Effective Face Validation Methodology to Evaluate Simulation for Training

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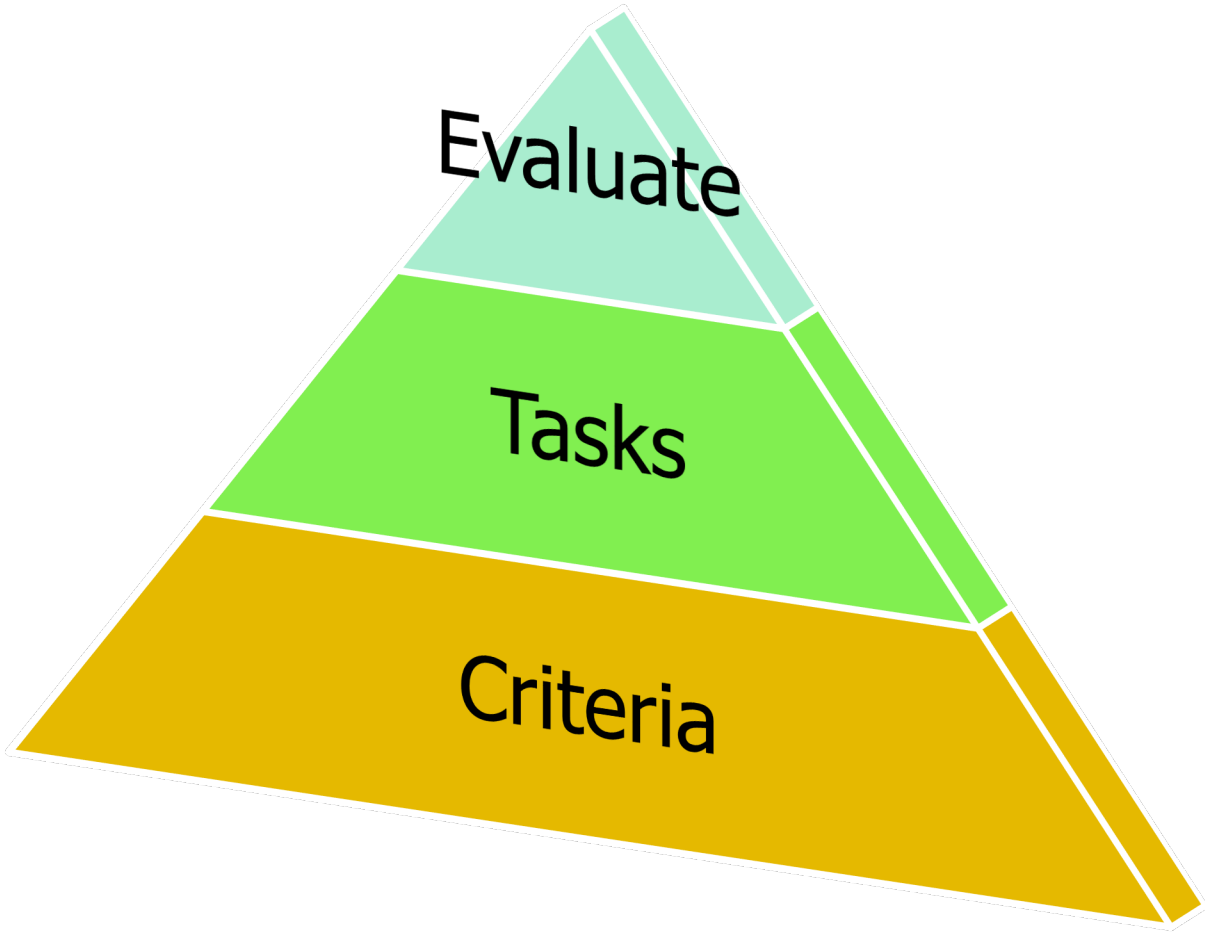
Learning Objectives

1. Understand what is face validation.
2. Determine evaluation criteria for simulation validation.
3. How to create a highly effective task list for validation.
4. Evaluation of results to determine simulation fidelity and capabilities.



Tutorial Guide - 10-Step Learning Path

1. Introduction to Verification and Validation (V&V)?
2. Why is V&V important for training systems?
3. What is the difference between V&V and a training effectiveness evaluation?
4. Introduction to roles and responsibilities
5. What is face validation?
6. Establishing face validation requirements
7. Methodology for creating effective tasks lists for face validation efforts
8. Methodology for evaluating fidelity critical to tasks
9. Selecting the right Subject Matter Experts (SMEs)
10. What to do with face validation results

Introduction to Verification and Validation

Taxonomy

Verification: The process of determining that a model implementation and its associated data accurately represent the developer's conceptual description and specifications.

Validation: The process of determining the degree to which a model and its associated data provide an accurate representation of the real world from the perspective of the intended uses of the model.

Accreditation: The official certification that a model, simulation, or federation of models and simulations and its associated data is acceptable for use for a specific purpose.

Telford, B. 2012. *Marine Corps Verification, Validation, and Accreditation (VV&A) Best Practices Guide*

Simplified Terms

Verification – Did I build the thing right?

Validation – Did I build the right thing?

Accreditation – Should it be used?

Telford, B. 2012. *Marine Corps Verification, Validation, and Accreditation (VV&A) Best Practices Guide*

Why is V&V important for training systems?

Steps Leading to Validation

Verify M&S Requirements – confirming that the requirements for the simulation match those needed for the current problem, and are correct, consistent, clear, and complete.

