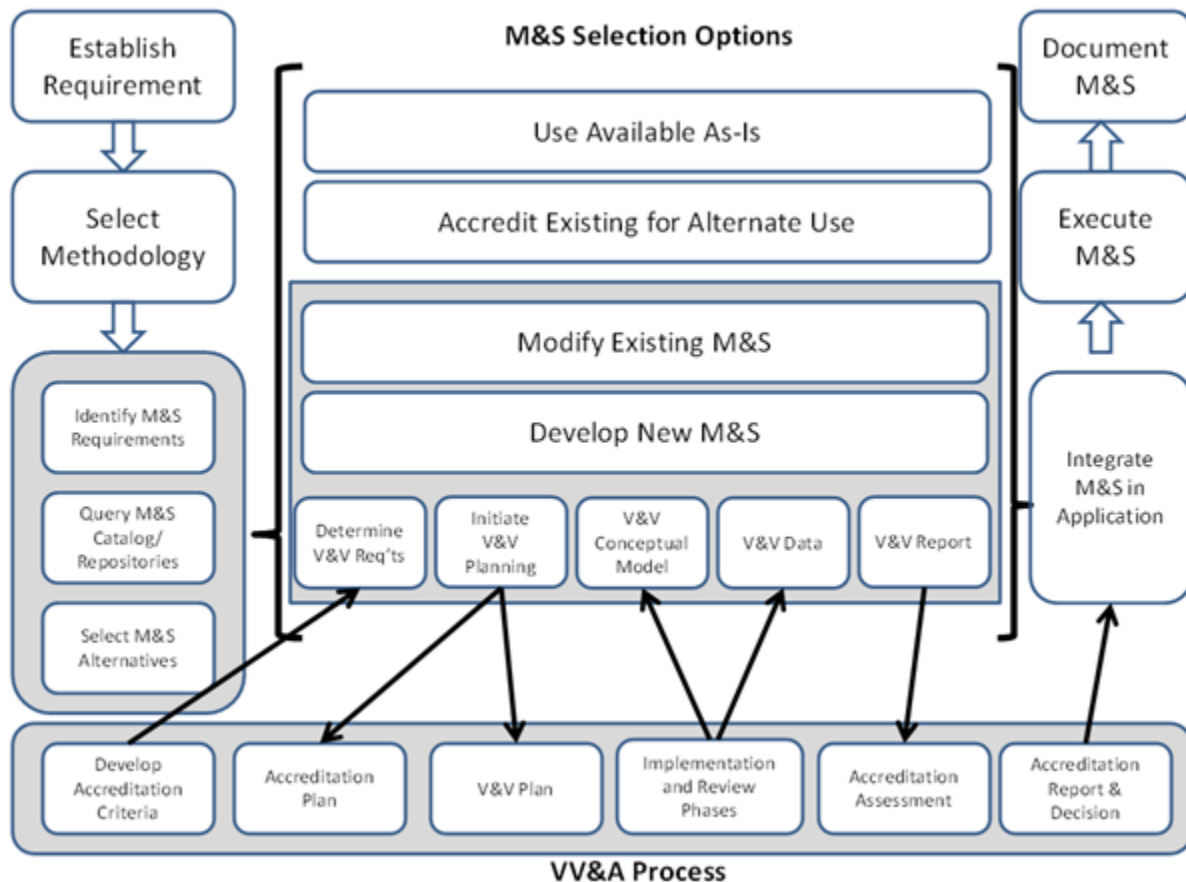
Section C—VV&A Framework, Functional Roles, and Processes

5. VV&A Framework.

- 5.1. M&S requirements developed as part of other processes (operational test, life cycle management, decision support, training, etc.) have varying levels of VV&A associated with the development and use of models for specific purposes.
 - 5.1.1. Verification is accomplished by identifying and eliminating mistakes in logic, mathematics, or programming. This process establishes whether the M&S code and logic correctly perform the intended functions. Further, it establishes to what extent M&S development activities conform to state-of-the-practice software engineering techniques.
 - 5.1.2. The validation process evaluates the effectiveness and suitability of the conceptual model of the M&S application. It has two main components: structural validation, which includes an internal examination of M&S assumptions, architecture, and algorithms in the context of the intended use; and output validation, which determines how well the M&S results compare with the perceived "real world."
 - 5.1.3. The accreditation determination considers the V&V status of a specific model version, its data support (source, quality, and verification), and the analysts or users that operate the model and interpret its results. The accreditation authority is the individual who is responsible and accountable for decisions or actions based upon the specific M&S usage. The decision to accredit a model or simulation rests solely with the accreditation authority. The accreditation authority determines the level of effort needed to support the accreditation decision, whether it consists of conducting additional V&V activities or simply reviewing the existing M&S documentation and past VV&A history. Accreditation is a management responsibility of the requiring agency, assisted by the designated V&V agent.

5.2. Steps in **Figure 1** illustrates the associated VV&A steps to meet an M&S requirement based upon the existence and type of VV&A already accomplished for the application of that model or data for M&S. The diagram does not show the non-M&S methodology options (e.g., actual flight tests) since they do not require VV&A.

Figure 1. M&S Options and VV&A Steps.



