



From RDML Locklear (close but not quite a quote) -

The generation coming, the Midshipmen, Ensigns, and JGs, are becoming so technically savvy that they will be the first generation to be able to design the solutions to the problems they will face.

Next slide, please.



- **Introduction**
- **VV&A Process**
- **VV&A Roles & Responsibilities**
- **Summary**
- **VV&A Documentation Tool**

So why am I here?

I'm here to share with you the Navy's M&S and VV&A processes.

Upfront, if there is no M&S, then there is no VV&A.

We go together like a hand in glove.

Next slide, please.



Why VV&A?

- **Introduction**
 - *Build credibility and confidence in the use of modeling and simulation (M&S)*
 - *Reduce risks of using M&S*
 - *Contain costs*
 - *Support reusability*
 - *Satisfy policy requirements*

Some of you will cringe when I say VV&A is about quality. In a sense, VV&A is more than quality. It is process improvement to get to the quality, meaning that quality will bring about credibility and confidence in use of the M&S.

In your process of implementing VV&A, you'll look at your program risk, decide on how much VV&A you will need, and balance the risks with the costs.

At the same time you will make your models available to others so that they can reuse them (that will be cost saving to them) and limit the cycle of reinventing the same thing.

Of course, some of you are thinking that you are doing it because it is a policy requirement.

Next slide, please.



M&S Management and VV&A Policy

- DoD Directive 5000.59, Department of Defense (DoD) M&S Management, 4 Jan 1994
- DoD Directive 5000.61, Department of Defense M&S VV&A, 13 May 2003
- SECNAV 5200.38A, Department of the Navy (DON) M&S Management, 28 Feb 2002
- SECNAVINST 5200.40, Department of Navy M&S Verification, Validation, Accreditation, 19 Apr 1999
- OPNAV Instruction 5200.34, Navy M&S Management, 28 May 2002

If we lived in a perfect world where we all knew what everyone wanted, then policy may not be required. Policy provides standard governance for everyone to operate from, like singing from the same sheet of music. And M&S has several.

First, there are M&S policies: DoD, individual services, and sub-components.

The DoD policy provides an umbrella.

SECNAVINST 5200.38A provides guidance for the management of DON M&S and publishes the DON vision for M&S.

OPNAV Instruction 5200.34 establishes the Navy Modeling and Simulation Management Office (NAVMSMO) as the single point of contact for the Navy on all M&S matters.

I will not read these to you. Hopefully, the slides will be available to you and the contents may be reference material as you implement your VV&A program.

Next slide, please.



V&A Definitions



Verification

Tests "FUNCTIONALITY"

Works the way
it was designed.



Validation

Evaluates "FIDELITY"

Looks and acts almost
like the real thing.



