

The Accreditation Agent's Role in the VV&A of New Simulations

RPG Core Document

5/15/01¹

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¹ This document replaces the 11/30/00 version. It contains minor editorial and formatting changes.

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VV&A Responsibilities and Challenges

This document addresses the role of the Accreditation Agent in a new modeling and simulation (M&S) development. The primary objective of the Accreditation Agent is to prepare for and conduct a cost-effective accreditation assessment that results in a logical, sufficient, and fully justified accreditation recommendation to the User. Accreditation is a judgment that a simulation is fit for a specific purpose. As illustrated in the Roles and Responsibilities table¹ discussed in Key Concepts,² the Accreditation Agent not only is responsible for planning and performing the accreditation assessment, but also assists the User with activities that help establish the scope of the problem to be addressed. The Accreditation Agent serves as the User's advocate throughout the M&S development process to ensure that the simulation being developed will meet the User's requirements and that sufficient evidence is available to justify an accreditation decision.

How Does the Accreditation Agent Impact VV&A?

The Accreditation Agent performs a series of tasks throughout the simulation development process to ensure there will be sufficient evidence to assess the simulation's capabilities, such as

- ensuring the M&S requirements³ and acceptability criteria are complete, sufficiently detailed, and fully documented
- developing an accreditation plan that identifies information needed for accreditation and the strategy for the assessment
- ensuring the V&V plan addresses all the needs of the accreditation assessment
- ensuring the V&V effort provides the information needed for the accreditation assessment
- gathering additional accreditation information (when necessary)
- conducting the accreditation assessment and providing a recommendation to the User
- preparing the necessary reports

The Accreditation Agent's contribution to the V&V effort depends greatly on when the User designates the agent. When designated at the beginning of the M&S development program, the Accreditation Agent can make a substantial contribution to the efficiency of the V&V program by

- participating in the problem analysis effort to assess risks

¹ See the diagram on Typical Roles and Their Responsibilities for additional information.

² See the Key Concepts section of the RPG web site for additional information.

³ See the special topic on Requirements for additional information.

- supporting the definition of M&S requirements
- determining appropriate measures (e.g., measures of effectiveness [MOEs], measures of performance [MOPs])⁴
- establishing VV&A priorities
- participating in M&S requirements definition and verification
- leading the effort to define accreditation information needs
- assisting in the development of V&V plans and the selection and focus of V&V activities

When appointment of an Accreditation Agent is delayed,⁵ however, the User, M&S Program Manager (PM), and V&V Agent should work together to ensure the V&V effort addresses the appropriate issues and can produce sufficient evidence to support the accreditation assessment.

When joining an M&S development program in progress, the Accreditation Agent should review the status of the program (e.g., objectives, M&S requirements, development paradigm, plans, progress-to-date) and evaluate the plans, objectives, and progress-to-date of the V&V effort to determine if they are sufficient to provide the information needed to establish the simulation's fitness for purpose. In particular, the Accreditation Agent should

- support the definition of acceptability criteria that will serve as the basis for accreditation
- assess the ability of the V&V activities to provide appropriate and sufficient evidence of simulation fitness for purpose to satisfy accreditation needs
- identify any deficiencies or inconsistencies that may lead to an unfavorable assessment and provide recommendations for their resolution

Once the status of the program is known and problems have been resolved, the Accreditation Agent should plan and conduct the accreditation assessment in coordination with the V&V process.

How Does VV&A Impact the Accreditation Agent?

The goal of the accreditation process is to accumulate and evaluate a body of evidence that increases the User's confidence in using the simulation for a specified application. Most (but not all) of the information required to support accreditation comes from the

⁴ See the special topic on Measures for additional information.

⁵ Instances in which the Accreditation Agent may not be selected at the beginning of the development process include: when funding is not available; a simulation is being developed for multiple Users and the first application has not been determined; spiral development or multiple builds are involved and early builds do not need to be accredited.

results of the V&V effort conducted during simulation development and preparation. Consequently, the scope and depth of the Accreditation Agent's tasking is profoundly affected by the effectiveness and appropriateness of the V&V tasks performed and the accuracy and completeness of the resulting products. A V&V effort that is underfunded, out of sync with the development process, or lacks clear accreditation information needs is unlikely to provide the amount of evidence necessary. A V&V effort that is not focused on appropriate priorities or uses inappropriate techniques is likely to produce misleading and unusable results.

What Are the Accreditation Agent's Responsibilities in VV&A?

The basic VV&A responsibilities of the Accreditation Agent are shown in the table below.

| Basic Responsibilities of the Accreditation Agent |
|--|
| <ul style="list-style-type: none">• Work with the User to refine the M&S requirements and develop appropriate measures and acceptability criteria |
| <ul style="list-style-type: none">• Work with the User and V&V Agent to develop an overall VV&A strategy and develop the accreditation plan |
| <ul style="list-style-type: none">• Support the V&V effort to assess the utility and sufficiency of the products in terms of meeting accreditation needs |
| <ul style="list-style-type: none">• Incorporate evolving M&S requirements and account for fluctuating risks and priorities in accreditation plans |
| <ul style="list-style-type: none">• Provide guidance and information to help the V&V Agent adjust V&V plans and activities to accommodate changes in priorities and objectives |
| <ul style="list-style-type: none">• Conduct and report on the accreditation assessment(s) as necessary |
| <ul style="list-style-type: none">• Represent the User's interests throughout the development process |

What Challenges Does the Accreditation Agent Face Relative to VV&A?

A number of the challenges that influence the accreditation of a new simulation are listed in the bullets below and described in the following paragraphs.

- [Clarity and Completeness of Objectives and Requirements](#)
- [Accuracy, Completeness, and Availability of V&V Documentation](#)
- [Soundness of the Configuration Management Program](#)
- [Delayed Appointment of the Accreditation Agent](#)
- [Inadequate VV&A Resources](#)
- [Locating and Using Subject Matter Experts](#)
- [Lack of Sound Software Practices](#)

Clarity and Completeness of Objectives and Requirements

Well-defined, measurable, consistent M&S requirements⁶ that are verified and traceable throughout the development process (i.e., from the objective statement through to the code) are fundamental to the credibility of the application. In order to establish the accreditation needs and appropriate V&V priorities, the Accreditation Agent requires

- clearly stated, consistent, completely defined, verified M&S requirements
- sufficient information to understand the level of operational risk that can result from the use of erroneous simulation outputs
- sufficient information to understand the level of credibility the User requires
- adequate metrics and acceptability criteria by which the simulation's ability to address each requirement can be evaluated

The Accreditation Agent should ensure that the M&S requirements are sufficiently detailed with appropriate metrics and acceptability criteria to enable complete and comprehensive accreditation and V&V planning. Because M&S requirements can evolve throughout the development process, the V&V effort should review them at reasonable intervals to ensure their continued currency, completeness, and consistency.

Accuracy, Completeness, and Availability of V&V Documentation

Because the information supplied by the V&V effort constitutes much of the evidence used in the accreditation assessment, the accreditation process can be significantly impacted by the inability to obtain the necessary V&V information in a timely manner and in a usable form. The Accreditation Agent should coordinate with the V&V Agent and M&S PM to develop the V&V plan and establish appropriate report formats and milestones. In addition, the Accreditation Agent should monitor the V&V effort throughout the development process to ensure potential problems can be addressed in a timely manner.

Soundness of the Configuration Management Program

A sound (and soundly managed) configuration management program is an indicator of simulation maturity and stability. Configuration management data gives the Accreditation Agent the means to correlate any information about the simulation (including V&V information) with a particular development version. This becomes particularly important when dealing with iterative development paradigms,⁷ such as the spiral and incremental development paradigms. The credibility of the information provided throughout simulation development and assessment is dependent in part on the reliability of the configuration management program.