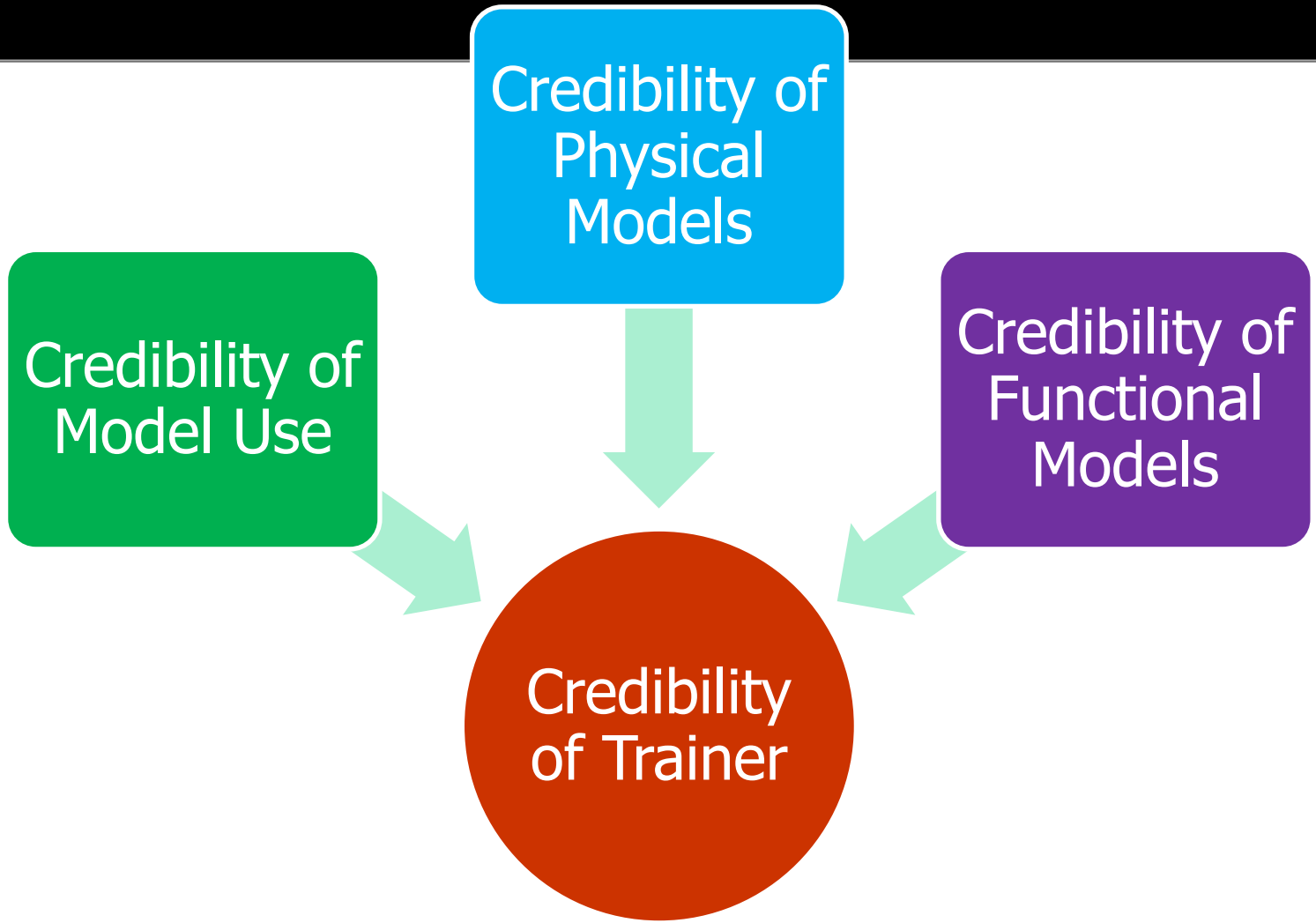
Develop V&V Plan – identifying the objectives, priorities, tasks, and products of the V&V effort; establishing schedules; allocating resources; etc. in coordination with simulation development and accreditation plans.

Validate Conceptual Model – confirming that the capabilities indicated in the conceptual model embody all the capabilities necessary to meet the requirements.

Verify Design – determining that the design is faithful to the conceptual model, and contains all the elements necessary to provide all needed capabilities without adding unneeded capabilities.

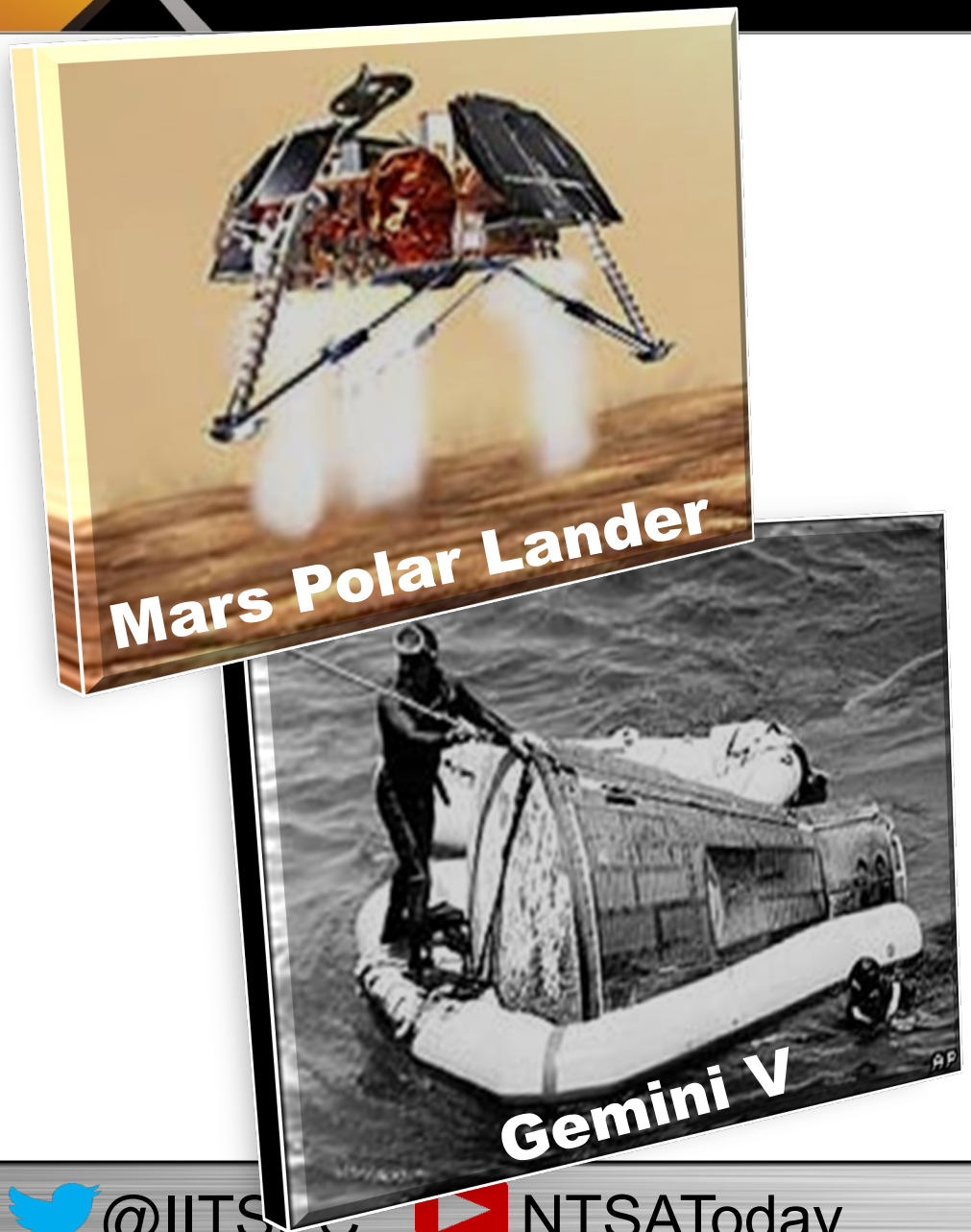
Verify Implementation – determining that the code is correct and is implemented correctly on the hardware.

Validate Results – determining the extent to which the simulation addresses the requirements of the intended use.



Performed for one reason:
To determine the credibility of a model or simulation based on its *intended* use.