Accreditation

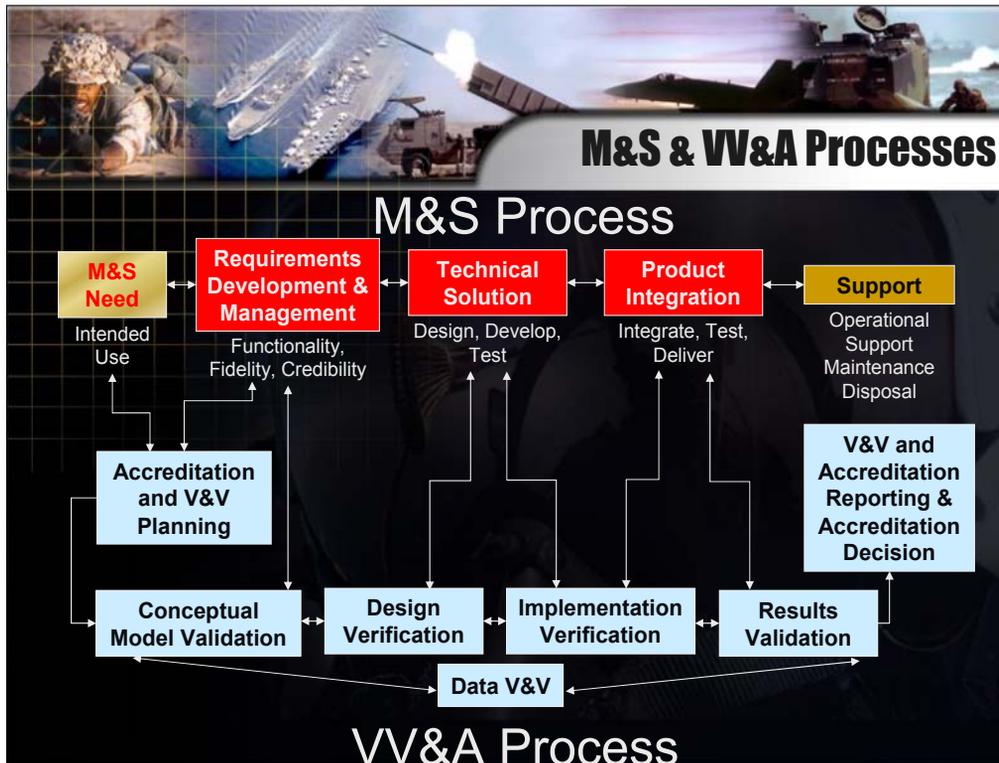
Determines "CREDIBILITY"

Can be used to do the job.

What do these policies have in common? The context of these definitions are the same. Yes, we may use slightly different words, but the meanings are the same.

For example, where we use "M&S" DoDI 5000.61 uses "model, simulation, or federation of models and simulations" or simply just "model".

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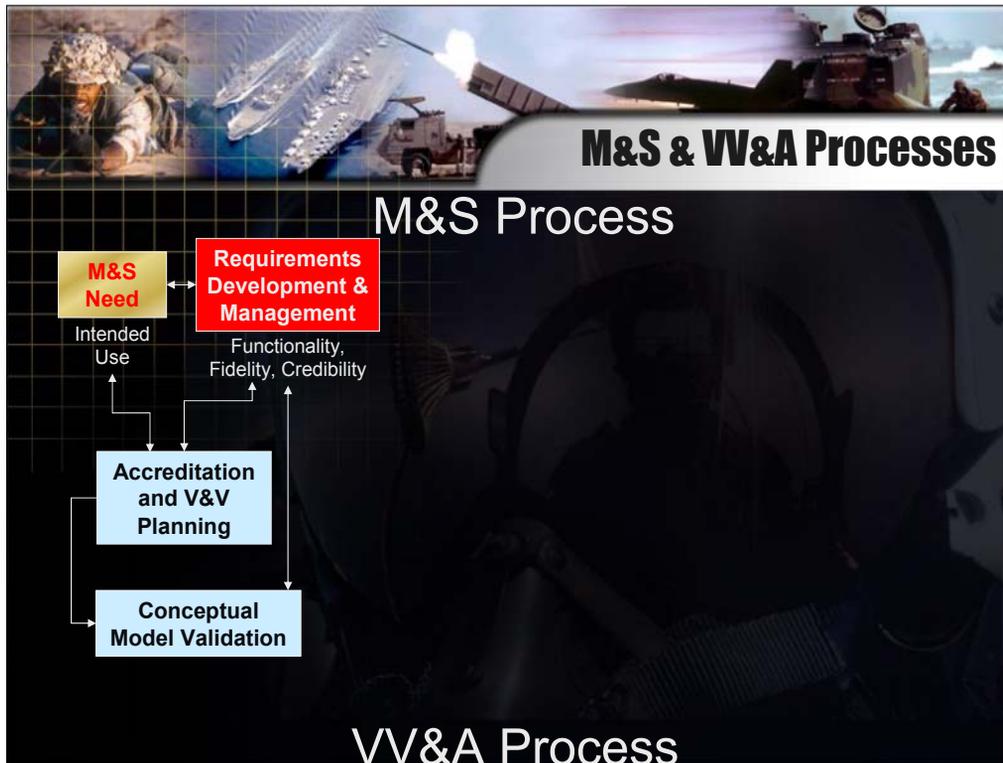
The credibility of M&S is based on conscientious application of the process of Verification and Validation (V&V). A formal process of accreditation shall be employed to establish official approval of M&S as adequate for use in a particular application. The entire process is known as VV&A.

