

Army Modeling and Simulation Policy and Guidance

Army-Navy VV&A TWG Meeting

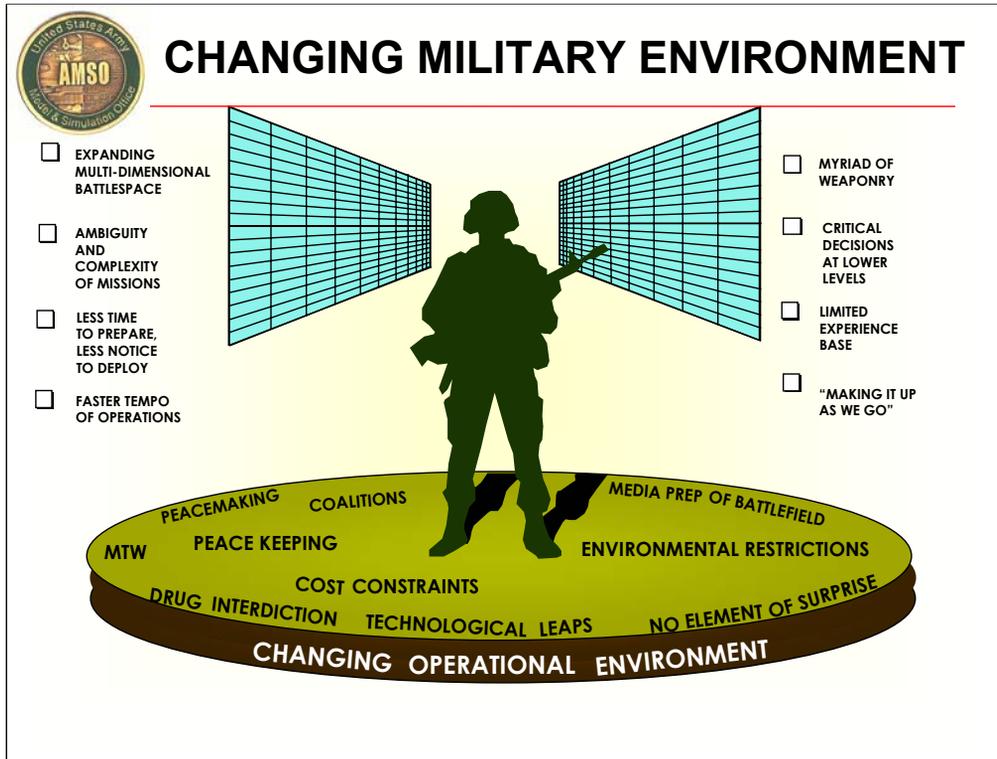
14-15 November 2001

Army Model & Simulation Office

Agenda



- **Why is M&S important?**
- **Who is AMSO?**
- **What is the Army M&S strategy?**
- **What are the Army M&S policies and guidance?**
- **What are some key points in AR 5-11?**
- **What are some key points in DA Pam 5-11?**
- **What is SMART?**



EVERY SUCCESSFUL ARMY HAS BEEN ABLE TO ADAPT TO CHANGING MILITARY AND OPERATIONAL ENVIRONMENTS.

THIS SLIDE DEPICTS SOME OF THE FACTORS WHICH OUR SOLDIERS AND LEADERS MUST ADAPT TO...WHAT IS ON A COMMANDERS MIND (LEFT AND RIGHT OF THE HEAD) AND THE CONDITIONS HE IS LIKELY TO FIND HIMSELF IN (BELOW THE FEET)

MORE THAT EVER SOLDIERS MUST APPLY THE RIGHT FORCE AT JUST THE RIGHT TIME AND BE RESPONSIBLE FOR ALL OF THE CONSEQUENCES

THESE SKILLS MUST BE HONED IN TRAINING ENVIRONMENTS THAT CHALLENGE THE SOLDIERS ABILITY TO PERFORM IN AMBIGUOUS AND COMPLEX CONDITIONS.

AT DCSOPS WE RECOGNIZE THAT TRAINING TIME IS A VALUED COMMODITY, NOT FROM A BEAN COUNTING OPTEMPO PERSPECTIVE BUT FROM OUR RECENT EXPERIENCES IN HAITI, AND BOSNIA WHICH SHOW THAT WE MUST TRAIN ON THE FLY....AND MAKE IT UP AS WE GO BECAUSE THE HOW-TO BOOKS HAVEN'T BEEN WRITTEN YET... (NOTE: LESS TIME TO PREPARE/LESS TIME TO DEPLOY.....MAKE IT UP AS WE GO).

U. S. Army Modeling & Simulation Bottom Line Up Front



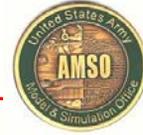
- ▶ **ARMY IS INCREASINGLY RELIANT ON M&S**
 - Increasing importance to training
 - Increasing importance for concept exploration
 - Increasing importance in materiel development programs

- ▶ **However: State-of-the-Art limits being pushed**
 - Inadequate modeling for emerging major mission areas and for high definition system modeling
 - OJT trained workforce
 - M&S systems still cost too much
 - Interoperability still a mystery
 - Cross-Domain Integration Necessitates a Cultural Change



Policy is key and it must be well coordinated and integrated.

AMSO Charter



Purpose for AMSO:

The CSA identified a lack of strategic-level focus and synchronization for the Army's efforts in models and simulations.