5.3. The figure shows where VV&A occurs within the overall M&S development and integration process. While the overall M&S process is out of the scope of this AFI, the broad aspects of the major steps before and after the VV&A portion are included here to provide context. It also illustrates the differing entry and exit aspects for the VV&A portion that depends on the decisions made earlier in the process.

5.4. The first step of the overall M&S selection process begins in the upper left, proceeds down along the left edge of the figure, then left to right and then back up, culminating with documentation. Starting in the upper left, the first step is establishing a requirement followed by selecting the methodology to fulfill that requirement. For the methodologies that include M&S, the Requiring Agency (reference [paragraph 6.3](#)) identifies the M&S requirements (reference [paragraph 7.1](#)), researches the availability of pre-existing models from the repositories (reference [paragraph 9](#)), then selects from the available M&S alternatives.

5.5. The center of the figure depicts the four M&S VV&A options that depend on the chosen model option.

5.5.1. The figure shows the four broad alternatives for M&S options within the bracketed center portion: Use Available As-Is, Accredited Existing M&S for an Alternative Use, Modify Existing M&S, or Develop New M&S. The first two options (Using Available As-Is and Accrediting Existing M&S For an Alternative Use) have greatly reduced verification and validation requirements compared to the other two alternatives, but will still have some documentation requirements for accreditation (see [paragraph 7.11](#)).

5.5.2. In most cases, a simple face validation during the selection process establishes the applicability of the selected M&S. Document the validation in the Accreditation Decision by the cognizant authority. There will be cases where there is no existing M&S to be used as-is or accrediting for this alternative use.

5.6. The top two M&S selection options (shown unshaded in [Figure 1](#)) have greatly simplified VV&A requirements due to the ability to leverage existing documentation. The second two options (in the shaded box in [Figure 1](#)) follow a more detailed VV&A process as shown on the bottom row of the figure, and as described in [paragraph 7](#). This includes determining the requirements for planning, designing, and implementing the various steps to complete the V&V process and necessary documentation to support the Accreditation Decision. Appropriate reuse of existing M&S is encouraged in order to reduce the potential impacts to resources and schedules from the development process.

5.7. Integrate the accredited M&S into the application or simulation in a way that complies with the Accreditation Decision's conditions (see [paragraph 7.10](#)). The final remaining step is to properly document the M&S, which includes the VV&A documentation addressed in [paragraph 8](#).

6. Functional Roles within the Air Force VV&A Process.

6.1. The Air Force VV&A process identifies six functional roles with differing responsibilities during each phase of the VV&A process. The roles are Requiring Agency, Accreditation Authority, Accreditation Agent, V&V Manager, V&V Agent, and Program Manager. There is an additional optional body to convene as required, the Technical Review Working Group. Greater detailed descriptions of the respective tasks are available in the rest of this instruction. The Requiring Agency may also appear as the User or M&S Proponent in other M&S documents.

Table 1. VV&A Roles & Documentation Responsibilities.

Task	Requiring Agency	Accreditation Authority	Accreditation Agent	V&V Manager	V&V Agent	Program Manager/ Developer
Define M&S Requirements	Lead	Monitor	Monitor	Monitor	Monitor	Assist
Acceptability Criteria	Assist	Approve	Lead	Review	Assist	Assist
Accreditation Plan	Review	Approve	Lead	Review	Review	Assist
V&V Plan	Review	Monitor	Monitor	Approve	Lead	Assist
V&V Implementation	Review	Monitor	Monitor	Approve	Lead	Assist
V&V Data	Review	Monitor	Monitor	Approve	Lead	Assist
V&V Report	Review	Monitor	Monitor	Approve	Perform	Assist
Accreditation Assessment	Monitor	Review	Lead			Assist
Accreditation Report	Monitor	Approve	Perform			Assist
Accreditation Decision	Review	Perform	Assist			
M&S Catalog/ Repository	Monitor	Monitor		Perform		
<u>Lead:</u>	Leads the task; normally involves active participation of others.					
<u>Perform:</u>	Does the task; normally requires little active participation of others.					
<u>Assist:</u>	Actively participates in the task.					
<u>Monitor:</u>	Oversees the task but does not normally participate.					
<u>Review:</u>	Reviews the results of the task and provides recommendations					
<u>Approve:</u>	Decides when the task is satisfactorily completed and a new task may begin; determines the future progress for the task.					

6.2. Dual Roles. The same individual or multiple personnel may fill the V&V roles of manager, accreditation authority, accreditation agent, and V&V agent. This will depend on the Requiring Agency determination of the scope and complexity of the model. At a minimum, the V&V agent and Accreditation agent should be different people, given available resources and if more than one person is filling these roles.

6.3. Requiring Agency.

6.3.1. Requiring Agencies are normally MAJCOMs or the organization with the validated requirement that includes M&S capabilities. Lead Commands are the Requiring Agency for the operational training M&S for their weapon systems. The Program Manager or Operational Test Organization is the Requiring Agency for T&E M&S. SAF/AQ determines the Requiring Agency for Integrated Life Cycle Management M&S. AF/A9 determines the Requiring Agency for Decision Support M&S. AF/A3 is the final authority for determining the Requiring Agency for Operational Training Infrastructure (OTI) M&S.

6.3.2. Use the following guidelines to identify the Air Force organization with VV&A management responsibility for a particular model or simulation that does not already have a designated model manager.