⁶ See the special topic on Requirements for additional information.

⁷ See the special topic on Paradigms for M&S Development for additional information.

Delayed Appointment of the Accreditation Agent

The selection of an Accreditation Agent may be delayed for a variety of reasons:

- funding is not available early in the program
- the development process is complex, involving multiple builds or iterations that do not require interim accreditation (e.g., incremental development)⁸
- the simulation is being developed as part of a multi-user program and a specific application has not been identified
- the User does not expect the simulation to need formal accreditation

Any delay in selecting the Accreditation Agent is detrimental; however, the longer the delay, the greater the risk that the V&V effort will not be able to provide all the necessary information and the greater the cost of establishing simulation credibility.

Inadequate VV&A Resources

Obtaining adequate funding for either the V&V effort or the accreditation assessment is difficult particularly if funding is allocated before detailed planning has been done. Because program budgets are often established before either the Accreditation Agent or the V&V Agent is appointed, funding and resource allocations are not likely to be based on sound information about the actual needs of the program. Consequently, the resources allotted to VV&A tend to be under-allocated.

The Accreditation Agent should define a comprehensive set of accreditation needs and work with the V&V Agent to identify V&V tasks needed to establish an acceptable level of simulation credibility. The cost of performing these V&V tasks and the risks associated with not performing them should then be estimated. Only then can the Accreditation Agent present the User with a clear explanation of the risks involved should the necessary V&V activities not be accomplished as well as a reasonable estimation of the costs⁹ involved. Such a presentation can make it easier for the M&S PM to justify the reprogramming of funds to cover the recommended activities and reduce the indicated level of risk. The Accreditation Agent and V&V Agent should make every effort to identify reasonable workarounds within the budget that still minimize risks and are acceptable to the M&S PM.

Locating and Using Subject Matter Experts

A major challenge to the Accreditation Agent is to identify and locate subject matter experts (SMEs)¹⁰ to participate in the accreditation assessment. The user community is

⁸ See the special topic on Paradigms for M&S Development for additional information.

⁹ Note that funding for the V&V effort is normally allocated by the M&S PM and funding for the accreditation assessment is normally provided by the User.

¹⁰ See the special topic on Subject Matter Experts and VV&A for additional information.

usually the best source for experts in the problem domain, and the User can often either supply these people or make good recommendations on whom to request and how to secure their help. Additional SMEs may be needed with expertise in other areas, such as the programming languages and methods used in the development effort or a specific subject (e.g., math, physics). Additional criteria to consider when selecting SMEs include background or formal training in analytical disciplines (e.g., operations research), availability, interest, experience, and willingness to support the effort for the specified time.

.Lack of Sound Software Practices

By employing sound software engineering principles and practices, such as those cited in the Software Engineering Institute's [Software Capability Maturity Model](#) (CMM),¹¹ a Developer can ensure a focus on formalized, quality products and documentation. In order to judge the simulation's fitness for purpose, the evidence collected must be complete, accurate, and verifiable. A lack of attention to disciplined simulation development and appropriate V&V activities can cause considerable difficulty for the Accreditation Agent in trying to build a case for accreditation.

Example:

In one program, VV&A planning discussions identified the following items as missing or nonexistent:

- documented configuration management plan
- standard development process
- configuration management log
- proven testing tools
- documented test results
- software development plan

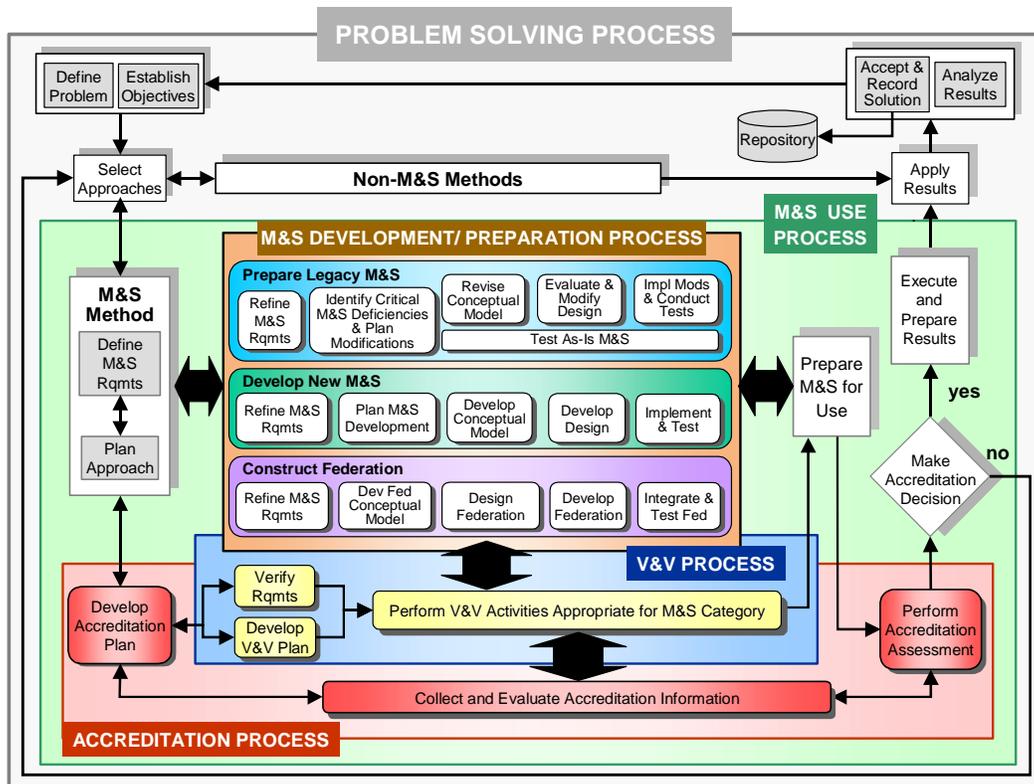
As a result, significant effort had to be expended to develop substitutes for each of these critical indicators of simulation credibility.

Role of the Accreditation Agent in the Overall Problem Solving Process

Problem Solving Process

The problem solving process diagram below shows how the M&S life cycle fits into the overall problem solving process.

¹¹ The Capability Maturity Model for Software (CMM or SW-CMM) is a model for judging the maturity of the software processes of an organization and for identifying the key practices that are required to increase the maturity of these processes. It is considered a de facto standard for assessing and improving software processes.



The Overall Problem Solving Process

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This diagram depicts the relationships between the **Problem Solving Process**, **M&S Use Process**, **M&S Development/Preparation Process**, **V&V Process**, and **Accreditation Process** as a series of nested boxes. Each nested process contains a series of individual boxes that represent the basic individual activities and functions considered essential to complete that process.

The overall problem solving process is the province of the User. The User initiates the process by establishing the problem domain. First, the problem is defined (e.g., as a problem statement) and the overall objectives are established. Then, based on the nature of the problem and scope of the objectives, the User selects the method or methods (e.g., modeling and simulation, experimentation, statistical analysis, live testing) to use in resolving the problem.