ADCSOPS directed AMSO to:

- **Specifically, monitor/influence activities across all domains to preclude duplication of effort and wasted resources.**
- **Prioritize major M&S thrusts across the domains, and to derive a sound investment strategy to achieve the coordinated needs of the synthetic battlefield.**
- **Monitor all programming and budgeting activities dealing with M&S to help synchronize efficient allocation of resources.**

Army Model and Simulation Office



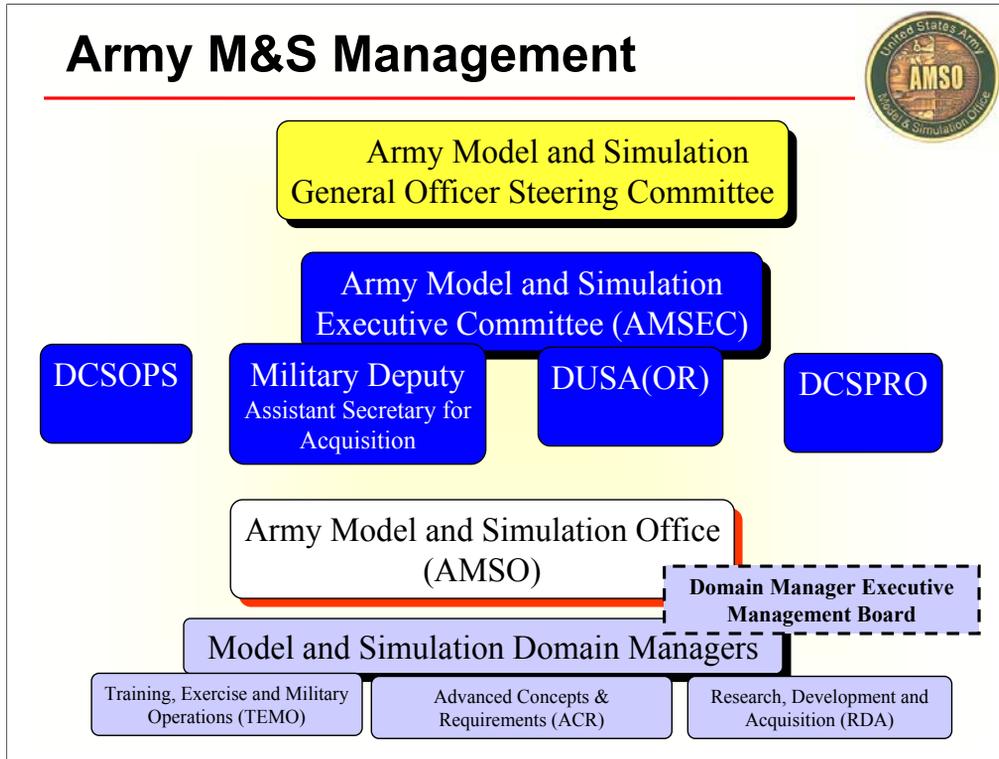
Mission Statement

In support of the Army - its mission and soldiers – the Army Model and Simulation Office (AMSO) provides the **vision, strategy, oversight, and management** of Models and Simulations (M&S) across all M&S domains.

Core Competencies

- **Develop and promulgate the Army's ;**
- Ensures the **integration of M&S** across Army M&S domains
- Assist senior leaders in properly **resourcing** Army M&S programs;
- **Foster reuse** and development of common M&S components and tools;
- Act as **focal point for Army M&S matters** with the Joint Staff, CINCs, DARPA, DMSO, Services, DoD Agencies and OSD staff elements;
- **Promote** the Army's **M&S research** program.
- Executive agent for Simulation & Modeling for Acquisition, Requirements and Training (**SMART**)
- Establish and Execute **Functional Area 57** Proponency

Army M&S Management



AMS GOSC--Army Model and Simulation General Officer Steering Council

AMSEC--Army Model and Simulation Executive Council

ASWG--Advanced Simulation Working Group

RIWG--Requirements Integration Working Group

AMSMP WG--Army Model and Simulation Management Program Working Group

TEMO--Training, Exercises, Military Operations

ACR--Advanced Concepts Requirements

RDA--Research, Development, and Acquisition

SCC--Standard Categories Coordinator

AMS GOSC Members:

Co-Chaired by: VCSA and AAE

DUSA(OR)

DISC4

DAS(R&T)

DCSOPS

DCSINT

DCG TRADOC

AMSEC Members:

Co-Chaired by: DCSOPS and DUSA(OR)

ASA(RDA)

DCSINT

ADO

OPTEC

AMC

FORSCOM

USAREUR

AWC

ASA(FM&C)

DCSPER

PAED

COE

SSDC

USARPAC

USARSO

DISC4

DCSLOG

USACAA

TRADOC

USAISC

EUSA

USASOC

HQDA Modeling & Simulation Management



SECRETARIAT

Deputy Under
Secretary
of the Army (OR)