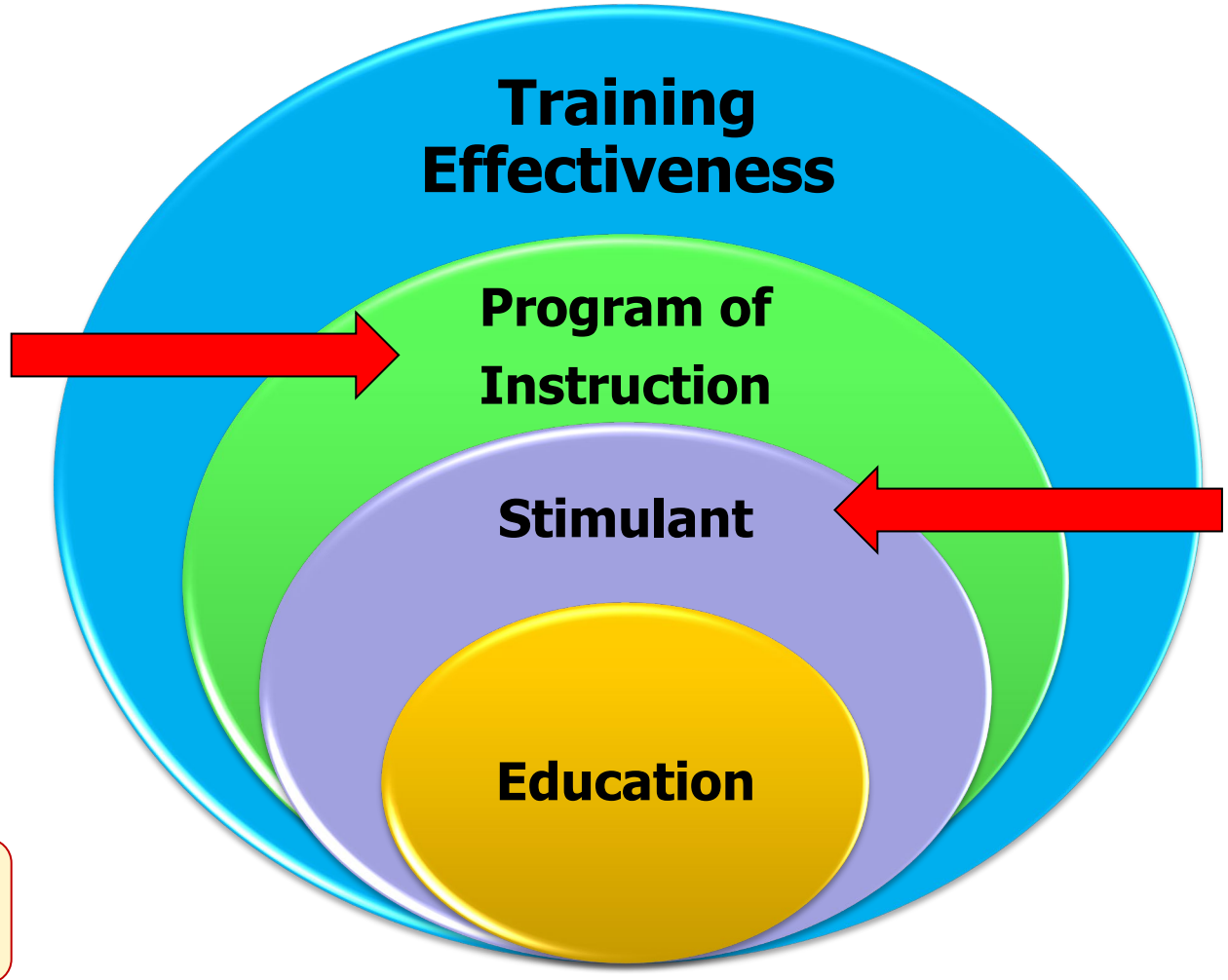
Notable Examples



Understand the difference between V&V and a training effectiveness evaluation (TEE)?

V&V versus TEE

Application of Multiple Stimulants



Validation of Simulation

CAUTION

Measurement of effectiveness is reliant on how stimulants are applied.

Introduction to Roles & Responsibilities

Roles & Responsibilities

Accreditation Agent: The individual, group, or organization designated by the Accreditation Authority to conduct an accreditation assessment for an M&S.

Accreditation Authority: T[Requirements Developer]e use of an M&S for a particular application. The A[Requirements Developer] User's interests. The Accreditation Authority is a Government entity.

M&S Developer: The indiv[Contractor]nsible for developing or modifying a model or simulation in acco[Contractor]rements and specifications.

M&S Proponent: The orga[Program Office]ibility for M&S planning and management that includes [Program Office]idation, configuration management, maintenance, use of the model or simulation, and others as appropriate. The M&S Proponent is a Government entity.

Telford, B. 2012. *Marine Corps Verification, Validation, and Accreditation (VV&A) Best Practices Guide*

Roles & Responsibilities

M&S User: The individua[Training Community]lts or products from a specific application of the model o[illegible]ent entity.

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.

Verification and Validation (V&V) Agent: The individual, group, or organization designated by the M&S Proponent to verify and validate the model or simulation.

Telford, B. 2012. *Marine Corps Verification, Validation, and Accreditation (VV&A) Best Practices Guide*

What is face validation?

Definition

Face validity is the extent to which a model or simulation is subjectively viewed as covering the concept it purports to measure.