SECNAVINST 5200.38A, 28 February 2002

The quality of the VV&A process depends on the quality of the M&S process. The M&S process encompasses the entire M&S lifecycle from requirements definition through development, use, and support. The intent of this tutorial is to provide VV&A guidance within the M&S process. VV&A complements the M&S process by gathering and examining its products to make an informed decision regarding the use of the M&S for a specific purpose.

VV&A is a tool that should be implemented early in the M&S process to help mitigate the risks of using the M&S. The conscientious implementation of VV&A provides credibility information so that the M&S can be used with an acceptable level of confidence, accuracy, and reliability. Additionally, VV&A helps to establish the quality of the M&S, balance risks with resources, and support M&S reuse as well as to meet policy requirements.

The DON has developed general processes for verifying, validating, and accrediting models and simulations. The processes depicted here serve as foundations for any M&S or VV&A effort. Each effort must strike a balance between cost-effectiveness, responsiveness, and sufficiency to succeed. To maintain the balance between



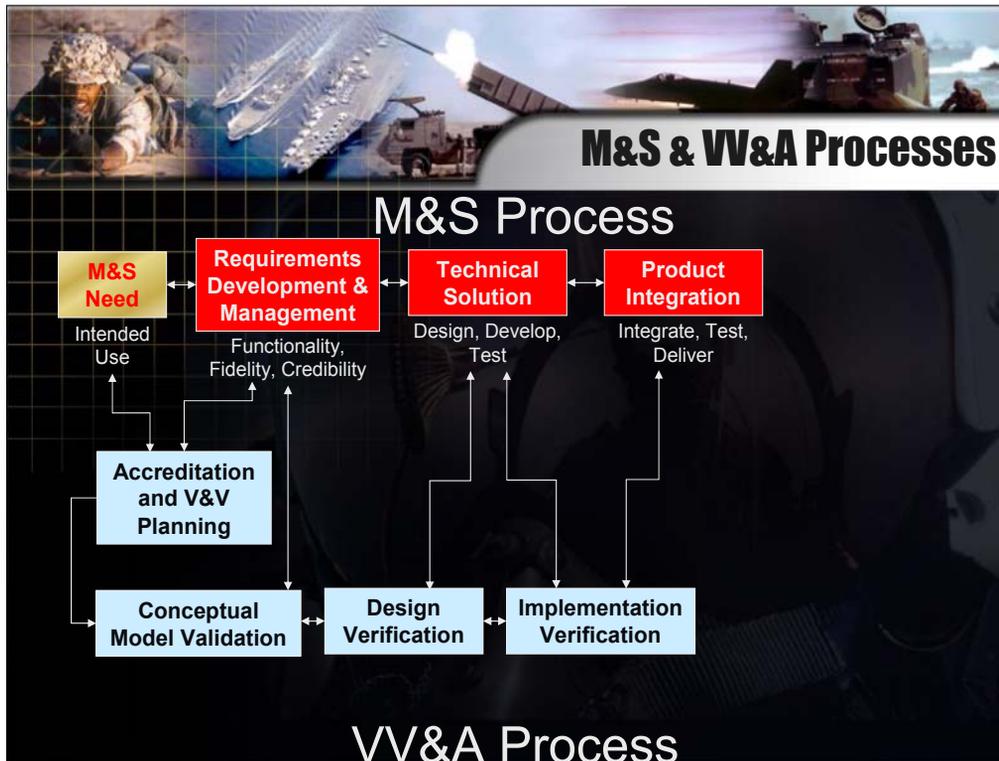
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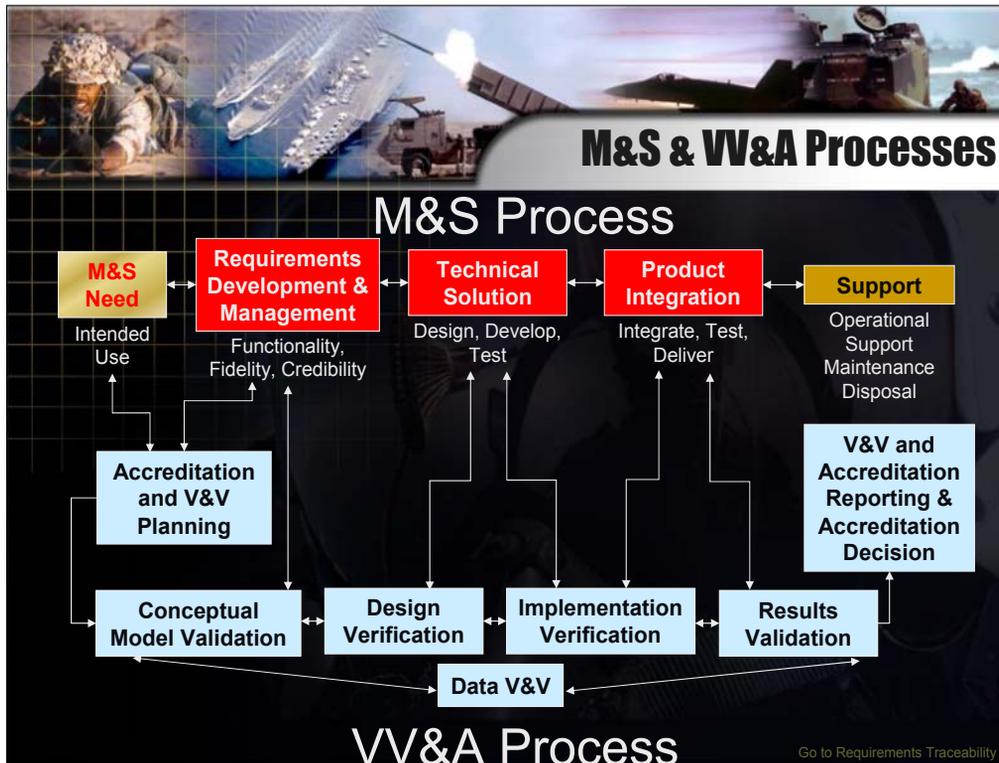
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Plan & Document

- **Identify Intended Use**
 - *Cooperatively develop, define, and derive requirements for the use of the M&S*
 - *Address user, simulation, and problem domains*
 - *Source documents: ORD, MND, Test Plan, System Performance Specification, etc.*
- **Plans**
 - **Accreditation**
 - M&S Requirements
 - Acceptability Criteria
 - MOP/MOE
 - **V&V Plan**
 - Methodology
 - Documentation
 - Organization
 - Re-use

Back to M&S & V&V Processes

Planning activities include documenting the intended use, identifying requirements for use of the M&S results, documenting acceptability criteria, and establishing the V&V methodology for addressing the acceptability criteria.

Before I do anything, I need to know what the problem is:

What will the M&S be used to do (the intended use)?

Who will use the results of the M&S and for what purpose?

How will the M&S be used?

What are the requirements for the use of the M&S?

What is the M&S suppose to do?

How was it built/how will it be built?

What are the defined or know risks?

Is there any other program guidance?

**Collect answers to your questions to minimize the UNKOWNS.
More you know, less risk you will have.**



Validate Conceptual Model

What is a Conceptual Model?

Assumptions, algorithms, formulas, and architectures that relate elements of an M&S to one another.