6.3.2.1. For models or simulations under development, either in-house or under contract by a sponsoring Air Force agency, the sponsoring Air Force agency is responsible. **(T-1)**.

6.3.2.2. If a single Air Force agency operates and maintains a model or simulation without a designated model manager, that agency is responsible. **(T-1)**.

6.3.2.3. For models or simulations that do not have a designated model manager, and have multiple users or separate users and maintainers:

6.3.2.3.1. If a configuration management or users group exists, the agency chairing this group is responsible. **(T-1)**.

6.3.2.3.2. If a configuration management or users group does not exist, the predominant Air Force user is responsible. **(T-1)**.

6.3.3. The Requiring Agency will:

6.3.3.1. Identify the Accreditation Authority. This may be internal to the organization, or assigned to external organizations or program offices depending on the scope of the effort and requirements. **(T-1)**.

6.3.3.2. Define the M&S requirements for the model or simulation. **(T-1)**.

6.3.3.3. Maximize use of existing accredited models and simulations or modifications of existing models before developing new models to maximize M&S reuse. **(T-1)**.

6.3.3.4. Sponsor or fund development and implementation efforts for that M&S application. **(T-1)**.

6.3.3.5. In coordination with the Program Manager, establish security guidelines for the protection of sensitive or classified information associated with the models and supporting documentation in accordance with existing security policy and guidance.

6.4. Accreditation Authority.

6.4.1. General Officers (GO) or Senior Executive Service (SES) personnel, who manage or develop material solutions or conduct studies, shall be the Accreditation Authority for those particular models or simulations, and may delegate this authority to subordinate staff at O5/GS14 or above. For T&E M&S, GO or SES personnel, or their subordinate staff, shall be the Accreditation Authority for those particular models, simulations, or both being used in that particular effort. The Accreditation Authority will:

6.4.1.1. Identify pertinent parameters and constraints that impact the V&V planning and implementation process, including M&S acceptance and accreditation criteria. **(T-1)**.

6.4.1.2. Determine the need to form a TRWG for review of V&V plans and results. **(T-1)**.

6.4.1.3. Select or approve personnel that are involved in the M&S VV&A activities (e.g., verification, validation, or accreditation agents, optional TRWG members, other subject matter experts (SME), etc.). **(T-1)**.

6.4.1.4. Approve and monitor the implementation of all V&V activities that directly support the upcoming accreditation decision. **(T-1)**.

6.4.1.5. Ensure completion and dissemination of appropriate accreditation reports. **(T-1)**.

6.4.1.6. Be responsible for funding and implementing the assessment and V&V activities supporting his or her specific model (application) accreditation. **(T-1)**.

6.4.2. M&S used for testing must have an Accreditation Authority approved by the intended user (Program Manager or Operational Test Agency). **(T-1)**.

6.5. Accreditation Agent.

6.5.1. Serves as a source of advice and expertise to the accreditation authority concerning VV&A issues.

6.5.2. Assists the accreditation authority in identifying M&S acceptance and accreditation criteria.

6.5.3. Performs M&S accreditation assessments and determines any deficiencies between documented capabilities and accreditation requirements which require further V&V.

6.5.4. Assists the accreditation authority in determining the need to form a TRWG and, as the accreditation authority's representative, chairing subsequent TRWG proceedings.

6.5.5. Ensures, as the accreditation authority's representative during the verification and validation planning and implementation process, that the approved accreditation plan will provide sufficient V&V to support the accreditation decision while remaining within accreditation authority-established constraints. **(T-3)**.

6.5.6. Prepares accreditation report documentation for accreditation decisions, and afterwards disseminates the completed accreditation report.

6.5.7. Documents M&S application accreditation decisions after reviewing supporting accreditation reports.

6.6. V&V Manager. Every major Air Force model will have a single V&V manager throughout its life cycle. **(T-3)** Depending on model size and complexity, assign this function to the model manager or to the agency with model management responsibility. For new models, identify the V&V manager at the start of model development activities. For existing models, the V&V manager will develop a time-phased plan to comply with these V&V responsibilities. **(T-3)**. The V&V manager for threat models or simulations will normally be the appropriate DIE entity per the Threat Modeling and Analysis Program.

6.6.1. At any one point in time there can be only one clearly designated V&V manager for a given model; however, there is no restriction to the transfer of V&V management responsibility between organizations. For example, the developing agency could simultaneously transfer both model management and V&V management responsibility to the model manager when delivering the completed model.

6.6.2. Responsibilities of the V&V Manager include:

6.6.2.1. Providing expertise on current and previous V&V efforts to HQ USAF or MAJCOM, Field Operating Agency (FOA), or Direct Reporting Unit (DRU) technical review committees.

6.6.2.2. Establishing baseline V&V status for legacy models, based primarily upon input from the user community and in conjunction with the model manager.

6.6.2.3. Developing, in conjunction with the model manager, a long-range plan that prioritizes V&V activities for known model deficiencies and upcoming model enhancements or upgrades.

6.6.2.4. Coordinating on the V&V requirements related to proposed model maintenance, upgrade, and configuration changes.

6.6.2.5. Maintaining a repository of all current and historic V&V information on the particular model or simulation and provide V&V status updates. Users will be able to access the information via the M&S Catalog or other repository that meets DoD requirements. **(T-3)**.