In establishing the problem domain and determining how to resolve the problem, the User addresses the following basic questions:

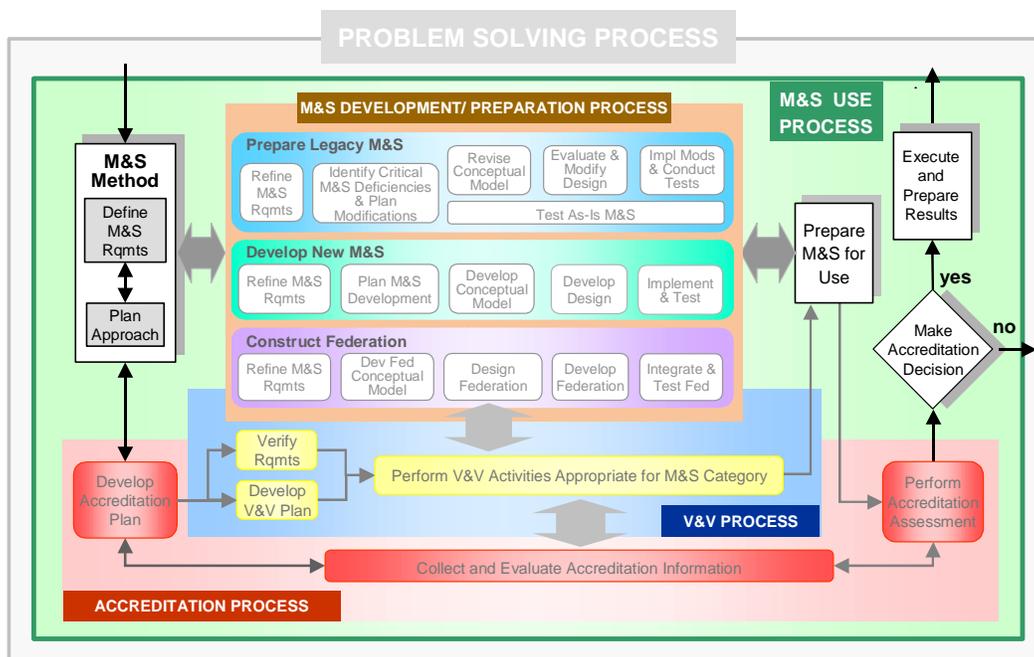
| Problem Domain Questions |
|--|
| • What is the basic problem to be solved? What are the objectives? What questions need to be answered? |
| • What particular aspects of the problem will M&S be used to help solve? What is the application? |
| • What is the scope of the problem? What boundaries or mission space apply? |

| Problem Domain Questions |
|--|
| <ul style="list-style-type: none"> • What decisions will be made based on the simulation results? |
| <ul style="list-style-type: none"> • What are the risks that might result from acceptance of erroneous simulation outputs or decisions based on them? |

Answers to these questions also provide the Accreditation Agent with information needed to establish what constitutes fitness for the given application.

M&S Use Process

Once M&S has been selected as the method to use, the **M&S Use Process**, the first nested process in the **Problem Solving Process** as shown in the figure below, begins.



M&S Use Process in the Problem Solving Process

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During the **M&S Use Process**, the M&S requirements¹² and their associated metrics and acceptability criteria are defined, risks are identified, and priorities are established. The questions listed below help determine what information is needed from the simulation and how accurate that information should be to address the needs of the application.

| M&S Requirement Questions |
|---|
| <ul style="list-style-type: none"> • What information is needed to support the key problem decisions or to resolve the key problem issues? |

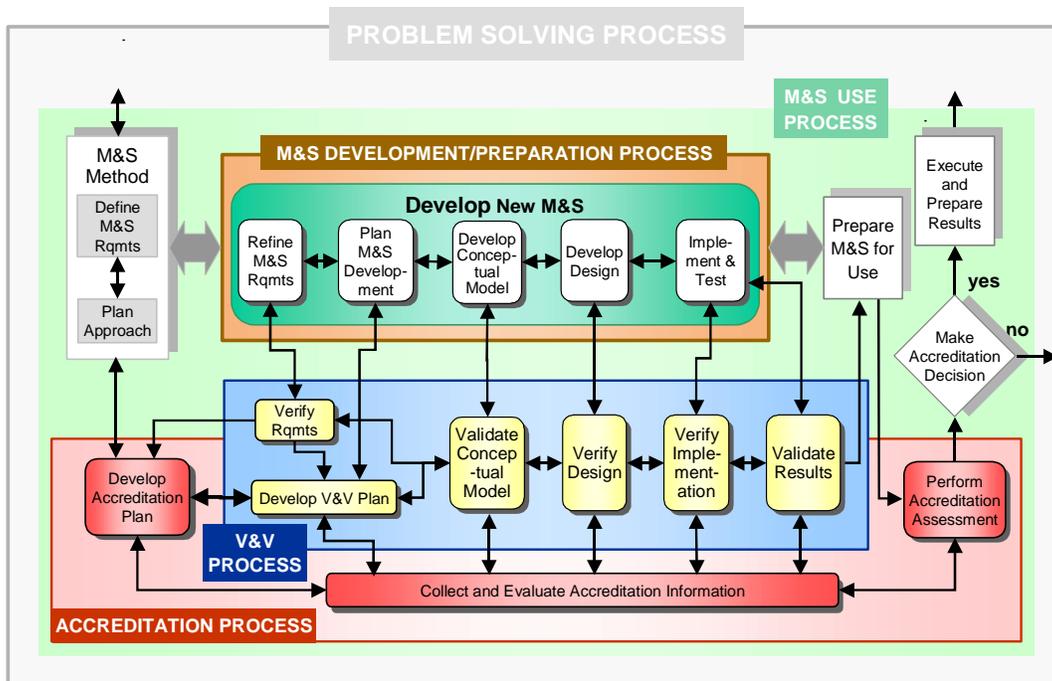
¹² See the special topic on Requirements for additional information.

| M&S Requirement Questions |
|--|
| • What specific simulation outputs relate to the information required? |
| • How good do these outputs need to be, i.e., what is the level of tolerance for uncertainty in the results? |
| • How will simulation output be used to produce the information needed to achieve the problem objectives, resolve the issues, and/or make the necessary decisions? |

The beginning of **M&S Use Process** is the optimum time for the Accreditation Agent to be designated to ensure decisions made during the planning phase are focused on establishing simulation credibility for the specified application. Ideally, the Accreditation Agent will be available to support the User and M&S PM during problem analysis¹³ and risk assessment.¹⁴ By participating in this effort, the Accreditation Agent can help determine accreditation information needs, appropriate metrics for each M&S requirement, and V&V priorities. This information can be used to shape the plans and select appropriate tasks in both the V&V and accreditation effort.

M&S Development/Preparation Process

The next nested process, **M&S Development/Preparation Process** (shown below for new simulations), begins when the M&S PM designates the Developer. Then, the M&S requirements are refined, the development paradigm is selected, and the development schedule is set.



M&S Development/Preparation Process for New M&S

¹³ See the special topic on Problem Analysis for additional information.

¹⁴ See the special topic on Risk and Its Impact on VV&A for additional information.

Regardless of which development paradigm¹⁵ is followed, the development process for new simulations (***Develop New M&S***) consists of the six basic phases shown [above](#). Associated with each phase of the development process is a corresponding activity in the V&V process that examines and tests the progress in that phase and collects evidence of the simulation's capabilities to be used in the accreditation assessment. The Accreditation Agent's role in these V&V and accreditation processes is discussed in the following section.

VV&A Functions of the Accreditation Agent Role in New M&S Development

The Accreditation Agent and the V&V Effort

Accreditation is "the official determination that a model or simulation is acceptable for a specific purpose" [DoDD 5000.59]. Accreditation is always associated with a specific purpose or application.¹⁶ In fact, any time a model or simulation is used to solve even a small, informal problem, a de facto or implicit accreditation decision is made. For formal programs with significant concerns about cost, safety, precision, etc., however, the accreditation decision should be explicit and based on knowledge of the credibility of the simulation and understanding of any risks involved.

Accreditation is a comparison between a simulation's capabilities and attributes and the M&S requirements¹⁷ generated by the specifics of the problem to which the simulation is to be applied. The figure below shows a logical depiction of the basic accreditation concept.