Back to M&S & V&V Processes

Validation Tasks

Determine M&S requirements are valid for the intended use

Check for completeness and correctness

Determine conceptual model elements are traceable to the acceptability criteria and M&S requirements

Determine data used are valid data

Identify authoritative data needed to validate the M&S results

Report discrepancies to the M&S Proponent and document results in the V&V Report

The conceptual model serves as a bridge between the defined requirements and the M&S design, providing the developer's interpretation of the requirements to



Verification

- **Design Verification (Specifications)**
 - *Technical Specification*
- **Implementation Verification (Functional Design)**
 - *Capability and Functionality of the M&S integrated as a whole system*
 - *Performance Specification*

Back to M&S & V&V Processes

Verification Tasks

Determine performance characteristics support intended use

Establish consistency and faithfulness to the validated conceptual model and traceability

Ensure required features, functions, behaviors, algorithms, and interactions are correctly and completely represented

Perform design walkthroughs

Document results in the V&V Report and report discrepancies to the M&S Proponent

Design twice, build once is an applicable mantra for M&S development. Once the requirements for the use of the M&S have been identified and baselined, then activity can begin to design and build the model or simulation.

The first design step is to document the Conceptual Model description.

The second step in the design process is to develop appropriate specifications that translate the conceptual description to functional requirements in terms of technical performance and mission needs. Specifications may be needed for the system or subsystems, software and hardware requirements, or interface requirements. The functional design is based on the specifications. The functional design provides the developer's blueprint for the development of the M&S. Design features emphasize functionality, information flow, ordering of processes, and data accessibility.

Design verification establishes the accuracy and consistency of the design translation from specifications and the conceptual model



Data V&V

- **Appropriateness**
- **Accuracy**
 - *Data validation ensures the data accurately represent aspects of the real world to be simulated.*
- **Integrity of Data**
 - *Data verification ensures the data selected are the most appropriate for the application and are properly prepared for use in the M&S.*

Back to M&S & V&V Processes

5 Types of Data

Reference. Descriptive information (metadata) including administrative, descriptive, and quality.

Hard-wired. Data values implemented in code.

Instance. Input and output data.

Validation. Real world facts.

Exchange. Data exchanged across a federation or distributed simulation.

This is new addition in the DoD and SECNAV instructions.

Data are critical to the successful application of most M&S in use today. Data used in M&S applications affect the M&S accuracy and credibility of results. Such data often must be interpreted and translated for use in a particular M&S application.



Validate Results

- **Determine extent the M&S addresses requirements**
- **Identify how realistic outputs are**
- **Satisfy Acceptability Criteria**
- **Meet the intended use of the M&S**

Back to M&S & V&V Processes

Validation Tasks

Identify scenarios, validation data, and expected results

Compare outputs to real world data

Compare outputs with SME opinion when empirical data is not available

Identify key SMEs

Trace M&S performance to acceptability criteria and M&S requirements

Adjudicate errors

Document results in the V&V Report and report discrepancies to the M&S Proponent

Results validation is the formal (i.e., documented) test and review process that compares the responses of the M&S with known or expected behaviors, in order to determine that the M&S responses are sufficiently accurate. Results validation is



Document & Decide

- **V&V Report**
 - *Document formal V&V evidence*
 - *Capture findings, assumptions, capabilities, limitations, conclusions, and recommendations*
- **Accreditation Report**
 - *Summarize M&S capabilities, assumptions, and limitations with regard to the intended use*
 - *Address how Acceptability Criteria were met/unmet*
 - *Provide accreditation recommendation*
- **Accreditation Decision Letter**
 - *Consists of the accreditation option with details of caveats, qualifications, constraints, and limitations for use*