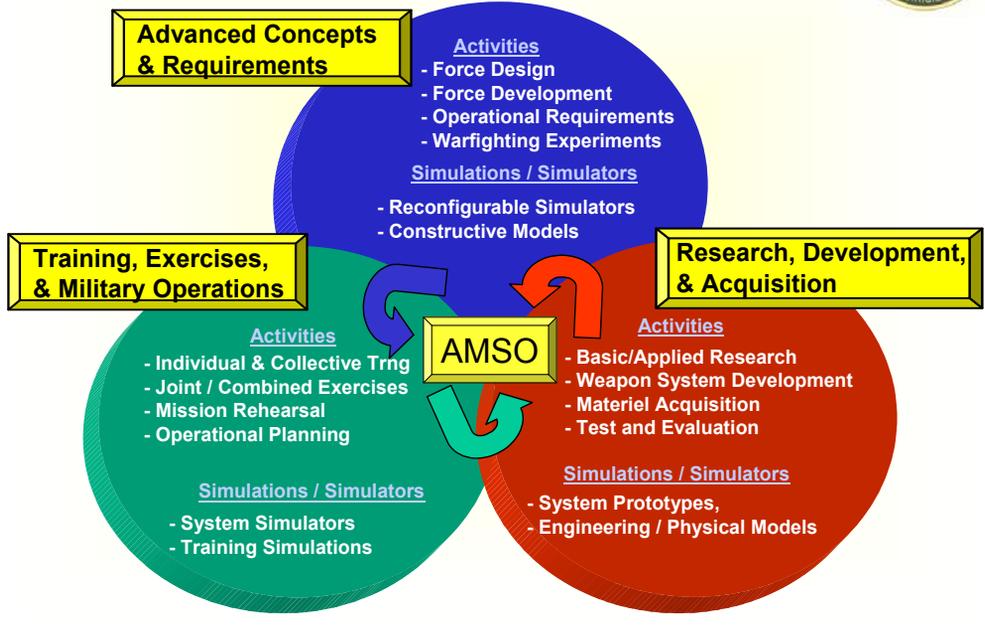


ARMY STAFF

Deputy
Chief of Staff
for
Operations & Plans

Army Model & Simulation Office

Army M&S Domain Structure



Army M&S Policy...



...shall be responsive to the dynamic M&S environment and will develop and maintain required M&S guidance, ensuring that it is integrated and synchronized into appropriate Army directives and publications. Further, shall ensure Service M&S guidance requirements are coordinated in the development of DoD and Joint directives and publications.

U. S. Army M&S Strategic Direction



Integrating the Community

- Fully Integrated Across ACR, RDA and TEMO Domains
- Fully Integrated with External Army M&S Activates

Advancing the Capability

- Concept to Full Mission Ready Without Leaving The Computer
- Full Integrated Live-Virtual-Constructive Operating Environment

Institutionalizing the Process

- Providing Vision, **Policy**, Resources, and Standard Products
- Providing for a Skilled Workforce

Institutionalizing the Process



➤ People

- **Professional Certification for M&S Professionals**
- **University Undergraduate/Graduate M&S Programs**
- **DoD Training**
- **U.S. Military Academy M&S Chair**

➤ Processes

- **Standard Practices Manual**
- **Standard Algorithms**
- **Integrating the DoD and commercial business practices**
- **SMART Lessons learned**

Army M&S Guidance

AR 5-11
MANAGEMENT
OF ARMY
MODELS AND
SIMULATIONS

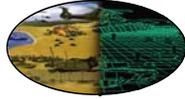
DA PAM 5-11
Management
Verification,
Validation,
and
Accreditation
of Army
Models and
Simulations

Policy

The Army
Model and Simulation
Master Plan

U. S. Army
Modeling & Simulation
Science & Technology
Master Plan

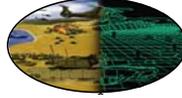
U. S. Army
Modeling & Simulation



**Investment
Plan**

Practice

U. S. Army
Modeling & Simulation



**Domain
Management
Plans**



PLANNING
GUIDELINES
FOR
SIMULATIONS AND
MODELS
FOR ACQUISITION,
REQUIREMENTS AND
TRAINING

Army's SSP

**Program
Management**

- SMART Execution Plan
- Transformation M&S Best Practices
- High Level Architecture (HLA) Policy
- Standard Algorithm Compendium

M&S Guidance Documents



DoD

2000 Oct	DoDD 5000.1	Defense Acquisition
1995 Oct	DoDD 5000.59-P	Modeling and Simulations Master Plan
2001 Jan	DoD 5000.2-R	MDEPS & MAIS Acquisition Programs
Being Staffed	DoDI 5000.61	DoD M&S VV&A
2000 May	DoD	DMSO - VV&A Recommended Practices Guide

ARMY

1997 July	AR 5-11	Management of Army Models and Simulations
1999 Sep	DA Pam 5-11	VV&A of Army Models and Simulations
1997 Oct		Army M&S Master Plan
1998 Oct		Army M&S Standards Report FY 99
2000 April		Guidelines: Use of M&S to Support T&E
2000 Nov		SMART Execution Plan
2000 Sep		Planning Guideline for SMART (Army's SSP)
TBD	DA Memo 5-11	Army HLA Implementation Procedures
1998 May	TECOM 73-4	Test & Evaluation M&S VV&A Methodology
1998 Nov	TR 5-11	TRADOC M&S Data Management

Army Regulation 5-11



AR 5-11

MANAGEMENT OF ARMY MODELS AND SIMULATIONS

UNCLASSIFIED

AR 5-11, Management of Army Models and Simulations

In General: This document is the Army's regulatory guidance governing the development, acquisition and use of models and simulations (M&S). Responsibilities of Headquarter Department of the Army (HQ DA) Staff are outlined, as well as the execution of M&S management through domain managers and agents. Establishes the roles of the Army Model and Simulation Office (AMSO), Army Model and Simulation General Officer Steering Committee (AMS GOSC) and the Army Model and Simulation Executive Council (AMSEC). Provides guidance for the Army M&S Management Program, Configuration Management, Data Management, M&S Release, Verification, Validation and Accreditation (VV&A), and M&S Life Cycle Management.