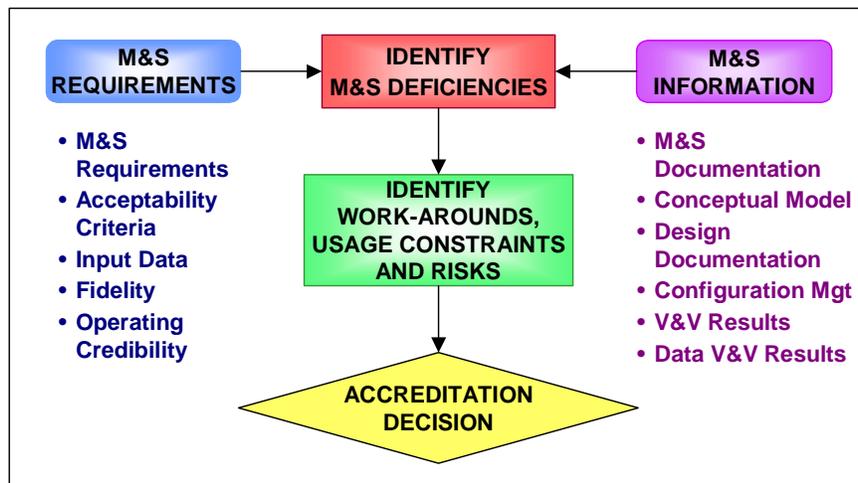
The primary purpose of the accreditation assessment is to establish simulation **fitness** within the context of its intended use. Much like building a body of evidence in a legal court case, the Accreditation Agent accumulates evidence about the simulation to support an objective judgment regarding the simulation's fitness for a specified application. This evidence generally consists of basic information about the simulation, results of the V&V effort, and metadata (information) about the input data.¹⁸

¹⁵ See the special topic on Paradigms for M&S Development for additional information.

¹⁶ One variation implemented by the Army is class accreditation in which a simulation is accredited for a specific group of applications (e.g., training, analysis, acquisition). Class accreditation is accomplished following the same processes as application specific accreditation; however, the end result is to demonstrate that the simulation is appropriate for consideration and/or restricted for use in a certain category of problems. When chosen for use in a specific application, Army regulation states that the simulation also needs to undergo VV&A for that application. See AR 5-11.

¹⁷ See the special topic on Requirements for more information.

¹⁸ See the reference document on M&S Data Concepts and Terms for more information.



A Practical Accreditation Concept

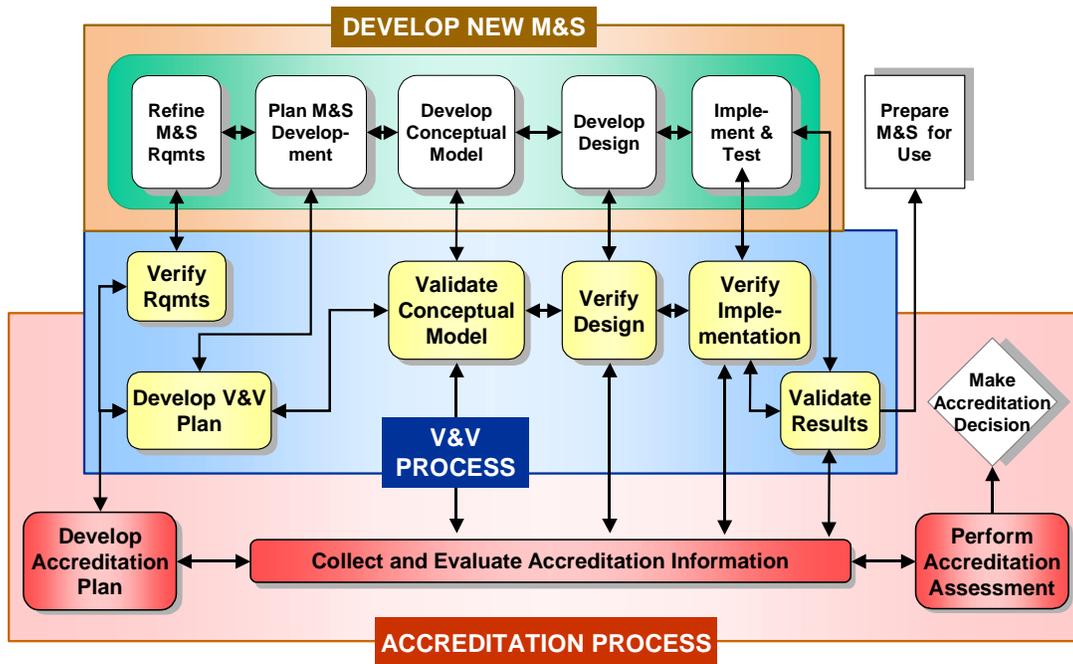
The focus of the accreditation assessment is to use this evidence to obtain answers to the questions shown in the table below that serve as the basis for judging simulation fitness.

| Questions for Judging Simulation Fitness |
|---|
| • What does the simulation do (i.e., what are the purpose and functions of the simulation)? |
| • How good is the software (i.e., is the software essentially free of coding errors)? |
| • Are the simulation outputs sufficiently realistic to meet the needs of the application? |
| • Can the simulation be operated properly and can the results be interpreted correctly? |
| • Are the input data sets satisfactory? |

The assessment of this evidence and the resulting accreditation decision are the final steps in establishing the simulation's fitness for the intended use.

The figure below illustrates the relationships and interactions between the accreditation process, V&V, and simulation development. The Accreditation Agent helps focus the V&V effort by providing information about what aspects of the simulation should be evaluated for the specified application and the relative importance (i.e., priority) of each based on the results of a risk assessment.¹⁹ During the accreditation assessment, the results of the V&V effort are combined with other factors to determine the extent to which simulation credibility (within the context of the specified application) exceeds the risks of using it in the specified application.

¹⁹ See the special topic on Risk and Its Impact on VV&A for additional information.



VV&A in New M&S Development

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Accreditation Process

The accreditation process consists of four key activities listed below. The Accreditation Agent conducts the first three. Once the accreditation assessment has been completed, the Accreditation Agent presents an accreditation recommendation to the User. The User then makes the accreditation decision. These activities are discussed in the following paragraphs.

- [Develop the Accreditation Plan](#)
- [Collect and Evaluate Accreditation Information](#)
- [Conduct Accreditation Assessment](#)
- [Make Accreditation Decision](#)

Accreditation Agent Role in Develop the Accreditation Plan

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Accreditation planning should begin as soon as the Accreditation Agent is designated. Ideally, this is at the beginning of the M&S Use Process so it can be done in coordination with planning for the M&S program. Accreditation planning should be an ongoing process and modifications should be made as needed to accommodate

program changes and evolving expectations. Additional information is provided in the Documentation Requirements section under [Accreditation Plan](#) (p. 18).

Specific tasks involved in the development of the accreditation plan include:

- **Obtain M&S requirements.** The Accreditation Agent should obtain the M&S requirements²⁰ and their associated metrics and acceptability criteria²¹ from the User. If the requirements are not sufficiently comprehensive or detailed, the Accreditation Agent should help refine and prioritize them based on the intended use of the simulation.
- **Identify accreditation information needs.** The Accreditation Agent should support the User in assessing the operational risks to determine the overall risk levels associated with using the simulation in the specified application (for more information on risk and risk assessment see the special topic on risk²²). Once the risks have been assessed and priorities determined, the type and scope of the information about the simulation needed to make the accreditation assessment can be defined.