Back to M&S & V&V Processes

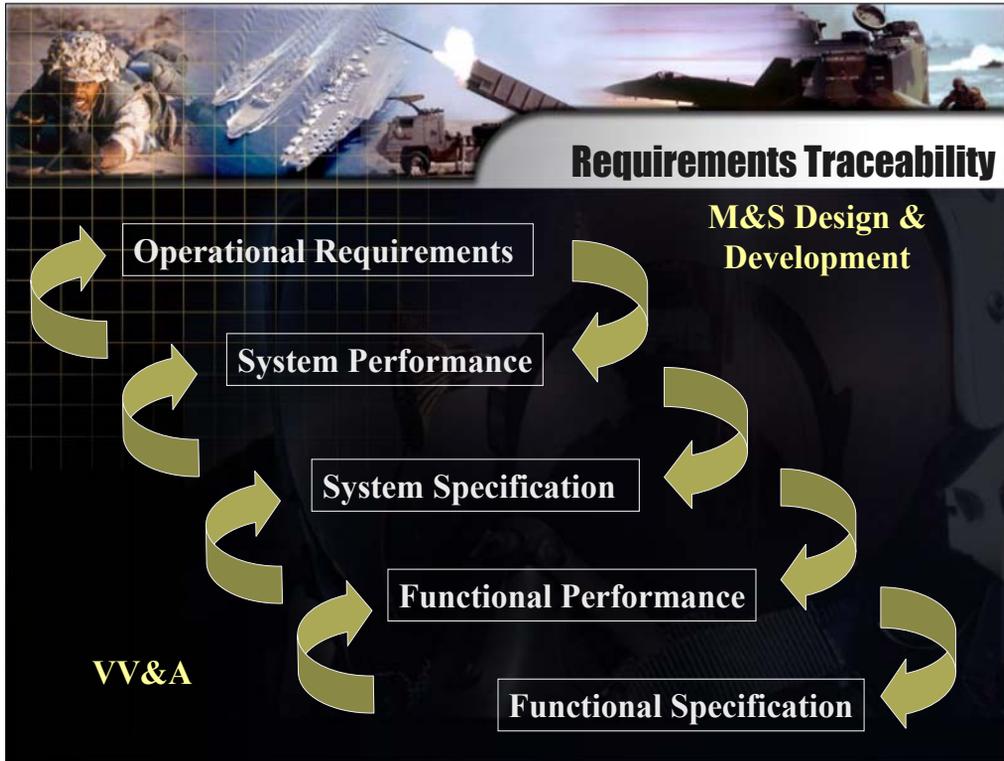
This slide is self-explanatory and I'll just let you read it for a moment.

No one, well, hardly, anyone likes to document what they do. But, the bottom line is this: If there is no VV&A documentation, then it never happened. The trick is to determine how much detail in the documentation is needed and then just capture that and no more. It isn't the thickness of the document that matters, but the information captured in it.

NAVMSMO has been working for the past few years to develop a capability to make the documentation process easier and more automated. We released version 1 of the VV&A Documentation Tool this year.

The VV&A Doc Tool guides the user through the steps necessary to complete the VV&A process. The tool is designed to aid those involved in the Navy's M&S efforts in collecting and documenting information pertaining to the VV&A of models and simulations. The concept of the tool and information contained in the tool is based on the VV&A Handbook.

VV&A Documentation Tool is organized by two main objectives, Planning and Implementation. The planning section guides the user on set up, schedule and overall planning of a VV&A, the implementation section is the area where products of the planning effort are found.



Requirements traceability as used for VV&A is defined as “The degree to which a relationship can be established between the M&S requirements, associated acceptability criteria for accreditation, and evidence collected during verification and validation implementation.”

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There are seven key roles in the VV&A process.

Depending upon the organization and the intended use of the M&S, multiple roles may be assumed by the same organization or individual.

For example, a Program Manager for an acquisition program undergoing developmental testing, may play the role of M&S Proponent, M&S User, and Accreditation Authority. The responsibilities for each role remain the same, they are just performed by or delegated by Program Manager.

Different personnel at a Navy Laboratory developing M&S for internal use, may play the roles of the M&S Proponent, M&S Developer, M&S User, Accreditation Authority, Accreditation Agent, and Subject Matter Expert.

And each player will be discussed separately. Just wanted to present their interactions in this slide.

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M&S User shall:

Plan, budget, and fund the implementation of VV&A and the use of accredited M&S.