Date of last published document: 10 July 1997

AR 5-11, Table of Contents

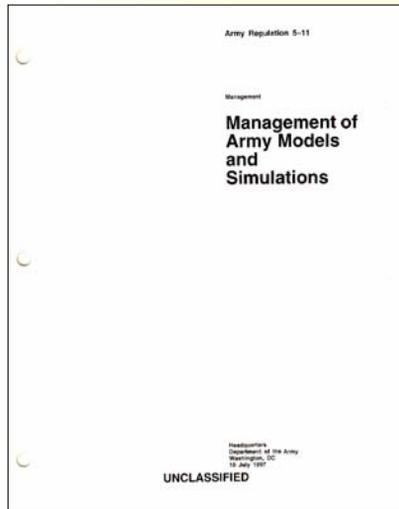
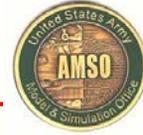
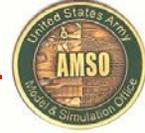


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- Chapter 2 - Concept and Execution
M&S Management in the Army
- Chapter 3 - General Policy
Guidance
- Chapter 4 - Army Model and
Simulation Management Program
- Chapter 5 - Verification,
Validation, and Accreditation
- Chapter 6 - Configuration
Management
- Chapter 7 - Data Management
- Chapter 8 - Model and Simulation
Release

AR 5-11: Some Key Points on VV&A



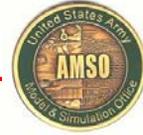
AR 5-11

MANAGEMENT OF ARMY MODELS AND SIMULATIONS

UNCLASSIFIED

- Army established VV&A policy in 1992
- Supports DoDD 5000.59 and DoDI 5000.61
- AMSO is the Army's focal point for VV&A
- Accreditation of an Army model is subject to the approval of the AMSEC
- VV&A will be accomplished in concert with and as part of , the overall configuration management of each M&S
- VV&A activities shall include a simulation support plan
- VV&A plans and reports shall be completed according to the details in DA PAM 5-11
- M&S proponent shall enter and maintain VV&A history information in the Army's MSRR

Department of Army Pamphlet 5-11



DA PAM 5-11

Management

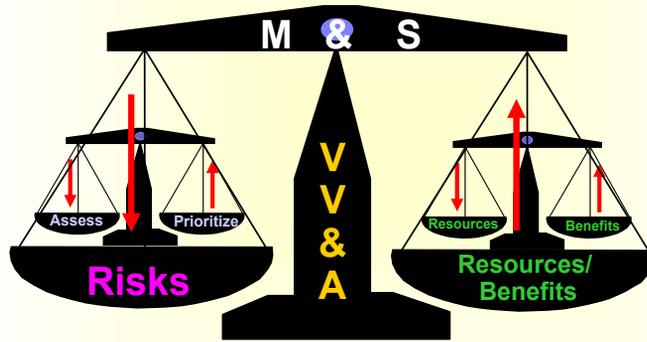
**Verification,
Validation, and
Accreditation
of Army
Models and
Simulations**

DA PAM 5-11, Verification, Validation and Accreditation of Army Models and Simulations.

In General: This pamphlet gives procedures for the "Management of Army Models and Simulations" (AR 5-11). The objective of this pamphlet is to assist the models and simulations (M&S) developer, proponent, and application sponsor in conforming to the verification, validation, and accreditation (VV&A) policies prescribed in AR 5-11. This pamphlet provides guidance for the development, execution, and reporting of all VV&A activities. This pamphlet also addresses data V&V and accreditation in reference to proper M&S use.

Date of last published document: 30 September 1999

What is all the fuss about?



“Establishing M&S Credibility”

VV&A is mandated documented in DoDD 5000.59-P, “Models and Simulations Master Plan”, 1994

Establishing M&S Credibility

is a VV&A function

balancing risks and (resources and benefits)