6.6.2.6. Advocating for resources needed to carry out the previously described M&S V&V management responsibilities.

6.7. V&V Agent.

6.7.1. Serves as a source of advice and expertise to the accreditation authority, accreditation agent, and V&V manager concerning V&V issues.

6.7.2. Develops a plan, including resource requirements, that addresses the V&V deficiencies identified by the accreditation agent while remaining within the accreditation authority-identified constraints. If this is not possible, the agent(s) will work with the accreditation agent to develop risk reduction and V&V plans that together will meet accreditation authority M&S acceptance criteria and constraints. **(T-3)**.

6.7.3. Provides a suggested list of TRWG members to the accreditation authority and accreditation agent, and actively participates in any subsequent TRWG meetings.

6.7.4. Performs all V&V activities and prepares the final V&V report for submission to the accreditation agent and the model or simulation's V&V manager. **(T-3)**.

6.8. Program Manager/Developer. The Program Manager/Developer funds development of V&V (V&V plan, implementation, data, and report) and assists other functions during the respective steps. (T-3). There may be personnel within the program office assigned to perform roles such as the Accreditation Authority or any others through V&V Agent. The program office may even be designated the Requiring Agency for some models or applications. Some of the key input the Program Manager provides during the VV&A process is assessing the impact to cost, schedule, and performance of the overall program on the various VV&A options considered.

6.9. V&V Technical Review Working Group. This working group forms on an as-needed basis. The group develops a community consensus on whether an approved V&V methodology will be adequate to support the proposed model accreditation decision, within identified constraints and associated risk mitigation strategies. Tailor the group's membership to the model and proposed application. Working group composition may include:

6.9.1. Accreditation Agent.

6.9.2. Verification and Validation Agent(s).

6.9.3. Model Manager.

6.9.4. V&V Manager (if different from model manager).

6.9.5. MSEA (if V&V activities directly involve their problem domain).

6.9.6. User's group chair (if applicable).

6.9.7. Other technical cognizance (organizational) representatives (membership optional).

6.9.8. Independent Technical Review representative (membership optional).

6.9.9. Data source(s) Verification, Validation, and Certification representative (membership optional).

6.9.10. AF/A3TI and other Service representatives (when multi-Service participation required).

6.9.11. Other Office of the Secretary of Defense (OSD) representatives (when multi-Service participation required).

7. VV&A Process.

7.1. Define M&S Requirements. The Requiring Agency and Program Manager/Developer (usually the responsible study or project team lead) first establish guidance impacting M&S support for a given project, including, but not limited to, available manpower and funding resources; project constraints (cost, schedule, performance); requirements that will be supported using M&S; and acceptability and accreditation criteria including pertinent accreditation criteria. (T-3).

7.1.1. Acceptability Criteria Development. Acceptability criteria are the most important content of the accreditation plan and should be the minimum criteria for accreditation. The requiring agency appoints an accreditation agent to establish a set of acceptability criteria to determine the suitability of the M&S for the intended use. Acceptability criteria are effectively a set of standards that a particular M&S must meet for accreditation for a given use. Sufficiently develop the criteria to the level of detail necessary to meet the requirement (e.g., accurately represent a specific weapon's fly out performance envelope and probability of kill for specific target types, or the circular error probable of a missile). Examples of high-level acceptability criteria to use as a starting point are:

7.1.1.1. The M&S fidelity and resolution are sufficient for the intended activity.

7.1.1.2. The M&S is suitable for the overall intended use (e.g., training, explanatory, predictive).

7.1.1.3. The M&S output or results clearly, adequately, and appropriately address the problem.

7.1.1.4. The levels of force structure and interaction have sufficient fidelity and resolution.

7.2. Existing M&S Assessment. The accreditation agent identifies the particular model(s) or simulation(s), including requisite modifications or enhancements, from available Air Force or DoD M&S repositories. The accreditation agent will assess the model or simulation to determine if its proposed usage falls within a previously validated and verified application domain. **(T-3)**. Correct any V&V deficiencies for the model or simulation to meet the accreditation authority's acceptability criteria. **(T-3)**. The Requiring Agency and Program Manager/Developer may accredit a proposed model or simulation if its documented V&V history sufficiently supports specified acceptance and accreditation criteria.

7.3. Accreditation Plan Development. The accreditation agent reviews the configuration management procedures, M&S documentation, and the V&V findings (if they exist) that will be used to make the determination on accreditation. These items become a part of the accreditation plan. Document all information considered in the accreditation process in the accreditation report. This report is the responsibility of the Accreditation Agent and is produced with the assistance of the Program Manager/Developer. **(T-3)**. A sample format for the plan is available in the DoD VV&A RPG.

7.4. V&V Plan Development. Verification and validation agent(s), based on accreditation acceptance criteria identified during the accreditation agent's M&S assessment, will develop a plan that ensures sufficient, documented model V&V to support accreditation acceptance criteria. **(T-2)**. A sample format for the plan is available in the DoD VV&A RPG.

7.4.1. The DoD MSEA will be consulted if V&V activities will be performed on portions of the model or simulation that lie within their problem domain (e.g., weather or atmospheric effects should be coordinated with the ASNE MSEA).