Coordinate with the Accreditation Authority and the M&S Proponent to develop and approve the M&S requirements.

Section 5.k, draft SECNAVINST 5200.40A

The M&S User utilizes the results from a specific application of a model or simulation. In a broader sense, the M&S User is the one for whom the M&S is developed, modified, and applied **to produce results to support a decision of some sort.**

The M&S User's responsibilities in the VV&A process include the following:

- Define the problem
- Determine how to solve the problem
- Designate M&S for VV&A
- Communicate and coordinate with the other key VV&A players
- Define M&S requirements
- Accept M&S results
- Provide funding for M&S development or modification activities



Accreditation Authority shall:

Support the M&S User by determining the appropriateness of the application of a M&S for an intended use.

Assist the M&S User and the M&S Proponent with defining the M&S requirements and establish the acceptability criteria.

Develop, document, and implement the Accreditation Plan.

Ensure that adequate V&V procedures have been implemented and the results documented prior to the use of M&S capabilities.

Make and document the accreditation decision to apply a model or simulation for specific purpose.

Document accreditation summary information in the NMSIS and update the information annually. Forward copies of all accreditation documents to the NAVMSMO for archiving.

The Accreditation Authority is directly responsible for approving the use of an M&S capability for a particular application. Accreditation authorities can be resource sponsors, program executive officers, program managers, directors, or whoever else might be responsible for the decisions being supported by the M&S results.

The Accreditation Authority is usually, but not always, a senior level member in the M&S User's organization. The primary function of the Accreditation Authority is to decide whether or not a model or simulation can be applied to a specific intended



- **The organization that has primary responsibility to initiate planning, development, configuration management, maintenance, and use of an M&S.**

[Back to Role Relationships](#)

M&S Proponent shall:

Plan and budget for implementation of V&V.

Follow M&S directives and policies.

Develop, document, and implement the V&V and configuration management plans for M&S undergoing accreditation.

Coordinate and communicate with the M&S User and the Accreditation Authority. Coordinate with the DoD-appointed M&S Executive Agents that serve as the final validation authority for environmental, threat, and intelligence process representations.

Document V&V summary information in the NMSIS and update the information annually. Forward copies of all V&V documents to the NAVMSMO for archiving.

Section 5.j, draft SECNAVINST 5200.40A

The M&S Proponent works with the M&S User and Accreditation Authority.

The M&S Proponent hires the V&V Agent and provides the



M&S Developer

- **The individual, group or organization responsible for developing or modifying a simulation in accordance with a set of design requirements and specifications.**

Back to Role Relationships

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Accreditation Agent

- **The individual, group, or organization designated by the Accreditation Authority to conduct an accreditation assessment for an M&S.**
 - *Plan, manage, conduct, and document the accreditation assessment*
 - *Coordinate with other key VV&A players*
 - *Develop an accreditation recommendation for the Accreditation Authority*

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V&V Agent

- **The individual, group, or organization designated by the M&S Proponent to verify and validate an M&S.**
 - *Plan, manage, conduct, and document the V&V of the M&S*
 - *Coordinate with other key VV&A players*

Back to Role Relationships

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Subject Matter Expert

- **An individual who, by virtue of education, training, or experience, has expertise in a particular technical or operational discipline, system, or process.**
 - *Assist with defining M&S requirements for the intended use*
 - *Assist with accreditation planning and assessment*
 - *Assist with V&V planning and V&V implementation*

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V&A Roles & Responsibilities