**VV&A is not
a rubber stamp**



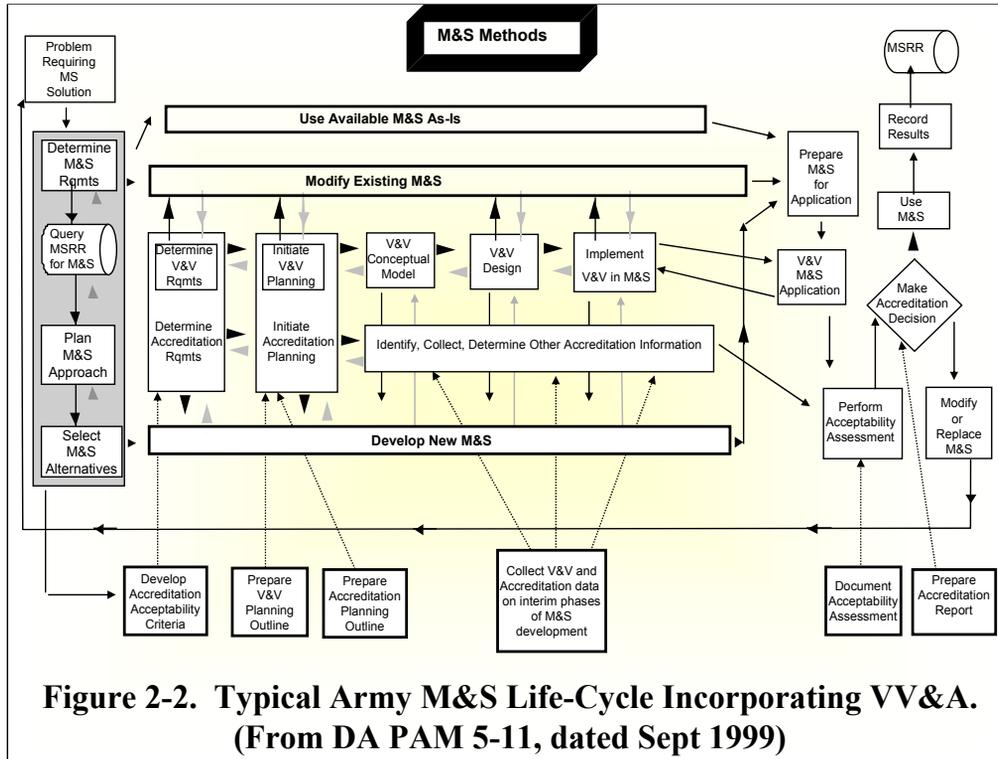
**Nor is VV&A a
check on a list**

**VV&A IS an
iterative process**

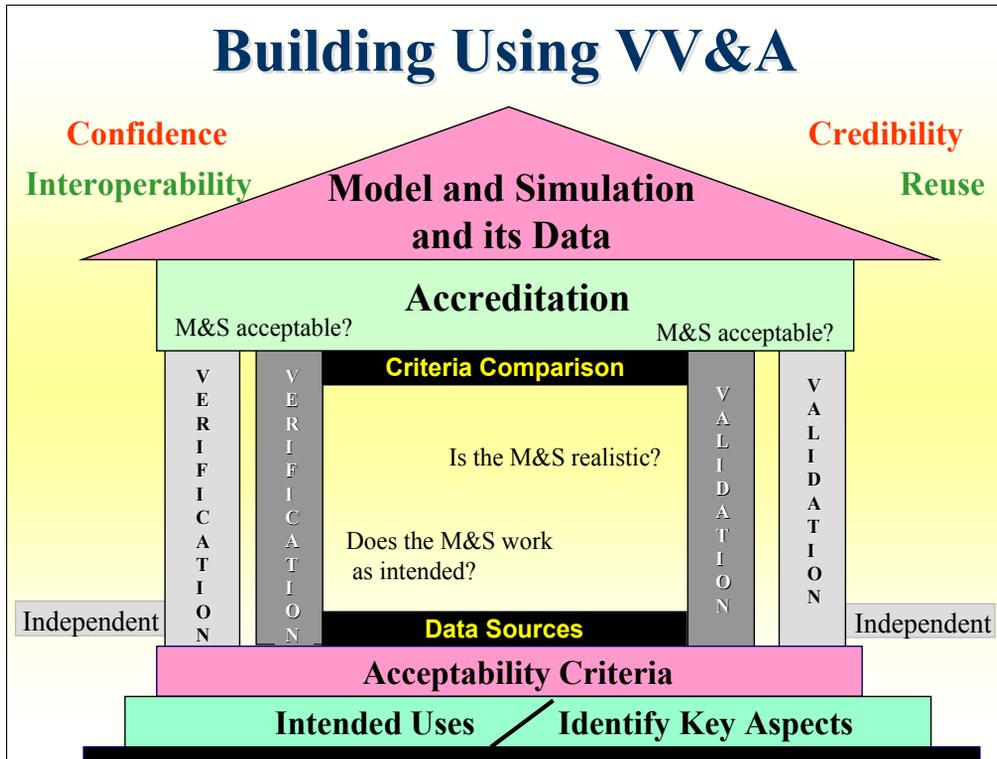


**End-to-End
Developer and User
Communication!!!**

Utilizing SMEs as needed



**Figure 2-2. Typical Army M&S Life-Cycle Incorporating VV&A.
(From DA PAM 5-11, dated Sept 1999)**



VV&A is a 3-phased process which begins after the purpose has been established

- Accreditation -- preparation
- Verification and Validation -- collection information and testing
- Accreditation -- evaluation

Checklist for VV&A of M&S



Step	Life Cycle Management of M&S	VV&A Action	VV&A Results
1	- Define problem - Determine requirements - Query MSRR for M&S and - Determine approach	- Develop Accreditation Acceptability Criteria	- Accreditation Acceptability Criteria Document
2	- Use M&S meeting requirements		
2.a	- Use Available M&S "As-Is"		
2.b	- Modify Existing M&S or - Develop New M&S		
2.b.1	- Determine modification requirements or - Determine M&S requirements	- Determine V&V requirements - Determine Accreditation requirements	
2.b.2	- Plan modifications or - Plan M&S development	- Initiate V&V planning - Prepare V&V planning outline - Initiate Accreditation planning - Prepare Accreditation planning outline	- V&V Plan - Accreditation Plan
2.b.3	- Modify conceptual model (<i>if it exists</i>) or - Develop conceptual model	- V&V conceptual model - Identify, collect and determine other Accreditation information - Collect V&V and Accreditation data on interim phases of M&S development	
2.b.4	- Develop and Test M&S modifications design or - Develop and Test M&S design	- V&V test design - Identify, collect and determine other Accreditation information - Collect V&V and Accreditation data on interim phases of M&S development	
2.b.5	- Implement and Test M&S modifications or - Implement and Test New M&S and - Post development Software Support	- Implement V&V in M&S - Identify, collect and determine other Accreditation information - Collect V&V and Accreditation data on interim phases of M&S development	- V&V Report
3	Prepare M&S for application	- V&V M&S Application - Perform Acceptability Assessment - Document Acceptability Assessment findings	
4	Execute M&S	- Make accreditation decision	- Accreditation Report
5	Integrate Results		
6	Present and record results		
7	Document results in MSRR		

DA Pam 5-11, VV&A M&S T&E Bottom line



DA PAM 5-11

Management

Verification,
Validation, and
Accreditation
of Army
Models and
Simulations

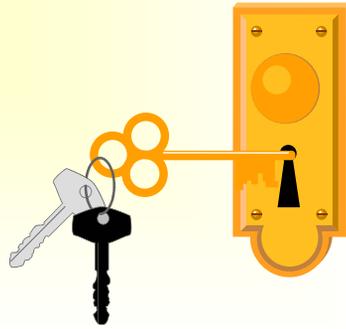
- VV&A is a value added function
 - “risk reduction” tool
 - provides an audit trail
- VV&A begins when M&S concept development begins
- Brings all the stakeholders together
 - communication from cradle to grave
 - helps to identify all input and output requirements and products

M&S involved with T&E must be ACCREDITED!