What It Is, What It Is Not

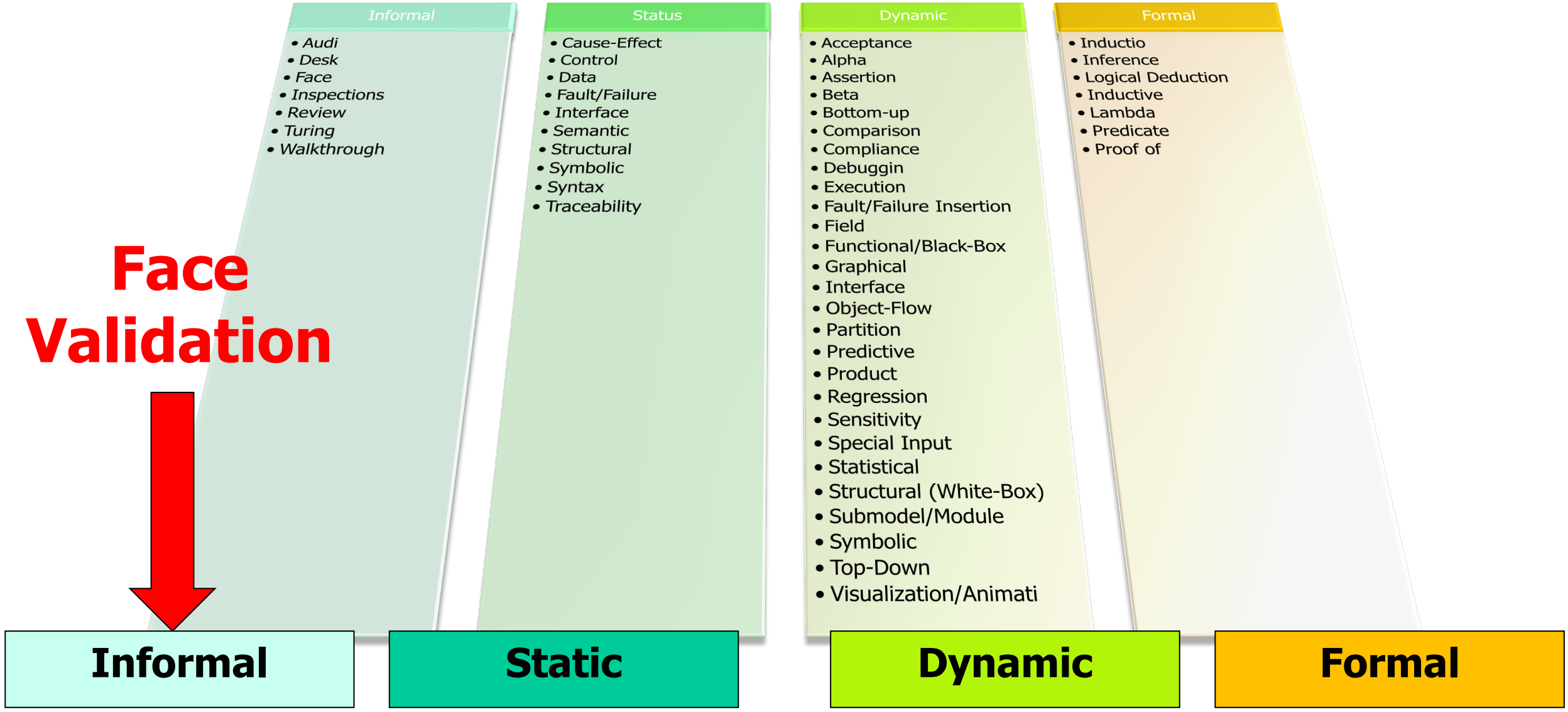
IS: Estimation of credibility in eyes of the user

IS NOT: Mathematical validation of models

Face Validation can still be a scientific evaluation with proper rigor applied.

Does not negate need for other validation techniques in evaluating models.

V&V Techniques



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Establishing face validation requirements

What's Good Enough?

Everything being equal in terms of simulation difficulty and technical uncertainty a simulation for an expensive new weapon system that will have a significant impact on military capability would require a more in-depth VV&A effort than a simulation used to evaluate inexpensive modifications or upgrades that may provide cost reductions but have limited impact on military effectiveness.

Telford, B. 2012. *Marine Corps Verification, Validation, and Accreditation (VV&A) Best Practices Guide*

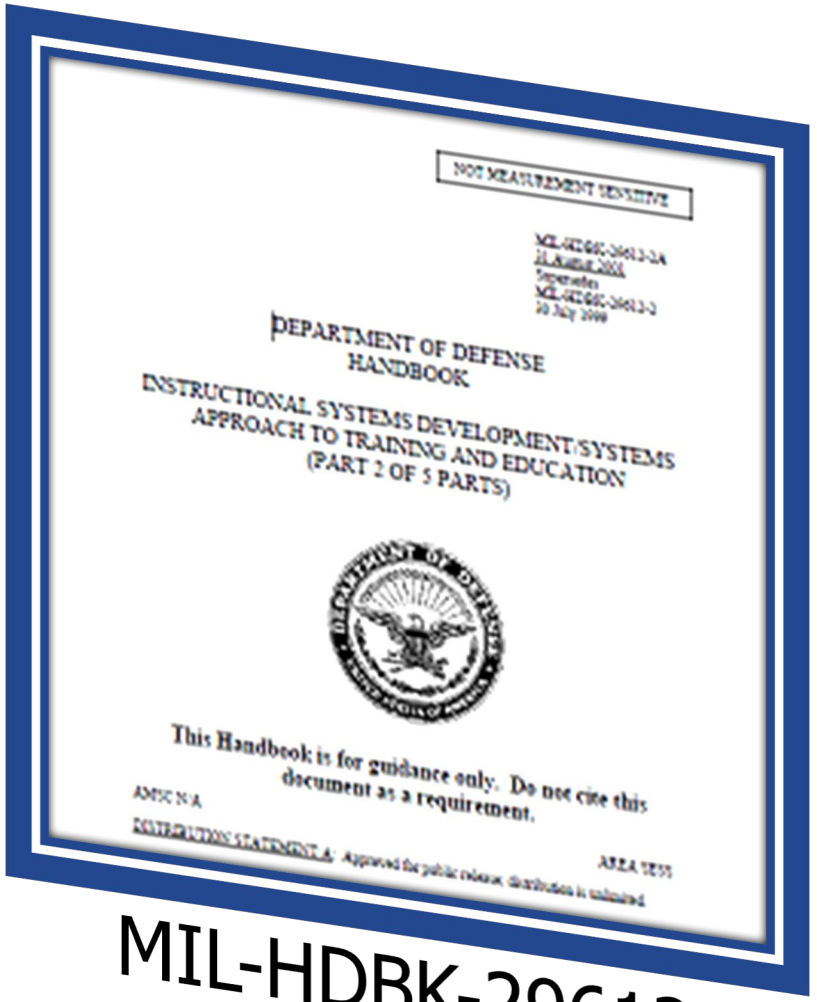
Methodology for creating effective tasks lists for face validation efforts

Develop Your Task List

Establishment of authoritative task list is key.

Your findings are limited to the validity and completeness of your task list.

Garbage in, Garbage out!



MIL-HDBK-29612

How Do I Start My Task List

User Need

"Joint Terminal Attack Controllers (JTAC), Joint Forward Observers (JFO), and Forward Air Controllers (FAC)…."

Training Standards:

T&R Training Events

TAC-SSUP-1101 Conduct two Simulated suppression of enemy air defense call for fire missions with an indirect fire asset.