	M&S User	Accred. Authority	Accred. Agent	M&S Proponent	V&V Agent	M&S Developer	SME
Define M&S Requirements	Lead/Approve	Review	Assist	Review	Assist	Assist	Assist
Acceptability Criteria	Assist	Approve	Lead	Review	Assist	Assist	Assist
Accreditation Plan	Review	Approve	Lead	Monitor	Review	Review	Assist
V&V Plan	Review	Monitor	Review	Approve	Lead	Review	Assist
V&V Implementation	Review	Monitor	Monitor	Approve	Lead	Assist	Assist
V&V Data	Review	Monitor	Monitor	Approve	Lead	Assist	Assist
V&V Report	Review	Monitor	Monitor	Approve	Perform		Assist
Accreditation Package				Approve	Perform	Assist	
Accreditation Assessment	Monitor	Monitor	Lead				Assist
Accreditation Report	Review	Approve	Perform				Assist
Accreditation Decision	Review	Perform	Assist				
VV&A Archive & M&S Catalog	Perform	Perform		Perform			
Accredit For Reuse	Review	Approve	Lead	Assist	Assist	Assist	Assist
Accreditation Status	Perform						

Responsibilities are divided into six categories: lead, perform, assist, monitor, review, and approve.

The definitions of each of these responsibilities are provided below.

- Lead – Leads the task; normally involves active participation from others.
- Perform – Does the task; normally requires little active participation from others.
- Assist – Participates actively in the task (e.g., conducts tests, provides information).
- Monitor – Oversees the task but does not normally participate.
- Review - Reviews results of the task and provides recommendations.
- Approve – Decides when the task is satisfactorily completed and another can begin; determines what task should be pursued next.

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Summary

- **VV&A is continuous process improvement to ensure credibility of an M&S**
- **It must be tailored for program specific needs**
- **VV&A ensures quality of M&S**

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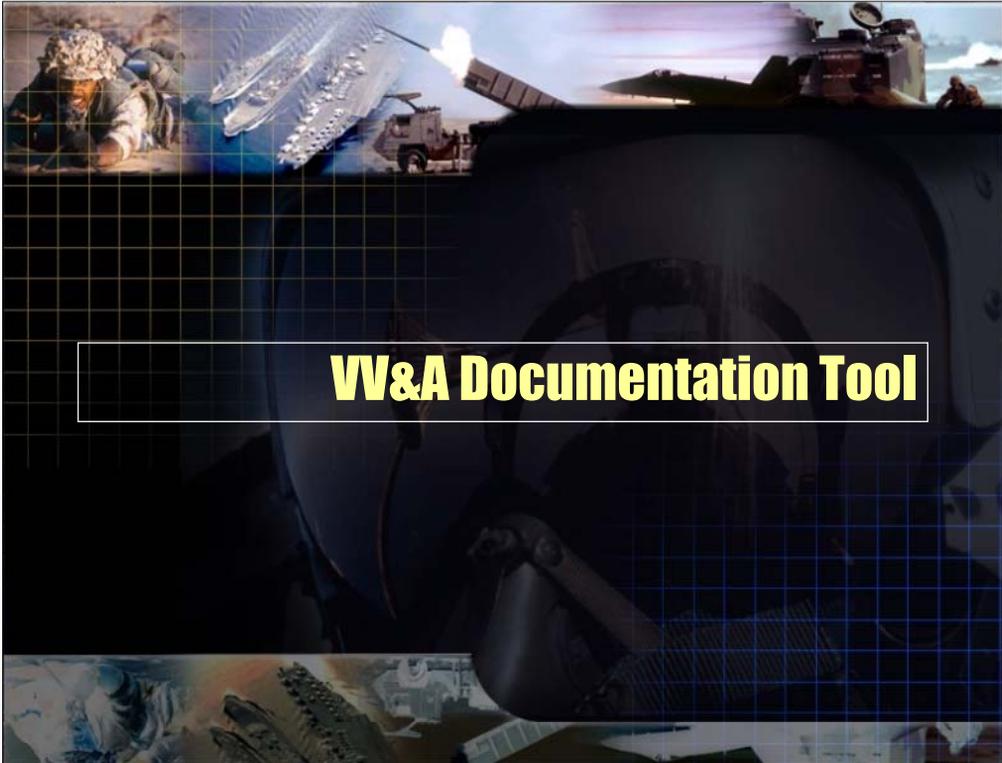
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