Army-Navy VV&A TWG MTG– Nov 2001

This means all M&S!!!

Keys to Conduct A Successful M&S VV&A





Keys To Conduct A Successful M&S VV&A



- 1** VV&A should be involved at the beginning of the M&S planning and preparation stage.
 - Easier to capture data while going through the process
 - Sets precedent for configuration management and what data should be captured, how it should be and evaluated



- 2** Realize some verification and validation activities are conducted on M&S, though not captured.
 - Information may or may not exist as expected
 - Need to identify where, then go back and capture it



- 3** Know how to accredit, which means understand the process.
 - Understand the official DoD definitions involved with VV&A
 - Relate this to the M&S and the resulting implications
 - Rqts, attributes, deficiencies, work-arounds, risks, constraints





Keys To Conduct A Successful M&S VV&A



- 4. Understand the problem clearly.**
 - Determine accreditation requirements - essential
 - Conduct impact and risk assessments
 - Think about what needs to be represented
 - Think about how it should be represented
- 5. Derive M&S requirements.**
 - Priorities help identify most critical V&V tasks
 - Basis for model selection and accreditation
 - Keep a record or log of the uses
- 6. Tailor accreditation requirements.**
 - Foundation for V&V planning
 - Tailor by risk assessment
 - Tailor by what is already known

**Sample
Documentation Outlines**

Sample Accreditation Plan Format

- a. Background**
- b. Accreditation responsibilities**
- c. Schedules, milestones, and resources**
- d. Intended uses of the M&S**
- e. Information sources**
- f. Acceptability criteria**
- g. Proposed accreditation methodology**

Source: DA PAM 5-11, Appendix H, dated Sept 1999

Sample Acceptability Criteria

- The levels of force structure and interaction have sufficient fidelity and resolution.
- **The M&S is suitable for the overall intended use (e.g., training, explanatory, predictive).**
- The M&S output/results may be used clearly, adequately and appropriately to address the problem.
- **The CM policy is in effect and responsive to the anticipated needs of the M&S users.**
- All required data values are well defined and data sources for obtaining accredited data have been identified.
- **The M&S runs may be accomplished and results analyzed within the project timelines. Excessive run time, however, does not discredit the appropriateness of the M&S for the problem or class of problems being addressed. (NOTE: This acceptability criterion should not use terms such as "fast", etc. Terms should be explicit in nature, e.g., "overnight", etc.)**
- There is availability of baseline scenarios, terrain data, threat data, and weapon performance data for the M&S.
- **The algorithms, terrain and environment representations are functionally adequate to address the issues.**
- The clarity, fidelity, complexity and level of detail of the simulated entities are acceptable for its intended usage.
- **The documentation, user training, and user help are adequate.**
- The M&S stability has been investigated and found acceptable for the hardware and software platforms, which will be utilized.
- M&S demonstrate appropriate sensitivity to data perturbations and response at boundary (limiting value) cases.

Source: DA PAM 5-11, Appendix H, dated Sept 1999

Acceptability Criteria

Will this M&S meet my objectives for this specific use?

- Establishes the M&S's success and failure criteria
- Sets standards by which M&S can be accredited for this specific use (failure to minimum to maximum)

Focuses and sets V&V efforts

Sample Format for a V&V Plan

- a. Purpose.
- b. Background.
 - 1-General M&S description.
 - 2-Configuration management procedures.
 - 3-Identification of agencies.
- c. V&V responsibilities.
- d. Intended uses of the M&S.
- e. Information sources.
 - 1-M&S documentation.
 - 2-M&S developers.
 - 3-SMEs.
 - 4-Identification of comparison data.
 - 5-Previous V&V.
- f. Verification plan
 - 1-Methodology design.
 - 2-Tasks and milestones.
 - 3-Report procedures and deliverables.
- g. Validation plan.
 - 1-Methodology design.
 - 2-Evaluation criteria.
 - 3-Tasks and milestones.
 - 4-Report procedures and deliverables.
- h. Required resources tied to V&V methodologies.
- i. Appendices.

Source: DA PAM 5-11, Appendix F, dated Sept 1999

The V&V Plan is Road map outlining:

- general descriptions
- management procedures
- information sources
- detailed tasks and activities
- design
- schedule
- evaluation criteria
- deliverables

This is based on Verification and Validation:

Verification

Does the M&S work as intended for this specific use?

- Correct design, code and logic
- Functions perform accurately
- Exhibits correct behavior
- Achieves necessary fidelity

Builds confidence in the structural integrity and quality of the M&S

Validation

Is the M&S realistic?

- Determine the degree that M&S represents the real world for this specific use; is it “Good Enough?”

Cornerstone on which the M&S’s credibility is built

Sample Format for a V&V Report

- a. Executive summary of the V&V results
- b. Overview of the V&V plan
- c. Description of the verification process and/or tests
 1. Logic verification
 2. Code verification
 3. Unresolved issues
- d. Description of the validation process and/or tests
 1. Evaluation criteria
 2. Structural validation
 3. Output validation
 4. Unresolved issues
- e. Identified assumptions, constraints and limitations
- f. Planned & accomplished V&V activities
- g. References/attachments
- h. Appendices.

Source: DA PAM 5-11, Appendix G, dated Sept 1999

The V&V Report is to Objectively document the V&V process:

- **Strengths & Accomplishments**
- **Weaknesses**
- **Limitations/constraints**
- **Addresses differences from the
V&V plan**

Sample Accreditation Report Format

a. Executive summary

b. Accreditation Assessment

1) Accreditation results and recommendations

2) List accreditation limitations for class of use

c. Acceptability criteria

List the criteria used for the basis of the accreditation decision.