7.4.2. The V&V plan will identify data sources to obtain verified, validated, and certified input data. **(T-3)**. Obtain from or coordinate with the appropriate intelligence source(s) scenario data reflecting current threat representations. Consider designated MSEAs or other authoritative source data valid and verified when used in accordance with their guidance. Otherwise, the V&V Manager is responsible for coordinating the data V&V as described in the VV&A RPG.

7.4.3. For non-government owned models or for new model starts, the plan must include establishment and operation of V&V management mechanisms and responsibilities by the accreditation sponsor. **(T-3)**.

7.4.4. The V&V plan will identify and source estimated planning and implementation manpower or funding. **(T-3)**.

7.5. V&V Technical Review Working Group Review. Upon completion of V&V activities, the committee can be convened to review actual versus planned V&V implementation and results, review or perform a risk assessment (for any unaccomplished V&V activities), and provide a written summary of their findings and recommendations to the V&V agents. The V&V agents will then prepare the V&V report that summarizes overall findings and recommendations. **(T-3)**.

7.6. V&V Implementation. V&V can be an iterative process as the models and data are refined to meet the requirements. Include Tester (developmental and operational) involvement early in the process, including the Operational Test Organizations, for acceptance of subsequent T&E results. Documented VV&A activities and findings in the following acquisitions documents: System Engineering Plan, Test & Evaluation Master Plan, and the Simulation Support Plan. **(T-2)**. Unless directed by the Requiring Agency, OSD, joint service, or other external agency, the plans, reports and other documents prescribed in this section should be consolidated or incorporated into existing acquisition or program documents, while ensuring program requirements are met.

7.6.1. Simulation Support Plans (SSP) are program documents that span the many simulations, their purpose, and their expected credibility. They typically start with a program office-level simulation support group of M&S experts who advise the program on M&S opportunities, establish the VV&A process, and document these procedures in the SSP, which extends across the life cycle of the system development, testing, and employment. It is vital that the SSP be fully coordinated with the Test & Evaluation Master Plan.

7.6.2. During the V&V process of the M&S, V&V of the data will also be occurring. This execution of the M&S is an iterative process that will continue until the M&S and data meet their intended use. The various V&V techniques are available in the DoD VV&A Recommended Practices Guide.

7.7. Data V&V. Data V&V examines the data used to develop and run the M&S. Data credibility is dependent not only on how the data are produced and maintained, but also on how the data are transformed and used in the M&S. Data verification is conducted to ensure that the data selected are the most appropriate for the application and are properly prepared or transformed for use in the M&S. Data validation is conducted to ensure that the data accurately represent aspects of the real world to be simulated.

7.7.1. Data that require V&V fall into five categories: data needed to (1) verify M&S requirements; (2) build the conceptual model; (3) validate the M&S; (4) perform experiments; and (5) run M&S decision aids. It is important that the data used to develop and validate M&S are the right data to use. Consider integrating data V&V activities along with the other V&V tasks to ensure that data are used for the appropriate purpose.

7.7.2. MSEAs serve as domain SMEs for the M&S community. Their roles are to provide timely and authoritative representations of the natural environment and systems, and to establish V&V procedures for common and general-use M&S representations and their data. The MSEAs are sources of valid and certified M&S data.

7.7.3. Data verification, validation, and certification ensures that the data used in M&S applications is credible and constitutes the best available data for that use.

7.8. V&V Report. V&V agents will forward the V&V report and supporting documentation to the accreditation agent for inclusion into the accreditation report. **(T-2)**. Forward a copy of this report and documentation to the appropriate model or simulation V&V manager for update and archiving purposes. **(T-3)**. A sample format for the report is available in the DoD VV&A RPG.

7.9. Accreditation Assessment. The accreditation authority (or the designated accreditation agent) will assess the following minimum requirements each time the model is accredited for a particular application:

7.9.1. Review the model or simulation's application domain based upon a description of capabilities by the developer. **(T-0)**.

7.9.2. Review the adequacy of the model's configuration version control and complete an acceptable face validation examination, if appropriate. **(T-0)**.

7.9.3. Compare the model or simulation's capabilities and credibility, based on V&V status, to the acceptance criteria. **(T-0)**.

7.9.4. Assess the risk of using the model or simulation's capabilities if they do not meet application criteria thresholds, or have not had sufficient V&V. **(T-0)**.

7.9.5. Ensure that model documentation exists and is current and sufficient for the intended use. This documentation will normally include the conceptual model, user's guide, programmer's and analyst's manual(s). **(T-0)**.

7.9.6. Ensure that data sources have been identified and both producer and user data validation and verification activities were accomplished. **(T-0)**.

7.10. Accreditation Report. The accreditation agent, based on the accreditation assessment, along with any additional V&V activities and independent endorsements from bodies with appropriate technical and domain expertise, will prepare an accreditation report. **(T-2)**. The accreditation authority will make and document the model accreditation decision. The accreditation agent will forward a copy of the accreditation report to the appropriate M&S V&V manager for update and archiving purposes. **(T-2)**. This report summarizes the evidence used to support the accreditation decision. The report shall contain the information

outlined in Department of Defense Instruction (DoDI) 5000.61, *DoD Modeling and Simulation (M&S) Verification, Validation, and Accreditation (VV&A)*. (T-0). A sample format for the report is available in the DoD VV&A RPG. Make and document a decision based on the Accreditation Report and a recommendation for accreditation. (T-0). The accreditation authority has several decision options available:

7.10.1. Full Accreditation: M&S produces results that are sufficiently credible to support the application.

7.10.2. Limited Accreditation: Constraints on simulation use based upon the evidence assessed, the need for additional information to be provided, or modifications required to the M&S.