TAC-SSUP-1101 Conduct Terminal Attack control with Simulated Fixed Wing or Rotary Wing Aircraft in a permissive environment on unmarked targets

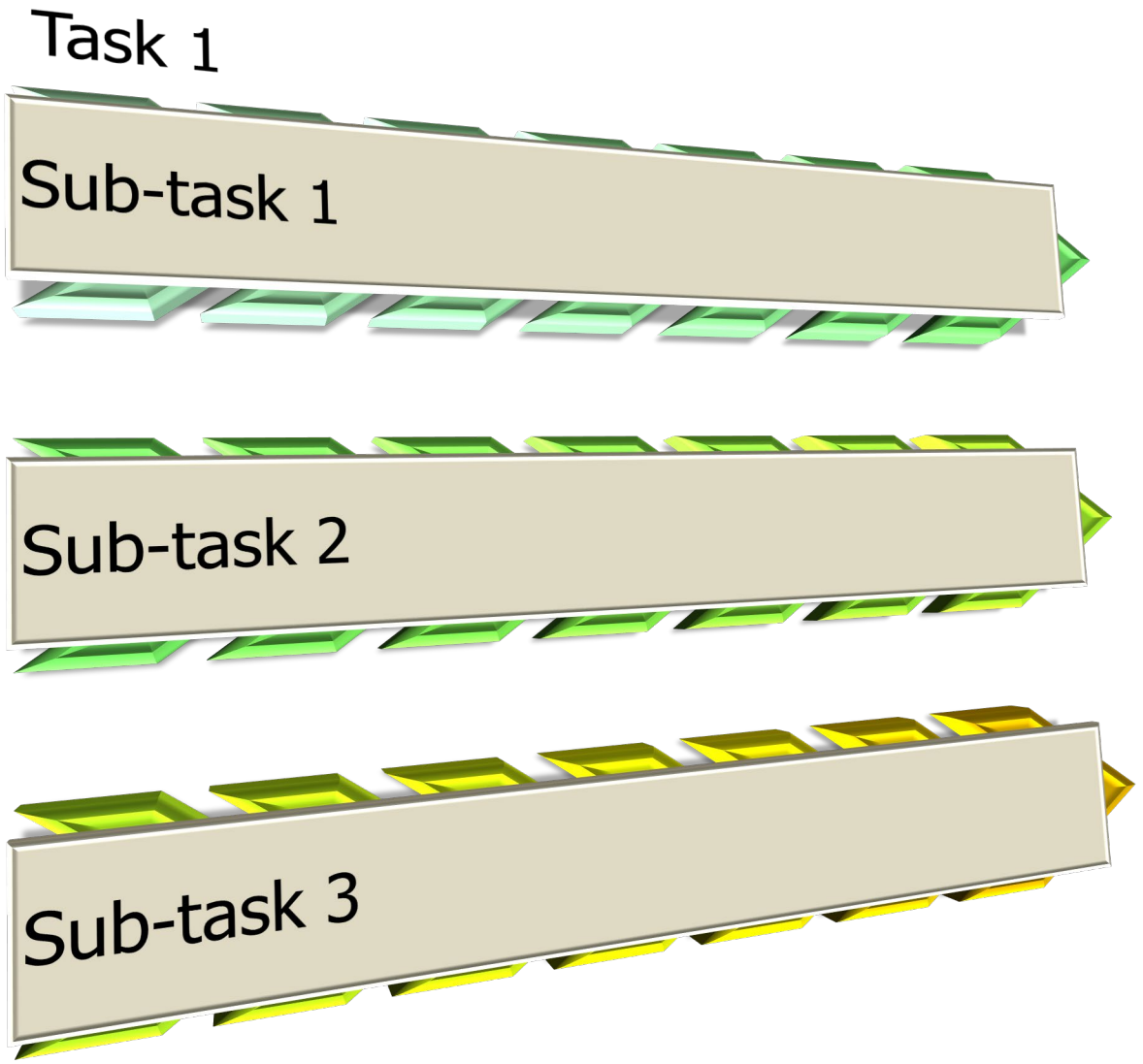
Conceptual Model/ System Capabilities

Display Type 1, 2 and 3 CAS missions for Rotary and Fixed Wing aircraft

Provide a visually immersive training environment to support close air support

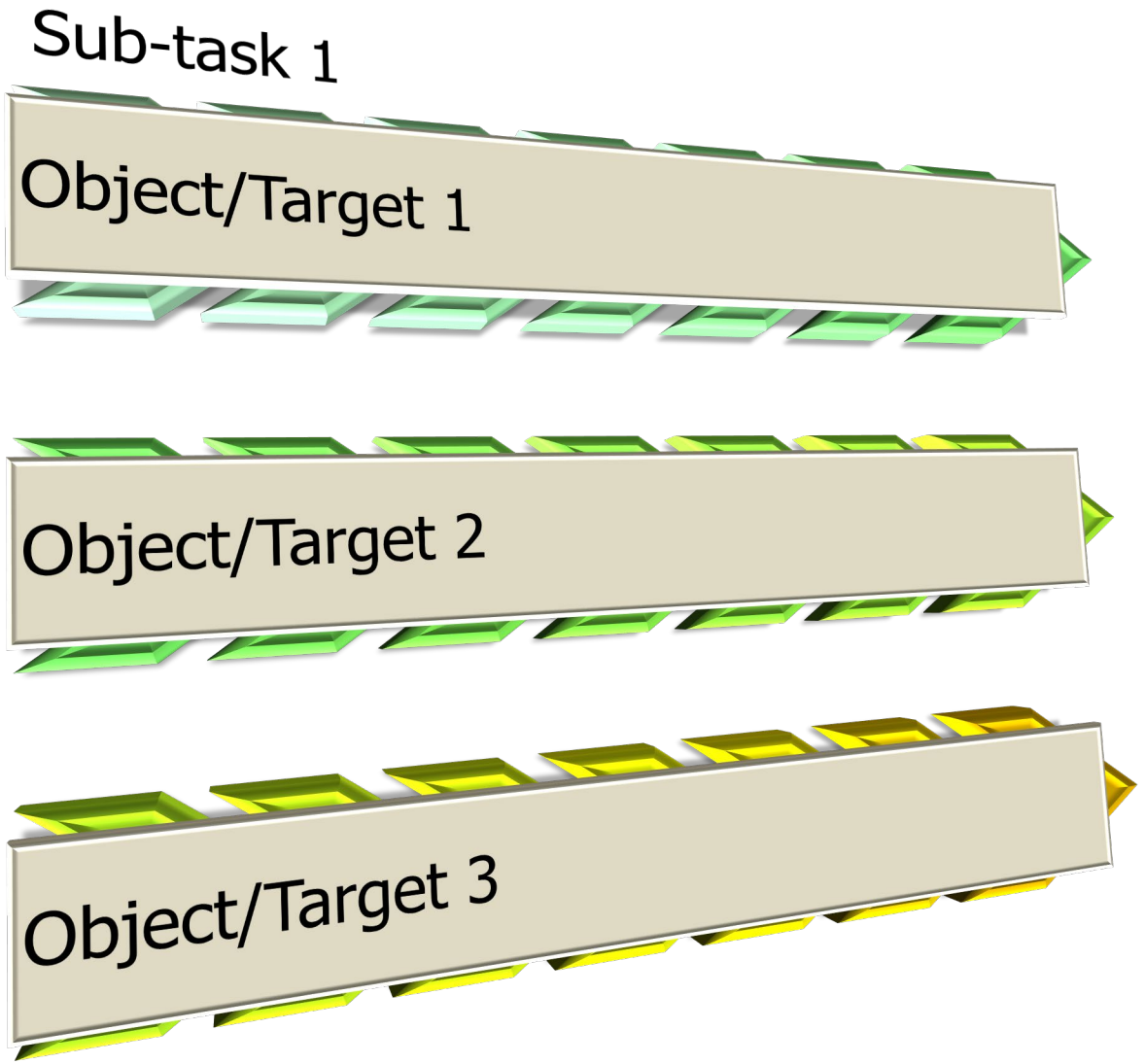
Include 260X60° high-fidelity dome that displays the virtual battlefield in both day and night virtual environments.