Source: DA PAM 5-11, Appendix I, dated Sept 1999

Accreditation Report should address

Is this M&S acceptable or suitable for this specific use?

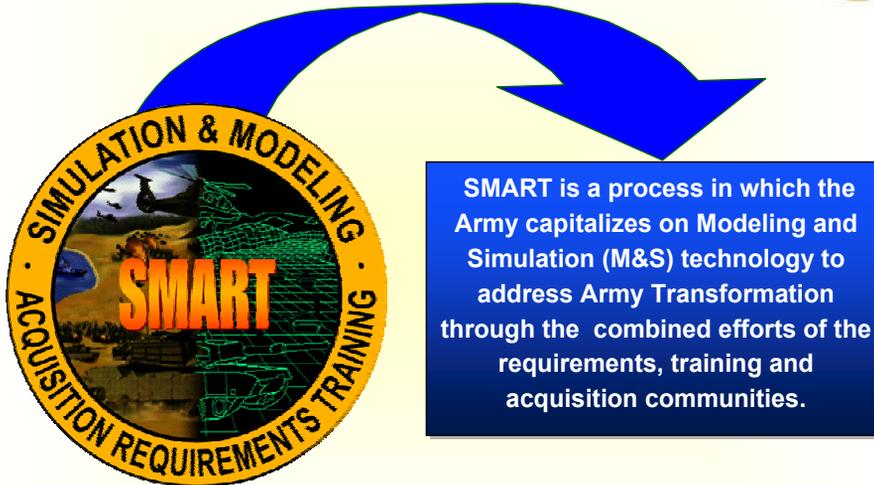
Based on properly performed and documented V&V, which is then compared to the acceptability criteria

Army V&V and Accreditation Responsibilities

	M&S Sponsor	M&S Developer	Accreditation Action Officer
V&V Plan	Responsible	Assists	Aware / <u>Assist</u>
Verification	Responsible	Performs	Use
Validation	Responsible	Assists	Use / Assist
V&V Documentation	Responsible	Assists	Awareness
Accreditation Plan	Assists	Assists	Responsible
Accreditation	Assists	Assists	Responsible
Accreditation Request	Assists	Assists	Responsible

For a description of the VV&A responsibilities by role
Go to Table 2-1 in DA PAM 5-11 dated September 1999.

SMART Initiative



Purpose is to build an information age infrastructure to enable Army Transformation.

Army-Navy VV&A TWG MTG – Nov 2001

SMART is an ARMY BUSINESS PROCESS

- Not just an acquisition initiative
- Impacts all Army functions

SMART CHANGES THE ARMY CULTURE

TIES TOGETHER THE REQUIREMENTS, ACQUISITION/LOGISTICS, TEST, AND TRAINING COMMUNITIES

REDUCES THE CONCEPT TO FIELDING TIME

REDUCES LIFE CYCLE COST

STRONG COLLABORATIVE ENVIRONMENT

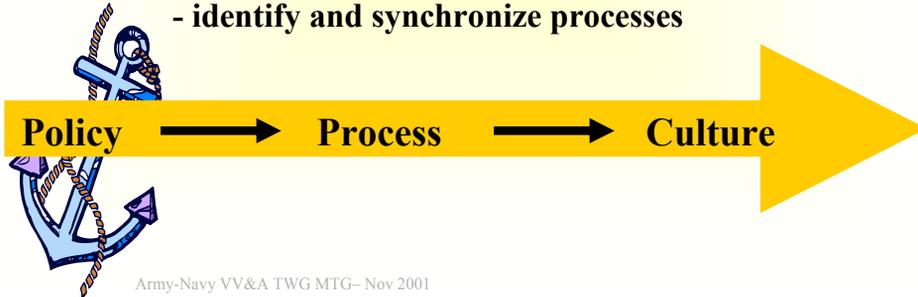
Impact of SMART on Army



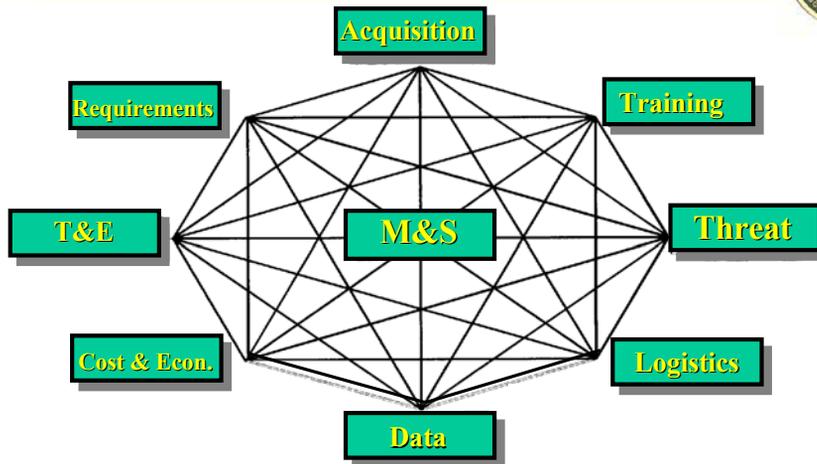
Goal: Formalize the role of M&S in the requirement, acquisition and training processes.