If the Accreditation Agent joins the development effort in progress, existing simulation development and V&V documentation and plans should be reviewed to determine if they are sufficient to meet the accreditation information needs. If not, the Accreditation Agent should work with the M&S PM and User to determine what adjustments should be made.

- **Plan the accreditation assessment activities.** Assessment activities are conducted to assess
 - adequacy of existing or planned documentation in light of expected operational risk levels
 - ability of planned and/or executed V&V activities to provide the necessary information in light of expected operational risk levels
 - ability of the simulation to meet M&S requirements in light of the defined acceptability criteria

The Accreditation Agent should identify the areas of expertise needed to address each M&S requirement; ascertain the necessary qualifications for SMEs in each area identified; determine the number and type of assessment activities needed to complete the assessments; and select assessment team members and types of SMEs to participate in each activity. For discussion of the basic factors in team assessment, see [Appendix A](#).

- **Establish the assessment process.** For each assessment activity, the Accreditation Agent should specify

²⁰ See the special topic on Requirements for additional information.

²¹ See the special topic on Metrics for additional information.

²² See the special topic on Risk and Its Impact on VV&A for additional information.

- type of activity (e.g., face-to-face meeting, video teleconference), location, length of time
- types of participants to be included
- preparation materials (e.g., orientation steps, read-ahead materials, training).
- activity organization (e.g., facilitator, recorder, mechanisms for capturing the results of the deliberations and methods for expeditiously resolving conflicts and gaining consensus)
- methods for preparing an accurate report of the deliberations

For additional information on establishing the assessment process, see [Appendix B](#).

- **Coordinate with V&V planning.** The Accreditation Agent should provide information to the V&V Agent regarding accreditation assessment needs and priorities and also review the V&V plan and activities to ensure they are sufficient to satisfy accreditation assessment information needs.

Accreditation Agent Role in Collect and Evaluate Accreditation Information

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Once the accreditation information needs have been identified, the Accreditation Agent collects and reviews the information to ensure it is sufficient. Specific tasks involved in this activity include:

- **Review preliminary work.** All work (development and V&V) done prior to Accreditation Agent involvement should be reviewed for sufficiency and focus, and recommendations should be provided on any changes needed to address deficiencies.
- **Monitor development activities.** Close contact with the User and M&S PM should be maintained to ensure all changes in the application or simulation can be promptly addressed. Risks should be reassessed and accreditation information needs updated as necessary. The Accreditation Agent should also coordinate with the V&V Agent to ensure priorities are adjusted and plans modified to reflect the current needs of the accreditation assessment.
- **Monitor V&V activities.** V&V activities and tasks should be monitored to ensure they conform to the V&V plan. The Accreditation Agent should participate in any V&V meetings with the M&S PM, Developer, and/or User to assess the adequacy of information exchange and review all V&V products to ensure they provide the information needed for the accreditation assessment.

In general, the V&V effort should answer the basic questions listed in the table below about the simulation and its use in the intended application.

| |
|--|
| Basic Accreditation Questions for V&V |
|--|

| Basic Accreditation Questions for V&V |
|--|
| • Do simulation capability and fidelity match problem requirements? |
| • Is the current version of the simulation software (including the implementation of a distributed simulation) accurate? |
| • Are the simulation outputs sufficiently accurate and realistic to meet the needs of the application? |
| • Are the data ²³ used in the simulation sufficiently accurate and suitable? |
| • Does the simulation have sufficient support to make it usable by the designated personnel in the intended application? |

- **Collect supplemental information.** Although the majority of the information is obtained from the V&V effort, some information is obtained from other sources to supplement the V&V information. Typical supplemental information gathered for a new simulation assessment is shown in the table below.

| Typical Supplemental Assessment Information | |
|---|------------------------|
| Supplemental Information | Source |
| • Model documentation (e.g., user, programmer, analyst manuals) | M&S PM or User |
| • Simulation descriptive documentation (e.g., specifications) | M&S PM or Developer |
| • Configuration management plans and implementation evidence | M&S PM |
| • Instance data metadata (for establishing data credibility) | Developer or V&V Agent |
| • Development schedule; execution deadline | M&S PM |
| • Operational resource requirements | M&S PM |

Accreditation Agent Role in Conduct Accreditation Assessment

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The accreditation assessment of a new simulation is usually done at the end of the development cycle to determine if the newly developed simulation can satisfy the needs of the specified application. This assessment can take one of two forms, depending on the complexity of the application and/or the simulation being used. If the application is straightforward and the simulation is simple, the assessment can usually be done by a single person. If either the simulation or the application is more complex, or if the level of operational risk is relatively high, subject matter experts (SMEs)²⁴ should be included in the assessment process. For such applications, an assessment team of experts is usually formed so that all aspects are addressed. An expert team is also desirable

²³ See the special topic on Data V&V for New Simulations for additional information.

²⁴ See the special topic on Subject Matter Experts and VV&A for additional information.

when the visibility of the problem requires unquestionable objectivity, such as when the project is relatively large or politically sensitive (see [Appendix A](#) for additional information).

Ideally, an accreditation assessment performed by a single analyst or by a team should produce the same basic result. However, the team approach is typically imbued with more credibility due to a perception of greater objectivity resulting from the increased breadth of technical expertise.

The procedure followed in a typical team assessment activity includes the following steps (See [Appendix B](#) for additional information):

- notify and brief assessment team members and SMEs
- ensure team member availability for all meetings and associated activities
- provide read-ahead information
- conduct and record assessment team meetings
 - document all deficiencies (in simulation and in the accreditation information), their effects, and associated risks if they remain uncorrected
 - identify potential work-arounds for each deficiency
- prepare a draft assessment report complete with recommendations
- submit the draft report for review and concurrence by all assessment team members
- prepare the final report
- present the final report and recommendations to the User

Accreditation Agent Role in Make Accreditation Decision

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The accreditation recommendation should be presented to the User in the same form that the final decision is to take. The range of accreditation decisions that are possible is shown in the table below. See the section on [Accreditation Assessment Report](#) for additional information (p. 21).

| Accreditation Decision Options | |
|---|--|
| Full accreditation | <ul style="list-style-type: none">• Simulation produces results that are sufficiently credible to support the application |
| Limited or conditional accreditation | <ul style="list-style-type: none">• Constraints are placed on how the simulation can be used to support the application |
| Modification of the simulation is needed | <ul style="list-style-type: none">• Simulation capabilities are insufficient to support an accreditation decision; modifications and subsequent V&V are needed to correct the deficiencies |

| Accreditation Decision Options | |
|---|---|
| Additional information is needed | <ul style="list-style-type: none">Information obtained about the simulation is insufficient to support an accreditation decision; supplemental verification, validation and/or testing should be conducted to provide the necessary information before the accreditation decision is made |
| No accreditation | <ul style="list-style-type: none">Results of the assessment show that the simulation is not fit to support the application |

Accreditation Agent's Relationship with Other Roles

Accreditation Agent's Relationship with the User

The Accreditation Agent serves as the User's advocate throughout the M&S development process to ensure the User's requirements for simulation fitness for purpose (e.g., functionality, accuracy, usability) are met. The User hires the Accreditation Agent and in most cases provides the funding and resources for the accreditation effort. The User should designate an Accreditation Agent as soon as possible to ensure decisions made during the planning phase are focused on establishing simulation credibility for the specified application.

The Accreditation Agent should work with the User throughout the initial phases of the M&S development program (e.g., M&S requirement definition, planning) to obtain information on overall application objectives, metrics, tolerances, thresholds, and risk.²⁵ This information is used to identify accreditation information needs and determine V&V priorities.

As the simulation development progresses, the Accreditation Agent should continue to work with the User to update accreditation needs as necessary to ensure that the latest M&S requirements are satisfied during the accreditation assessment. At the end of the accreditation assessment, the Accreditation Agent provides a report and recommendations to the User who then makes the accreditation decision.