7.10.3. Non-accreditation: Results of the assessment show that the simulation is not fit to support the application.

7.11. Accrediting Reused M&S. Reuse encompasses not only the use of a model or simulation itself, or components of the model or simulation, but also leveraging the VV&A artifacts (documentation, test results, and reports). Accreditation by definition is for a specific intended use. Accreditation for the intended use determines M&S application for a unique purpose. Accrediting for a new intended use, or re-accreditation, requires a new accreditation decision. Reusing an existing M&S requires M&S accreditation for the new intended use.

7.11.1. Reusing previously accredited simulations requires some level of VV&A. If the intended use is similar, then little effort may be required. If the intended use is different, then significant V&V effort might be necessary. If the use is the same, but the system modeled has changed, then M&S re-accreditation determines whether it still represents the modeled system and is the right M&S for the intended use.

7.11.2. If the M&S has changed and the intended use is the same or similar to the one for which it was originally accredited, then verify and validate the changes to the M&S to determine the impact, if any, to the intended use. The changes made to a previously accredited M&S should have been kept under configuration control and documented, making the V&V easier to do.

7.11.3. Consider prior accreditation V&V reuse, if applicable, when building an accreditation package for the new intended use.

7.12. Accreditation Status Maintenance. The V&V Manager is responsible for maintaining the status of the model in the respective repositories, including any changes to the accreditation status for the model. (T-2).

8. VV&A Documentation. This section defines the minimum set of items to document as part of implementing the verification, validation, and accreditation processes for models, simulations, and associated data. The use of standardized templates will help enable the efficient reuse of M&S data and tools. Unless directed by the Requiring Agency, OSD, joint service, or other external agency, it is optional to incorporate documentation into other products and not generated as separate products. Sample formats for the various VV&A reports are available in the RPG.

The VV&A Documentation Tool (VDT) is a web-based system that assists with capturing VV&A information in a consistent form, with consistent content, that meets requirements for sharing, discovery, and retrieval. It is available at https://vva.msco.mil/Ref_Docs/VVTools/vvtools.htm.

8.1. Common documentation requirements per DoDI 5000.61:

8.1.1. Identification of the date performed and the person or organization performing the verification, validation, or accreditation activities. **(T-0)**.

8.1.2. Identification of the version or release of the model, simulation, and associated data undergoing verification, validation, or accreditation. **(T-0)**.

8.1.3. Identification of the intended use of the model, simulation, or associated data undergoing verification, validation, or accreditation. **(T-0)**.

8.1.4. List of, or reference to, the M&S requirements and associated accreditation criteria for the model, simulation, and associated data undergoing verification, validation, or accreditation. **(T-0)**.

8.1.5. List descriptions of the verification and/or validation and/or accreditation activities. **(T-0)**.

8.2. Additional Documentation Requirements for Verification and Validation. Summary of results, including the capabilities, limitations, risks, potential impacts to the specific intended use, and assumptions of the model, simulation and associated data undergoing verification and validation. **(T-0)**.

8.3. Additional documentation requirements for accreditation activities.

8.3.1. Summary of the results of the accreditation assessment. **(T-0)**.

8.3.2. Identification of the user or accreditation authority and record of the accreditation decision. **(T-0)**.

9. VV&A Repository. In conjunction with the model manager, the V&V manager will use the M&S Catalog or establish, operate, or maintain a repository accessible via the M&S Catalog. **(T-1)**.

9.1. The V&V manager will ensure their repository is consistent and compatible with the M&S Catalog. **(T-1)**.

9.2. Repository operations must facilitate M&S community queries and data access to establish the current model version's baseline V&V status and model VV&A and usage history. **(T-1)**.

9.3. The repository will contain pointers to documentation on all ongoing and completed VV&A (stand-alone and Federation-related) activities, such items as test input data sets, V&V plans, and documented conceptual and data models, that will allow potential users to evaluate the model's capabilities against their M&S requirements. **(T-1)**.

9.4. The M&S Catalog is available to all model users and is the primary repository for DoD M&S systems. Systems may employ other registries (e.g., Space Analysis Resource Portal (SARP), web link: <https://halfway.peterson.af.mil/SARP/>) if they have classification or other issues that preclude the use of the M&S Catalog. To the maximum extent possible, upload M&S discovery metadata to a system capable of providing data to the OSD repository in the required format and includes all required information per DoDI 5000.70, *Management of DoD Modeling and Simulation (M&S) Activities*. (T-0).

10. Multi-Model or Federated Architectures. In general, consider each component model or simulation being included in the distributed architecture for identification and separate validation and verification for intended Distributed Interactive Simulation (DIS) or High Level Architecture (HLA) usage. Assemble, validate, and verify an entire distributed architecture as a single entity, with the V&V level of effort tailored to support acceptability criteria given accreditation authority-identified constraints. When using different M&S together, validate and verify individual M&S components independently and validate and verify the entire architecture as a combination with the V&V level of effort tailored to support acceptability criteria given accreditation authority-identified constraints. (T-1). V&V reporting will be on the components and their combinations.