How: Define system relationship from cradle to grave through M&S

- emphasizing integration and interoperability
- establish and show M&S links and correlation
- identify and synchronize processes

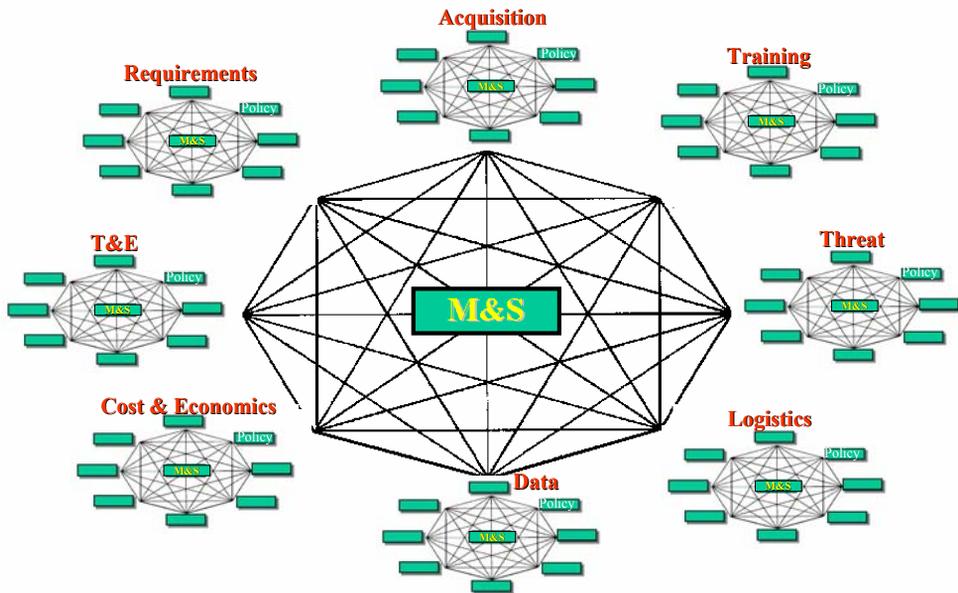


Sample SMART Global View

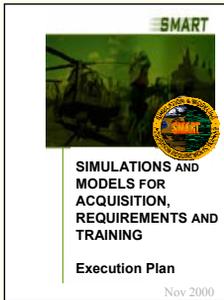


More nodes could be included in this network, such as military operations, personnel, contracts, C4I, RD&E, etc., it just depends on the needs of the infrastructure built.

Expanded SMART Global View of Sample



SMART Execution Plan



➤ Objective 1-1:
“... modify policies to effectively leverage M&S and synchronize efforts of the requirements, training and operations, acquisition, and fielding communities to reduce duplication of effort.”

➤ 10 policy tasks associated with this objective.

SMART Conference – Building A Culture



M&S Life Cycle
(Training & Rehearsal)

M&S Life Cycle
(Operational Analysis)

M&S Life Cycle
(Cost)

Partnership
(NASA)

Education
(USMA)

16-19 April 2001 Orlando, FL



M&S Life Cycle
(Test & Evaluation)

M&S Life Cycle
(Logistics)

M&S Life Cycle
Technical Engineering

Partnership
Partnership
(DOT)

Education
Education
(DSMC)

April 2002 Salt Lake City, UT



M&S Life Cycle
M&S Life Cycle
(Deployability)

M&S Life Cycle
M&S Life Cycle
(Personnel Assessment)

M&S Life Cycle
M&S Life Cycle
(Risk)

Partnership
Partnership
Partnership
(Industry)

Education
Education
Education
(ALMC)

April 2003 San Antonio, TX (Tentative)



M&S Life Cycle
M&S Life Cycle
(Training & Rehearsal)

M&S Life Cycle
M&S Life Cycle
(Operational Analysis)

M&S Life Cycle
M&S Life Cycle
(Test & Evaluation)

Partnership
Partnership
Partnership
(DOE)

Education
Education
Education
Education
(War College)

April 2004 New Orleans, LA (Tentative)



M&S Life Cycle
M&S Life Cycle
(Logistics)

M&S Life Cycle
M&S Life Cycle
Technical Engineering

M&S Life Cycle
M&S Life Cycle
(Cost)

Partnership
Partnership
Partnership
Partnership
(JOINT)

Education
Education
Education
Education
Education
(CGSC)

April 2005 Seattle, WA (Tentative)

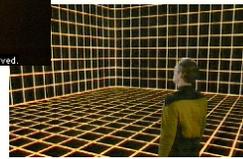
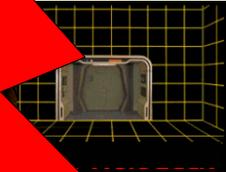
Parting
Shot

Virtual Prototyping

Bringing



We've got to
Make This a Reality,
NOT JUST A VISION
Thus **VV&A of M&S**
IS ESSENTIAL!!!



Serious
It Is The Essence of Innovation

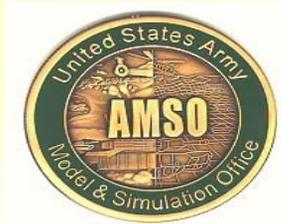
Debra C. Ridgeway

Army Model & Simulation Office

Policy and Technology Division

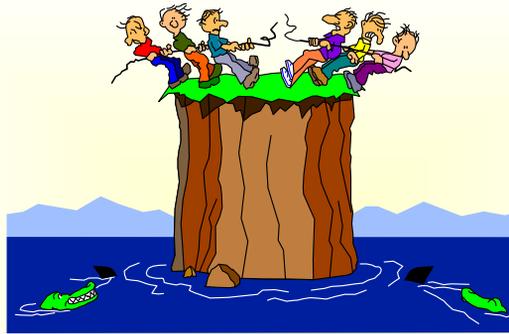
AMSO website

<http://www.amso.army.mil>



Disparity Island

Don't put yourselves on Disparity Island!



Oh boy, dinner!

Yeah, somebody didn't verify some units,
another didn't val...

Who cares?

Yeah, we get to bite their dust
'cause in VV&A they didn't spend the bucks.