Sample Task List Development



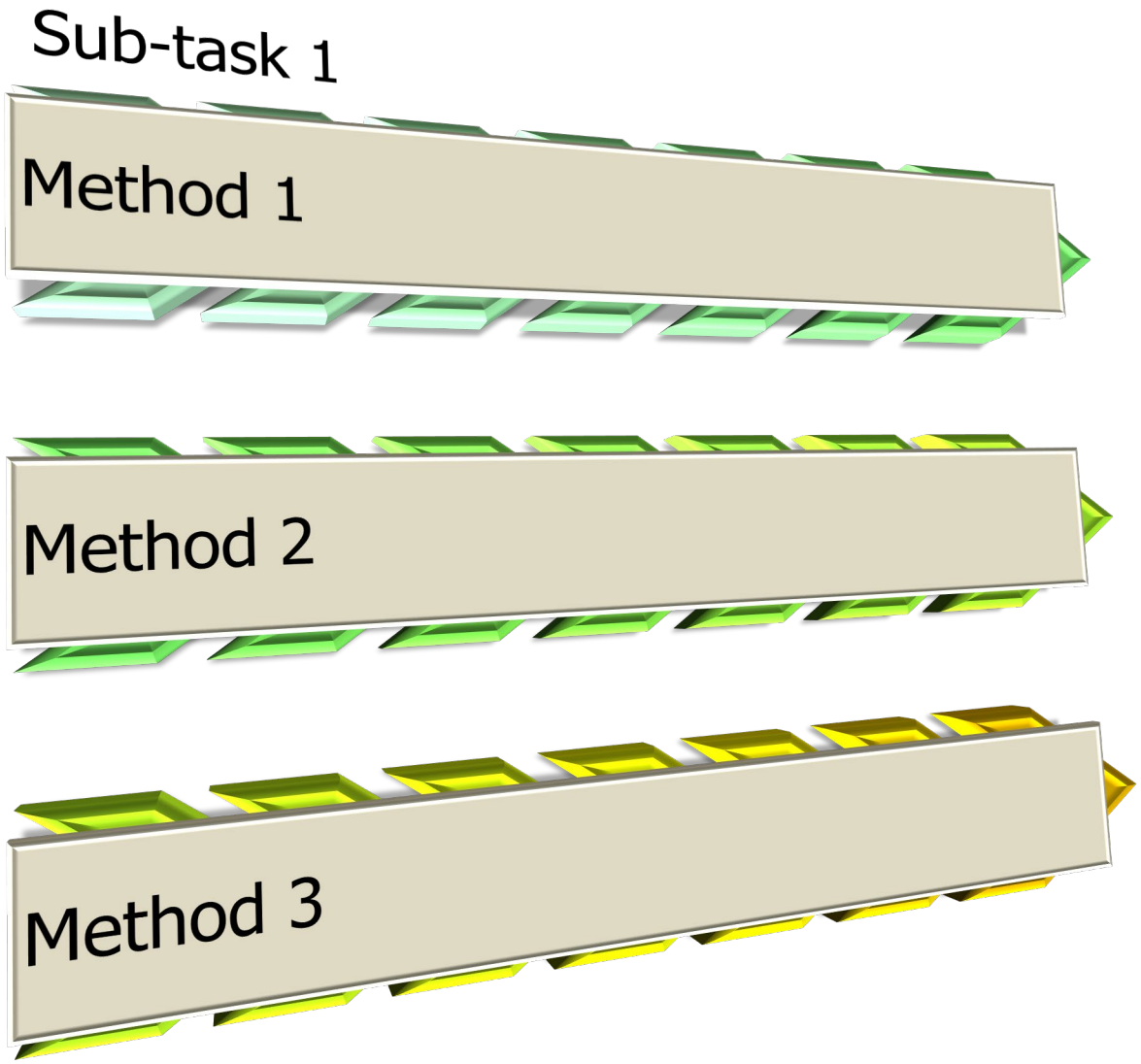
Step 1:
Establish tasks and sub-tasks

Sample Task List Development



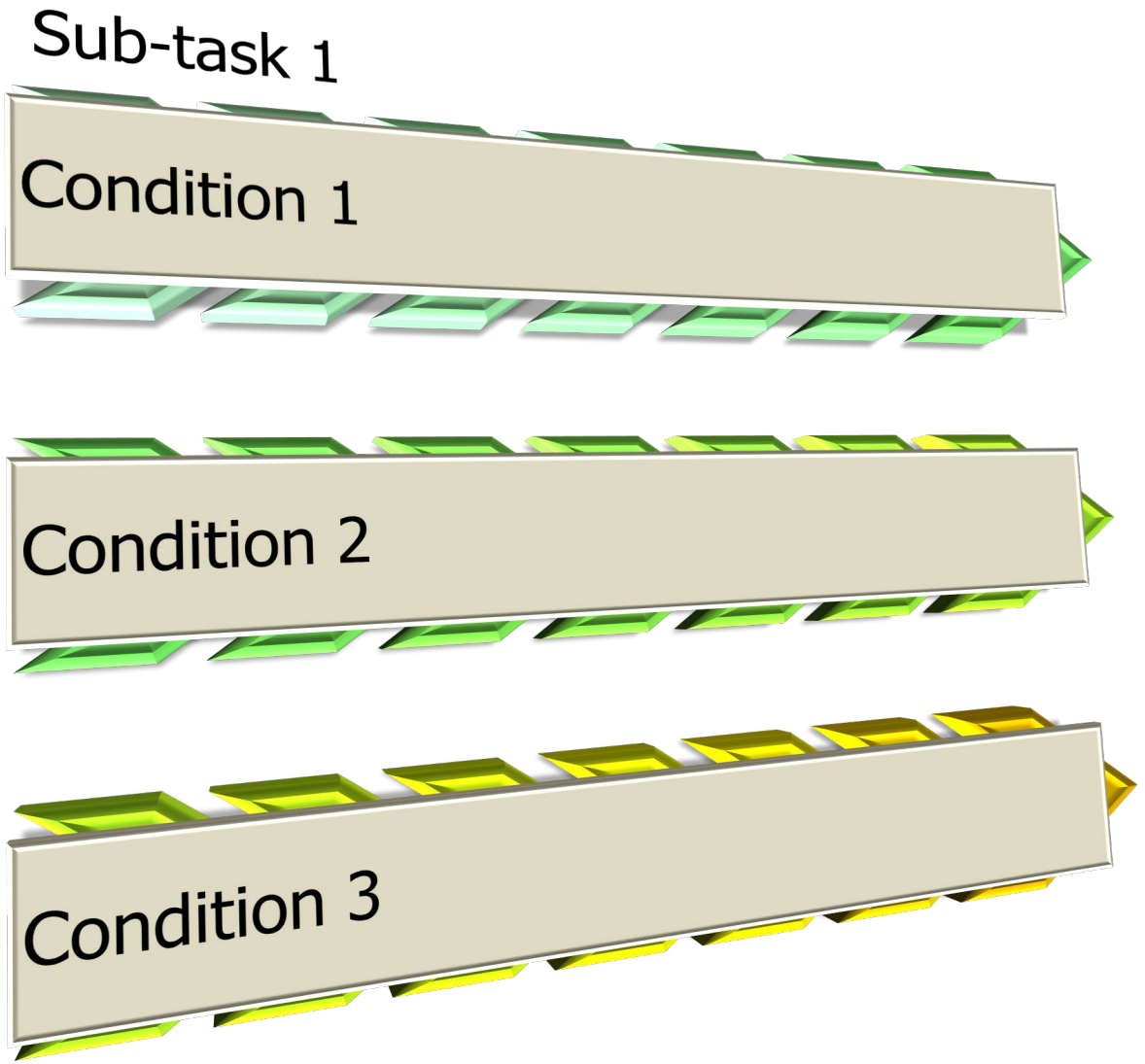
Step 2:
Establish what you are looking for.