10.1. Validate and verify models that are individual components in a DIS or HLA architecture for the specified use. (T-2). The accreditation sponsor is responsible for implementing and funding those VV&A activities required to prepare and subsequently integrate the stand-alone model into the exercise. For joint exercises, validate and verify Air Force constructive models portraying force structure, doctrine, and tactics representations for use in the particular exercise in accordance with [paragraph 10.5](#) and approved for use by the appropriate HQ USAF DCS or ACS (or designated representative). (T-2). All other models, whether being submitted for first time DIS or HLA use, or reuse of a model currently residing in a DIS or HLA repository, will use MAJCOM, FOA, or DRU procedures for validation, verification, and approval. (T-2).

10.2. When the Air Force is the DIS or HLA accreditation sponsor, the sponsor should reference the Institute of Electrical and Electronics Engineers (IEEE) document 1278.4-2003, *Recommended Practice for Distributed Interactive Simulation - Verification, Validation, and Accreditation* for tailoring and constructing the DIS exercise. This document identifies specific points for development of both the V&V plan and report.

10.3. An Air Force V&V focal point, normally a member of the Air Component Commander's staff, will be designated for joint HLA exercises that use models portraying Air Force force structure, doctrine, and tactics representations. Otherwise, the focal points for joint HLA exercises will be identified by the participating Air Force agencies and approved by AF/A3TI.

10.4. DIS or HLA V&V Manager (focal point):

10.4.1. For a DIS or HLA environment owned by the Air Force, the Air Force accreditation sponsor is responsible for overall management responsibilities (component model, VV&A, and configuration management).

10.4.2. For a joint DIS or HLA environment, and the Air Force is not designated as the accreditation sponsor, the Air Force exercise Point of Contact (or designated representative) will represent the Air Force on issues concerning the DIS or HLA environment and Air Force models within the DIS or HLA confederation. This Air Force focal point will coordinate the VV&A requirements with the joint DIS or HLA manager. **(T-1)**.

10.5. The accreditation of a federation of M&S will include a determination whether:

10.5.1. Federation elements can appropriately exchange data. **(T-2)**.

10.5.2. Exchanged data items are accurate and correct to the extent required across the federation. **(T-2)**.

10.5.3. System response times meet the scenario's requirements. **(T-2)**.

10.5.4. The federation meets the functionality, appearance, performance, fidelity, and interoperability requirements for the intended purpose. **(T-2)**.

10.5.5. Security classification levels of the federation and data are appropriate and commensurate with the application. **(T-2)**.

MARK D. KELLY, Lt Gen, USAF
Deputy Chief of Staff, Operations

Attachment 1**GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

DoDI 5000.61, *DoD Modeling and Simulation (M&S) Verification, Validation, and Accreditation (VV&A)*, 9 December 2009

DoDI 5000.70, *Management of DoD Modeling and Simulation (M&S) Activities*, 10 May 2012

DoD 7000.14-R, *Department of Defense Financial Management Regulation*, May 2019

AFPD 16-10, *Modeling and Simulation*, 23 January 2015

AFI 33-360, *Publications and Forms Management*, 1 December 2015

AFI 63-101/20-101, *Integrated Life Cycle Management*, 9 May 2017

AFI 99-103, *Capabilities-Based Test and Evaluation*, 18 November 2019

AFI 33-322, *Records Management and Information Governance Program*, 23 March 2020

MIL-STD-3022, *Documentation of Verification, Validation, and Accreditation (VV&A) For Models and Simulations*, 28 January 2008

IEEE 1278.4-2003, *Recommended Practice for Distributed Interactive Simulation - Verification, Validation, and Accreditation*, 30 November 1997

Modeling and Simulation Coordination Office, *VV&A Recommended Practices Guide*, <https://vva.msco.mil/key/key.htm>

DoD M&S Glossary, <https://www.msco.mil/MSReferences/Glossary/MSGlossary.aspx>

DoD M&S Catalog, <https://www.msco.mil/DoDTools/DoDEnterpriseManagementTools/MSCatalog.aspx>

Prescribed Forms

None

Adopted Forms

AF Form 847, *Recommendation for Change of Publication*

Abbreviations and Acronyms

ACS—Assistant Chief of Staff

AF—Air Force

AFI—Air Force Instruction

AFMAN—Air Force Manual

AFPD—Air Force Policy Directive

ASNE—Air and Space Natural Environment

DCS—Deputy Chief of Staff

DIE—Defense Intelligence Enterprise
DIS—Distributed Interactive Simulation
DoD—Department of Defense
DoDI—Department of Defense Instruction
DRU—Direct Reporting Unit
GO—General Officer
FOA—Field Operating Agency
HLA—High Level Architecture
IEEE—Institute of Electrical and Electronics Engineers
LVC—Live, Virtual and Constructive
M&S—Modeling and Simulation
MAJCOM—Major Command
MSEA—Modeling and Simulation Executive Agent
OPR—Office of Primary Responsibility
OSD—Office of the Secretary of Defense
OTI—Operational Training Infrastructure
RPG—Recommended Practices Guide
SARP—Space Analysis Resource Portal
SES—Senior Executive Service
SME—Subject Matter Expert
SSP—Simulation Support Plan
T&E—Test and Evaluation
TEMP—Test and Evaluation Master Plan
TRWG—Technical Review Working Group
V&V—Verification and Validation
VDT—VV&A Documentation Tool
VV&A—Verification, Validation and Accreditation

Terms

Accreditation—The official certification that a model or simulation and its associated data are acceptable for use for a specific purpose. (DoDI 5000.61)

Authoritative Data Source—A recognized or official data production source with a designated mission statement or source/product to publish reliable and accurate data for subsequent use by customers. An authoritative data source may be the functional combination of multiple, separate data sources.