Accreditation Agent's Relationship with the M&S PM and M&S Developer

The Developer and M&S PM serve as sources of supplemental information needed for accreditation assessment (e.g., model documentation, configuration management status, data). Most of the time, however, the Accreditation Agent can rely on the V&V Agent for this information.

²⁵ See the special topic on Risk and Its Impact on VV&A for additional information.

Accreditation Agent's Relationship with the V&V Agent

The relationship between the Accreditation Agent and the V&V Agent is critical for a successful and cost-effective VV&A effort. The Accreditation Agent should work with the V&V Agent to ensure that the V&V activities are sufficiently robust and focused to address all the accreditation needs. The Accreditation Agent serves as both a guide for and a customer of the V&V Agent. As a guide, the Accreditation Agent provides accreditation information requirements and V&V priorities to the V&V Agent to shape the V&V plan and process. As a customer, the Accreditation Agent receives information about the simulation's capabilities and limitations to use in the accreditation assessment.

Accreditation Agent's Relationship with Others

Subject Matter Experts

Subject matter experts (SMEs)²⁶ play an important role in accreditation assessment by serving as members of the assessment team or temporary consultants. It is worthwhile for the Accreditation Agent to anticipate SME resource requirements and coordinate with the User, the Developer, or other outside sources to ensure that adequate resources are provided for their participation. Frequently, the M&S PM and V&V Agent will be involved in this coordination effort as well because of competing requests on the same SMEs. In many cases, it is preferable to have consistency in SMEs throughout the program rather than assemble separate SME teams for individual tasks. This approach can be very cost-effective as well as technically efficient.

Documentation Requirements

The accreditation process results in three major products:

- [Accreditation plan](#)
- [Accreditation assessment report](#)
- [Accreditation report](#)

Accreditation Plan

The essential elements to include in an accreditation plan are listed in the table below and discussed in the following paragraphs.

| |
|---|
| Elements of the Accreditation Plan |
|---|

²⁶ See the special topic on Subject Matter Experts and VV&A for additional information.

| Elements of the Accreditation Plan |
|---|
| • Problem (intended use) statement and objectives |
| • Verified M&S requirements and associated metrics and acceptability criteria |
| • Accreditation information needs <ul style="list-style-type: none">- Supporting risk assessment documentation- V&V information- Supplemental information |
| • Regulatory information |
| • Assessment plan |
| • Accreditation report structure and outline |

This information can either be included in the plan or in other documents referenced in the plan.

Problem statement and objectives

The problem or intended use statement and objectives provided by the User serve as the starting point for any accreditation. If these items are documented somewhere else, they may be summarized in the Accreditation Plan along with a reference to the source document.

Verified M&S requirements and associated metrics and acceptability criteria

M&S requirements²⁷ is the collection of requirements that the User, M&S PM, and Developer derive from the objectives to define the capabilities of the simulation. During problem analysis the User, assisted when possible by the Accreditation Agent, identifies appropriate metrics (e.g., measures of effectiveness [MOEs], measures of performance [MOPs])²⁸ by which each can be measured and standards (acceptability criteria) that define how well the simulation must accomplish each requirement in order to be acceptable for the current application. Documentation reporting the process for determining the metrics and the acceptability criteria should be referenced.

Accreditation information needs

A risk assessment should be conducted to determine the type and scope of the information needed about the simulation to make an accreditation assessment. In addition to the list of information needs, the accreditation plan should include or reference a description and results of the risk assessment. This description should include a list of risks addressed, their impacts, and the probability that their occurrence would give erroneous simulation output.

²⁷ See the special topic on Requirements for additional information.

²⁸ See the special topic on Measures for additional information.

Another product of the risk assessment is a prioritization of the functions within the simulation that have the greatest impact on the simulation outputs of interest to the user. This prioritized list of functions should also be documented in the accreditation plan, either directly or by reference to another document.

Accreditation information needs can be separated into information to be obtained from the V&V effort and information to be obtained elsewhere to supplement that obtained from the V&V effort (i.e., supplemental information).

- **V&V information** -- The V&V information needed to make a reasonable accreditation decision depends on the risks associated with the intended application. It is included in the accreditation plan to help the V&V Agent prepare the V&V plan and to serve as a basis for the accreditation assessment planning (see the sections on [Develop the Accreditation Plan](#) (p. 13) and [Collect and Evaluate Accreditation Information](#) (p. 14) for additional information).
- **Supplemental information** -- The accreditation assessment also needs information that cannot be acquired directly from the V&V effort. This information is obtained from a variety of sources, including the User, M&S PM, Developer as shown in the table below (see the section on [Collect and Evaluate Accreditation Information](#) (p. 14) for additional information).

| Supplemental Information | Source |
|---|------------------------|
| <ul style="list-style-type: none"> • Model documentation (e.g., user, programmer, analyst manuals) | M&S PM or User |
| <ul style="list-style-type: none"> • Simulation descriptive documentation (e.g., specifications) | M&S PM or Developer |
| <ul style="list-style-type: none"> • Configuration management plans and implementation evidence | M&S PM |
| <ul style="list-style-type: none"> • Instance data metadata (for establishing data credibility) | Developer or V&V Agent |
| <ul style="list-style-type: none"> • Development schedule; execution deadline | M&S PM |
| <ul style="list-style-type: none"> • Operational resource requirements | M&S PM |

Regulatory information

Each Service and Department within DoD has unique VV&A policies and governing requirements. This section of the plan should identify the policies and regulations governing the program and describe the steps that should be followed after the accreditation assessment is done to accommodate them. Any procedures to be followed or requirements calling for a review of the assessment, either before or after the accreditation decision is made, should be listed. Any requirements for posting or archiving the accreditation report and the supporting information should be detailed.

Assessment plan

A detailed plan for conducting the accreditation assessment should contain

- type of assessment (single person or team effort), with supporting rationale
- types of people needed for performing the assessment
- assessment method(s) to be used
- assessment procedures to be followed

If a team approach is to be used, the preplanning steps to be followed to make the assessment meeting(s) efficient should also be outlined (see [Appendix A](#) for additional information).

Accreditation report structure and outline

The report outline or template can help focus the assessment team on the **fitness** of the simulation for the application instead of the simulation's **capability** and can provide a framework for assessment meetings. It can also serve as a checklist to ensure the supporting plans (i.e., V&V plan and assessment plan) include activities that will provide the necessary information.

Accreditation Assessment Report

The essential elements of the accreditation assessment report are listed in the table below and discussed in the following paragraphs.

| Elements of the Accreditation Report |
|--|
| • Annotated list of simulation acceptability criteria |
| • Description of simulation capabilities, assumptions and limitations |
| • Results of the accreditation assessment and supporting documentation |
| • Accreditation recommendation |

They can be contained in either a single report or in multiple documents. The Accreditation Agent should ensure the User recognizes the importance of archiving this information and should coordinate with the M&S PM to develop appropriate formats and techniques for capturing it and determine adequate resources are available for preserving it.

Acceptability criteria list

A description of how the acceptability criteria were derived from the basic problem objectives and parameters should be included, both to demonstrate that they are

complete, and to allow others to review and validate them if necessary. In addition, this type of explanation facilitates the process of updating acceptability criteria as new requirements and applications emerge.

Simulation capabilities, assumptions, and limitations

All simulation assumptions and limitations identified during the development and associated V&V efforts should be documented. Simulation capabilities should be contained in the validated conceptual model²⁹ developed as part of the new model development process.