Sample Task List Development



Step 3:
Establish how task is performed.

Sample Task List Development



Step 4:
Establish conditions.

HINT:
Include performance standard in condition description.

Sample Single Task

1. • Define Task: Identify anti-aircraft weaponry
2. • Define what you are looking for: MANPADS
3. • How task performed: unaided vision
4. • Define conditions of how performed: at 50 meters

Sample Task List

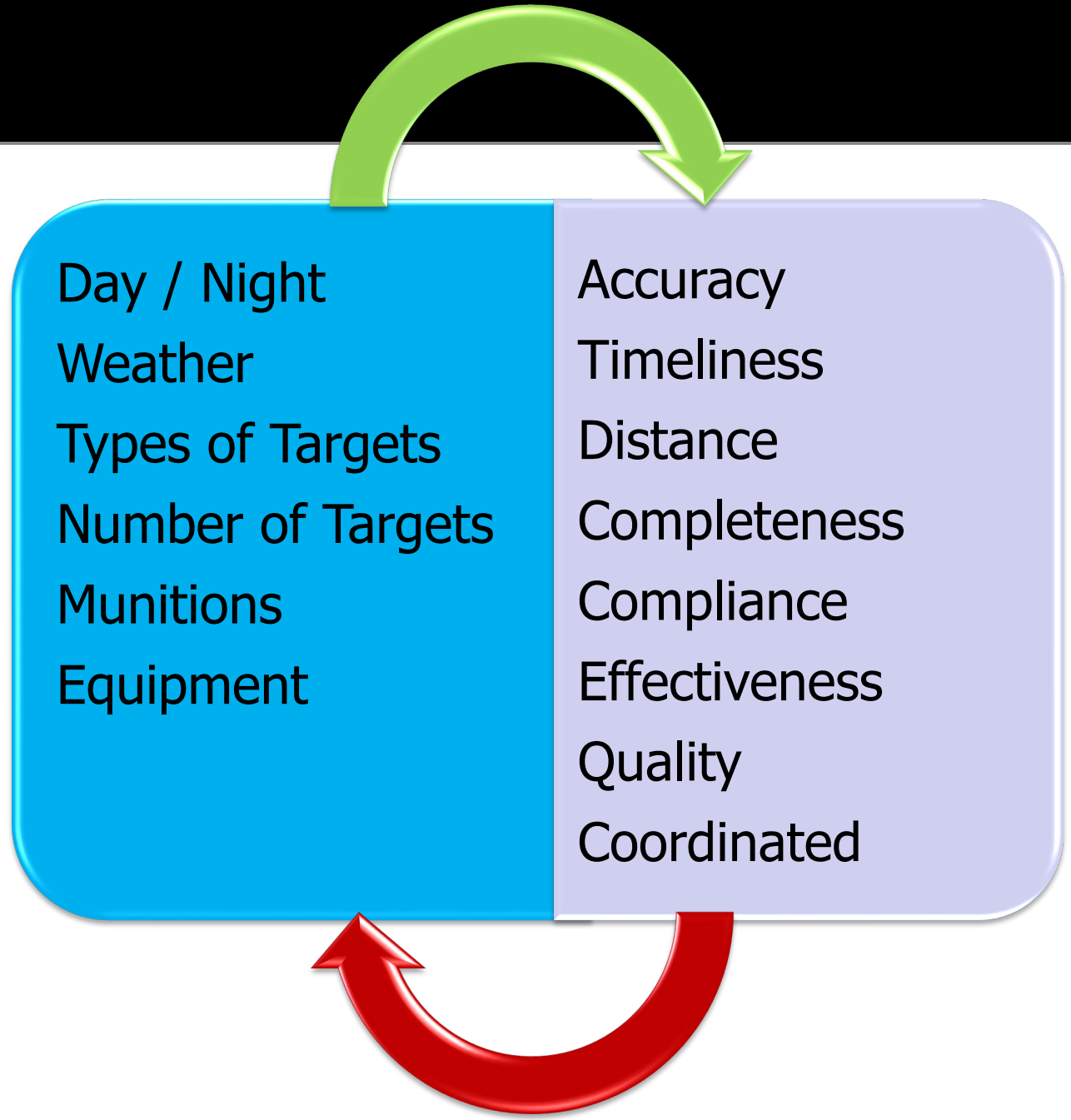
TASK	WHAT	HOW	CONDITION
Identify anti-aircraft weaponry	MANPADS	unaided	minimum distance 50m
Identify anti-aircraft weaponry	MANPADS	unaided	maximum distance: 100m
Identify anti-aircraft weaponry	MANPADS	binoculars	minimum distance: 100m
Identify anti-aircraft weaponry	MANPADS	binoculars	maximum distance: 800m
Identify anti-aircraft weaponry	MANPADS	vector	minimum distance: 100m
Identify anti-aircraft weaponry	MANPADS	vector	maximum distance: 1200m
Identify anti-aircraft weaponry	ZSU23-4	unaided	minimum distance: 50m
Identify anti-aircraft weaponry	ZSU23-4	unaided	maximum distance: 100m
Identify anti-aircraft weaponry	ZSU23-4	binoculars	minimum distance: 100m
Identify anti-aircraft weaponry	ZSU23-4	binoculars	maximum distance: 800m
Identify anti-aircraft weaponry	ZSU23-4	vector	minimum distance: 100m
Identify anti-aircraft weaponry	ZSU23-4	vector	maximum distance: 1200m

Distance, posture, etc.