Data certification—The determination that data have been verified and validated. The designated agent determines data user certification by verifying and validating data is appropriate for the specific M&S usage. Data producers determine data producer certification by verifying and validating the data against documented standards or criteria.

Data producer—Refers to a program, an organization (government or commercial), a person, or even a machine process that controls, manufactures, or maintains data assets within the Department, other government activities in the National Security Arena, as well as allied or coalition partners. Data providers include operators and supporting developers who use resources provided by DoD programs of record to create or expose data to significant audiences.

Data validation—The documented assessment of data by subject area experts and its comparison to known values. Data user validation is an assessment, as appropriate, for use in an intended M&S. Data producer validation is an assessment within stated criteria and assumptions.

Data verification—Data producer verification is the use of techniques and procedures to ensure that data meets constraints defined by data standards and business rules derived from process and data modeling. Data user verification is the use of techniques and procedures to ensure that data meets user specified constraints defined by data standards and business rules derived from process and data modeling, and for proper data transformation and formatting.

Data Verification, Validation, and Certification—The process of verifying the internal consistency and correctness of data, validating that it represents real-world entities appropriate for its intended purpose or an expected range of purposes, and certifying it as having a specified level of quality or as being appropriate for a specified use, type of use, or range of uses. The process has two perspectives: producer and user process.

Distributed Interactive Simulation (DIS)—(1) Program to electronically link organizations operating in the four domains: advanced concepts and requirements; military operations; research, development, and acquisition; and training. (2) A synthetic environment within which humans may interact through simulation(s) at multiple sites networked using compliant architecture, modeling, protocols, standards, and data bases.

Face validation—The process of determining whether a model or simulation seems reasonable to people who are knowledgeable about the system under study, based on performance. This process does not review the software code or logic, but rather reviews the inputs and outputs to ensure that they appear realistic or representative.

Federation of models and simulations—A system of interacting models, simulations, and supporting infrastructure that are based on a common understanding of the objects portrayed in the system. (MIL-STD-3022)

High level Architecture (HLA)—Major functional elements, interfaces, and design rules, pertaining, as feasible, to all DOD simulation applications and providing a common framework within which specific system architectures can be defined.

Key M&S asset—An M&S tool, data set, or service, including models, simulations, or data assets, that either exceeds \$5M in annual expenditures, or is less than \$5M but determined by the DoD Component to be “key.” The total annual expenditure will be determined using standard justification documentation for DoD appropriations, such as Research, Development, Test and Engineering (R-docs), Procurement (P-docs), and Operations & Maintenance (O&M exhibits), which are provided to Congress pursuant to DoD 7000.14-R, *Department of Defense Financial Management Regulation*.

Model Manager—Refers to an organization (government or commercial) or a person that will endeavor to satisfy the Requiring Agency’s need. The model manager will undertake activities such as project management and overseeing development of the model. This will typically include subject-matter experts providing mission space knowledge and knowledge engineers eliciting, structuring and documenting knowledge.

Modeling and Simulation (M&S)—1. The discipline that comprises the development and use of models and simulations. (DoDD 5000.59, DoDI 5000.61) 2. The use of models, including emulators, prototypes, simulators, and stimulators, either statically or over time, to develop data as a basis for making managerial or technical decisions.

M&S assets—M&S tools, data, and services, including models and simulations, and data assets.

M&S data—Data used to develop models or simulations, data used as input to models and simulations, and data produced by models and simulations.

M&S Executive Agents (MSEA)—The Under Secretary of Defense for Acquisition, Technology, and Logistics designates MSEAs to serve as domain SMEs for the M&S community. Their roles are to provide timely and authoritative representations of the natural environment and systems, and to establish V&V procedures for common and general-use M&S representations and their data. The MSEAs are sources of valid M&S data.

Metadata—Searchable information describing the characteristics of data; data or information about data; or descriptive information about an object’s data, data activities, systems, and holdings. For example, metadata for a model or simulation will include keywords and a description of the capabilities along with developer and user information.

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

Reuse—The practice of using again, in whole or part, existing M&S tools, data, or services.

Simulation—A method for implementing a model over time. Simulations are typically described as live, virtual, constructive, or a combination, depending on the application.

Validation—The process of determining the degree to which a model or simulation and its associated data are an accurate representation of the real-world from the perspective of the intended uses of the model. (DoDI 5000.61)

Verification—The process of determining that a model or simulation implementation and its associated data accurately represents the developer's conceptual description and specifications. (DoDI 5000.61).