Accreditation assessment results and supporting documentation

The assessment results should present evidence showing how well the simulation meets the acceptability criteria and what risks are associated with the simulation's limitations. If one or more criteria are not met, this document should include or reference an assessment of the impact of not meeting the specified criteria and a listing of potential workarounds and their associated risks. These impact assessments allow tasks to be reprioritized and resources redistributed objectively to meet simulation acceptability criteria.

The assessment results should also include

- appropriate references and explanations for each conclusion so the rationale can be traced back to original sources and supporting information (e.g., accreditation plans, risk assessments, requirement reports, V&V plan, a specific V&V report)
- evaluative comments and recommendations regarding the adequacy of simulation configuration management and the credibility and accuracy of the data being used
- discussion, when appropriate, of the suitability of the operators and analysts necessary to properly run the simulation and interpret its results (e.g., training simulations, human-in-the-loop [HITL] simulations)

Accreditation recommendation

The accreditation recommendation is typically a concise (one page) executive summary that includes

- a synopsis of the rationale for the accreditation recommendation
- a list of the limitations and recommended constraints on the accreditation
- an approval statement for the User to sign

²⁹ See the special topic on Conceptual Model Development and Validation for additional information.

By itself, the accreditation recommendation shows only that an accreditation assessment has been completed. However, when signed by the User and included in a package accompanied by supporting documents that contain detailed information and cross-references to source data, the entire package becomes the Accreditation Report.

Accreditation Report

The accreditation report is a package of all the formal documentation associated with the accreditation. It should contain a copy of the [accreditation plan](#) (p. 18), the [accreditation assessment report](#) (p. 21), and the signed accreditation decision. The accreditation assessment report is the essential document needed by the User in making the accreditation decision.

The [accreditation decision](#) (p. 16) consists of the accreditation option selected by the User with details of all caveats, qualifications, constraints, and limitations to be addressed.

Standardized Documentation

If all VV&A documentation could be prepared according to a standardized structure, such as the one shown in the table below, then the information captured would be much more understandable and usable for both current and future Users.

| Standardized Documentation Structure | | | |
|---|--|-------------------|--------------------------|
| Impact Statements | Description (in Operational Terms) | | |
| Impact a | • impact of a on or limitation to usage | | |
| Impact b | • impact of b on or limitation to usage | | |
| Impact m | • impact of m on or limitation to usage | | |
| Result Summaries | Result Categories | | |
| | Assumption | Limitation | Proven Capability |
| Result 1 | x | | |
| Result 2 | | | x |
| Result n | | x | |
| Concluding statement | • characterizing the actual utility of the simulation for the specific application | | |

Using standard formats and structures to prepare the V&V and accreditation reports can provide benefits and cost savings to both those preparing the reports and those who read them (e.g., Users, Accreditation Agents, V&V Agents). They reduce preparation time, help ensure that the information provided is complete and consistent, and decrease the amount of time needed for review. Documentation standards also aid future Users by providing easy access to the particular information they need.

Cost Implications and Resourcing

The Accreditation Agent is not usually the primary driver behind the VV&A program for a new M&S and thus has little control over the overall cost involved. The only costs of the VV&A program that the Accreditation Agent directly controls are those associated with the accreditation assessment. However, by ensuring the V&V effort includes only those tasks absolutely necessary for accreditation, the Accreditation Agent can ensure that resources are not wasted chasing matters of low importance or relevance to simulation fitness for the specified use.

The major cost driver in a VV&A program is the V&V effort. The scope and depth of the V&V tasks are typically driven by the need to determine if the simulation can meet the M&S requirements of the intended use. When the V&V effort is successful, the accreditation effort, which relies on information provided by the V&V effort, costs comparatively little. When the V&V effort is not focused on the accreditation needs, however, the cost of the accreditation assessment rises due to the need to research and (when necessary) reproduce key information.

Major factors in the accreditation assessment process that affect costs include:

- [Time](#)
- [Planning information](#)
- [Accreditation information needs](#)
- [Team selection](#)

Time

The cost of the actual accreditation assessment is a function of the amount of time available and the number of people involved. Normally, a team of SMEs is selected and appropriate face-to-face meetings are scheduled. The time required to plan and arrange each meeting, the preparation and dissemination of read-ahead packages, and the preparation of the results add to the expense of the accreditation assessment.

When time is short, SMEs with extremely high levels of expertise regarding the simulation's representations and intended use may need to be called in to avoid lengthy "learning curves" leading up to an accreditation assessment. When more time is available, because there is sufficient time for training and gaining experience, the SMEs may initially require less specific knowledge about the simulation and its intended use.

Planning Information

Normally, the Accreditation Agent relies on inputs and reviews either from those who perform the planned tasks or those who evaluate or approve the final accreditation package (e.g., User, M&S PM) to provide the information needed to scope the accreditation problem and plan the assessment. The cost associated with accreditation planning is inversely proportional to the Accreditation Agent's level of understanding of basic accreditation principles and requirements and directly proportional to the amount of support and involvement of the User, M&S PM, and V&V Agent in defining accreditation needs based on application requirements and risks.

Accreditation Information Needs

In order to ensure that V&V planning focuses on elements of greatest impact to the credibility of the simulation, accreditation information needs must be defined and articulated as early in the development process as possible. Without appropriate accreditation information needs, the V&V effort may tend to overemphasize minor activities "just in case" or underemphasize potentially important activities.

Team Member Selection

In planning the assessment effort, it is important that the Accreditation Agent carefully select the team members. Team members who do not have the right experience and background, or who do not have the time to invest in preparing for and attending all the team sessions can cause time to be wasted in the assessment deliberations. This can lead to unnecessary work in trying to achieve consensus, prepare a report, or worse yet, may necessitate additional meetings. Besides selecting the right team members, the Accreditation Agent should ensure that they are adequately prepared, and that they accept the methodology and criteria to be used in the assessment. Again, without adequate preparation and "buy in" there is a good chance that the actual meetings will be delayed or disrupted.

References

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External Links in This Document

Software Engineering Institute (SEI), *Capability Maturity Model for Software*, Carnegie Mellon, <http://www.sei.cmu.edu/cmm/>

RPG References in This Document

select menu: *RPG Diagrams*, select item: "Typical Roles and Their Responsibilities"

select menu: *RPG Introduction*, select item: "Key Concepts"

select menu: *RPG Special Topics*, select item: "Conceptual Model Development and Validation"

select menu: *RPG Reference Documents*, select item: "M&S Data Concepts and Terms"

select menu: *RPG Special Topics*, select item: "Data V&V for New Simulations"

select menu: *RPG Special Topics*, select item: "Measures"

select menu: *RPG Special Topics*, select item: "Paradigms for M&S Development"

select menu: *RPG Special Topics*, select item: "Problem Analysis"

select menu: *RPG Special Topics*, select item: "Requirements"

select menu: *RPG Special Topics*, select item: "Risk and Its Impact on VV&A"

select menu: *RPG Special Topics*, select item: "Subject Matter Experts and VV&A"

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In the web-based version of this document, the appendix below appears as a hot link in the Develop Accreditation Plan, Conduct Accreditation Assessment, and Documentation Requirements sections.

Appendix A: Factors in Team Assessment

In planning a team assessment, several factors should be addressed:

- [Selecting appropriate team members](#)
- [Establishing objectives and procedures](#)
- [Building consensus](#)
- [Documenting the results](#)

Selecting Appropriate Team Members

There are two general reasons for including someone on the assessment team: technical expertise and organizational responsibilities. Technical expertise is needed in four areas:

- operations being simulated
- key systems represented within the simulation
- technology or physical science underlying the problem
- the application itself

Although representatives of the simulation Developer, or anyone with a vested interest in the simulation itself, should be available to answer questions about details of the simulation, they should not normally be considered part of the "assessment team" per se because of the possible conflict of interest. Similarly, experts with an alternative agenda (e.g., a competing simulation developer) should be excluded.

Other major considerations to consider are availability and political considerations.

- **Availability** -- Availability involves not only having the time available to participate but also the willingness to commit to serve for the entire effort, including preliminary study and preparation for all meetings, attendance at all meetings, and participation through the documentation phase.
- **Political considerations** -- Although technical expertise should be the primary factor in selecting team members, political considerations must also be accommodated in the practical world. In many cases, the assessment team must include members who represent the organizations having some responsibility related to the problem. Although these members should be technically capable, in some cases they may lack the technical proficiency

needed to avoid time-consuming basic explanations. Therefore, it is essential to have a perceptive facilitator to mitigate any potentially disruptive effects.

Establishing Objectives and Procedures

Accreditation assessment planning should be based on a clear set of objectives and procedures. Although the objective (accreditation assessment) seems obvious, planners all too often lose sight of their goal and get involved in addressing detailed issues raised by one of the team members. In other cases, review planners do not have a clear set of criteria by which to assess the selected simulation. As a result, the review turns into a design critique rather than an assessment of whether or not the model or simulation fulfills the requirements of the application.

The basic information needed for a successful review includes a full set of M&S requirements, a description of how the model functions, all V&V data, and possibly results of model runs and sensitivity analyses. During the planning phase, all team members must be given the opportunity to become familiar with the application, the M&S requirements, and the simulation itself. Developer briefings can be used, as necessary, to aid in understanding model strengths, weaknesses, and design. These background briefings can be conducted prior to the review, but are often more conveniently done at the beginning of the review.

Building Consensus

The goal of any assessment process is to achieve consensus of the participants on the issues. Involvement in decision-making is essential for building team consensus. Assessment team members should participate in developing the review objectives, criteria, and procedures, determining how the review will be conducted, and selecting the questionnaires or scoring techniques to be used. They should also be encouraged to contribute to development of the agenda.

Consensus is best achieved through communication. In some cases, it is a good idea to have a preliminary review video teleconference so that coordination items can be presented and discussed in a structured fashion.

Documenting the Results

Accreditation assessment planning should address the issue of how the key discussion topics, discussions, viewpoints, and action items will be identified, recorded, and integrated into a report. One successful technique is to outline the intended product, even to the extent of developing an annotated outline that is missing only the review results. Such an outline can be used to guide discussions and help the assessment team focus on the real objectives. The planning effort may also include a scheme for taking minutes of the deliberations, reviewing the minutes, and then reducing them to a draft report.

In the web-based version of this document, the appendix below appears as a hot link in the Develop Accreditation Plan, Conduct Accreditation Assessment, and Documentation Requirements sections.

Appendix B: Accreditation Assessment Success Factors

The accreditation assessment begins with thorough planning and careful selection of the participants. In addition, there are two other factors that determine the success of an accreditation assessment:

- [Focused deliberations](#)
- [Complete, accurate reporting](#)

Focused Deliberations

To have focused deliberations, all participants need to be aware of the issues to be discussed and the procedures to be followed. Well in advance of the meeting date, packages containing all the information needed (e.g., problem statement, objectives, M&S requirements, acceptability criteria, simulation description and specifications, V&V evidence, session objectives, products, procedures, and agenda) should be distributed to the participants. At the beginning of the actual review session, the leader should review the session's objectives and products and the evaluation process to be used. Any issues regarding the procedure should be resolved at the start.

The accreditation assessment may be conducted in one session or several. All team members should attend all review sessions to avoid repetitious discussions. Representatives of the Developer should be present to clarify and explain model capabilities as necessary. Representatives of the User should be present to answer questions about requirements when they arise. One person, preferably a representative from the Accreditation Agent or the program using the simulation, should be the facilitator, to keep the discussions focused on simulation **fitness to purpose**.

One technique to keep the discussions focused is to have a list of questions that must be answered for the final report. The deliberations should begin with a review of the problem, objectives, M&S requirements and acceptability criteria followed by a description of simulation capabilities and design with time allowed for discussion. The actual assessment is usually done one requirement at a time. The requirement is presented and evidence of any shortcomings in model functionality or fidelity is identified and explained. The discussions should focus on the impact of these shortcomings on the outcome of the application, and its associated risks. The discussions should also address related issues, such as how the model will be used, the capabilities of the analysts running the simulation, and what data will be used as inputs. The team should reach some preliminary judgment about model fitness to purpose and the feasibility of potential work-arounds for unacceptable deficiencies.

One hazard is to allow the discussion to focus on the simulation itself, evaluating simulation performance or design, and discussing its weak features and how it can be improved without regard for what the current application really needs. This type of discussion does little to support an accreditation decision. Focus must be maintained on the critical issues that relate to the simulation's utility in the particular application being considered, and how well the simulation compares to the acceptance criteria for credible, low risk use in this application. Discussions about how to improve the simulation are of little value unless they are focused on how to modify the simulation for use in this application.

If model deficiencies are identified during the review, the discussion should lead to some assessment of whether the deficiency is tolerable. However, in some cases, team members may view a deficiency as being intolerable only because they know of a better modeling technique that avoids the deficiency. The question then becomes, "Why live with this deficiency when we can use a different model or modify this one?" Such discussions can derail the accreditation assessment by introducing alternatives that cannot be addressed effectively at the time available.

A structured approach should be followed to really assess how a deficiency will impact the intended use. This approach should

- analyze the deficiency's impact on model outputs
- determine if the outputs will be biased high or low (or if the expected variation is unknown)
- address the validity of these expected biases for some or all conditions of the application and instance data values
- assess the utility of the model outputs considering all the risks and restrictions placed on its use

Any actions or steps that can be taken to mitigate the impact of model weaknesses should be examined as well, such as

- manually adjusting input or output values
- changing parameters within the model
- modifying the scenarios to exclude problem areas
- limiting the model's use to certain scenarios where the outputs are known to be acceptable

Complete, Accurate Reporting

The last key to a successful review is accurate, complete, well organized, and timely reporting. When the discussions are complete, the findings should be assembled and an overall assessment made about model fitness to purpose and the risks of using the

model as it is. Any recommendations for model changes or additional V&V work should be prioritized. A summary of the results should be drafted and reviewed prior to team dispersal.

To ensure accurate and complete recording of each discussion, a person with expertise in the simulated operations and knowledge of the application should be designated to take the minutes and be the principal report author. Ideally this recorder should not be someone who is relied upon for major contributions to the discussions, since the recorder duties will preclude any significant inputs. The recorder should have the ability to recognize significant points in the discussions and be able to construct a draft report that will require minimal changes by the team members.

The designated recorder should keep a set of minutes that are reviewed and approved by the team during the review sessions. These minutes will be valuable to the team in preparing its summary findings, and to the recorder in drafting the final report. If possible, a running draft of the final report should be developed in parallel with the minutes, either as the discussion progresses or at the end of each day's session. A comprehensive outline that was drafted during the planning stage will prove invaluable in this regard.

Review of the draft minutes and draft report is an essential part of the reporting process. Minutes of each session should be reviewed and corrected at the beginning of the next session. When the draft report is prepared, (ideally within 7 to 10 working days after the review), it should be circulated to team members for comments and concurrence. Planning should include provisions for these reviews, and team members must commit to providing timely responses.

In most cases, the report reviews can be done through the exchange of documents (either paper or electronic). However, if consensus is not reached during the assessment or if significant disagreements develop over the content of the draft report, it may be necessary to reconvene the team (either in person or via video teleconference) to resolve the differences. If consensus cannot be obtained, an appendix or a separate report containing strong minority opinions should be included in the final report.

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