Standard: Accuracy in terms of correct ID

Condition

Conditions



Standards

Methodology for evaluating fidelity critical to tasks

Fidelity Evaluation

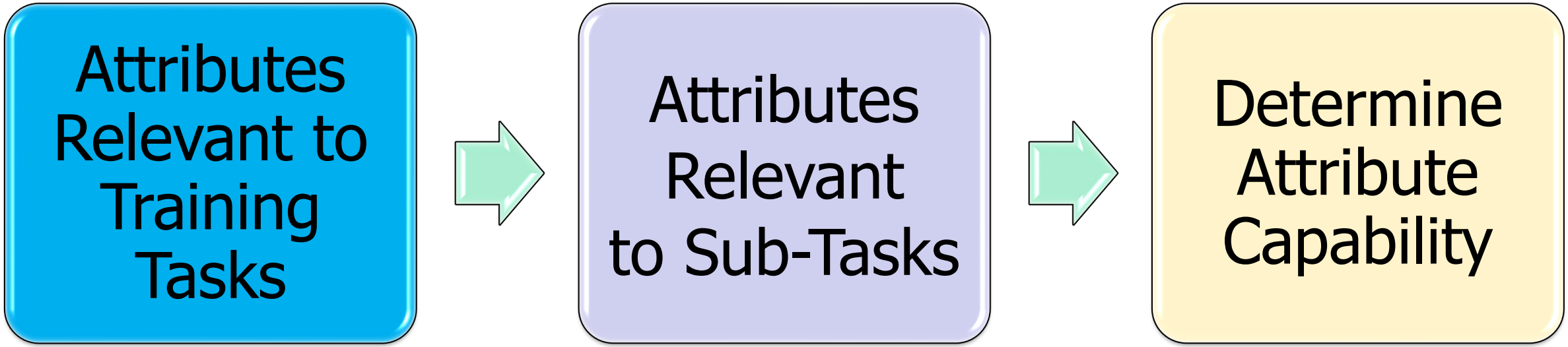
Fidelity: The degree to which a model or simulation reproduces the state and behavior of a real world object or the perception of a real world object, feature, condition.

Goal is to assess that fidelity of simulation is sufficient to perform task to standard.

Evaluate attributes to determine capability to provide necessary fidelity.

Topcu, O. (2003) *Review of Verification and Validation Methods in Simulation: Literature Survey, Concepts, and Definitions.* DRDC Atlantic TM 2003-055

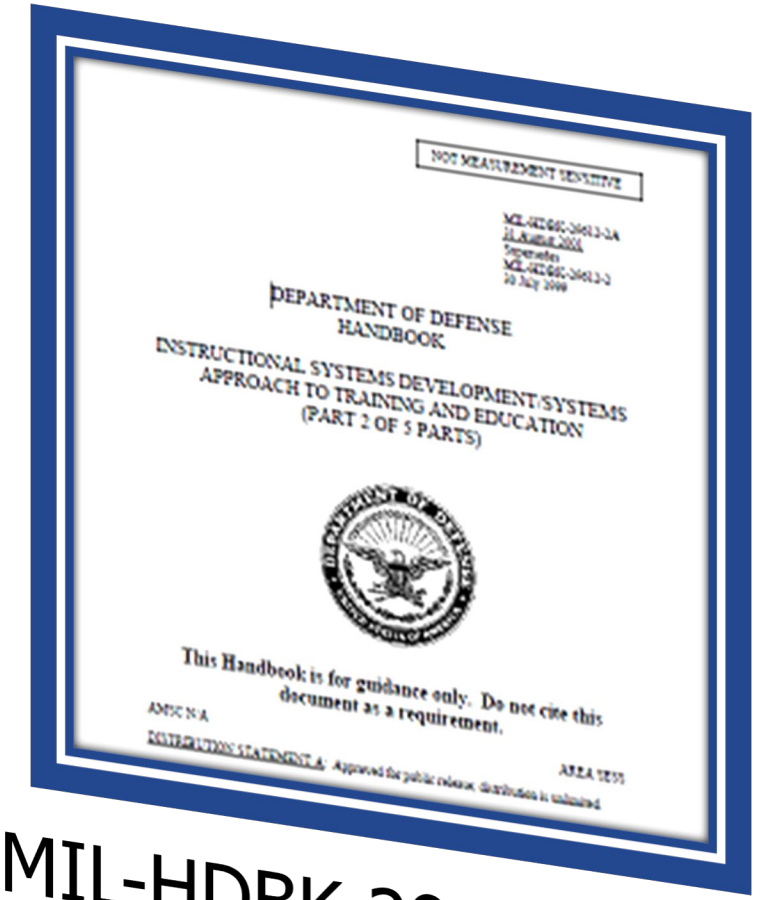
Identify and Evaluate Attributes



Sample Attributes to Evaluate

- Visuals cues
- Tactile cues
- Olfactory cues
- Affective cues
- Auditory cues

No fixed rules on attributes:
Add what is pertinent to your training.


DEPARTMENT OF DEFENSE
HANDBOOK

INSTRUCTIONAL SYSTEMS DEVELOPMENT/SYSTEMS APPROACH TO TRAINING AND EDUCATION
(PART 2 OF 5 PARTS)

This Handbook is for guidance only. Do not cite this document as a requirement.

MIL-HDBK-29612-2A
"sensory stimulus cues"

Sample Capability Rating Scale

Rating	Capability	Description
5	Fully Capable	Device is fully capable of providing attribute to support task execution with little or no deficiencies and no departure from realism. No compensation needed to support task execution.
4	Effectively Capable	Device effectively provides attribute to support task execution with minor/annoying deficiencies and some departure from realism. Minimal compensation needed to support task execution.
3	Borderline Capable	Device is borderline capable of providing attribute to support task execution with moderate deficiencies and significant departure from realism. Considerable compensation needed to support task execution.
2	Marginally Capable	Device is marginally incapable of providing attribute to support task execution with significant deficiencies and very little realism. This severely diminishes the device's capability of supporting task execution.
1	Completely Incapable	Device is completely incapable of providing attribute to support task execution.

USMC Systematic Team Assessment of Readiness Training Evaluation Report for Augmented Immersive Team Trainer (AITT). (2016) Unpublished report.

Sample Task-Attribute Rating Matrix

Attributes

CAPABILITY BASELINE	Physical Look and Feel			Functionality		Auditory				Visual				
	Appearance (physical properties)	Tactile Feel (touch sensation)	Environment (atmosphere)	Haptic Cues (kinesthetic response)	Systems Response & Interaction	Environmental & Battle Sound	Sound Bearing	Audible Systems Signals (devices)	Verbal Communication (single / multi-channel)	Static Visuals (projected)	Active Visuals (projected)	Aero Models	Resolution	Depth Perception
Tasks	**3.82**	**3.81**	**4.57**	**4.44**	**3.80**	**2.71**	**1.67**	**2.20**	**4.81**	**3.21**	**3.28**	**2.50**	**3.14**	**3.06**
Operate Target Location Equipment (LRF-Vector, etc)	4	4	5	5	4					3	4		4	3
Operate Target Location Equipment (Azimuth Finder-Vector)	4	4	5	5	4					3	4		4	3
Operate Target Location Equipment (GPS-DAGR)	5	5	5	5	5					3				
Operate Target Location Equipment (Compass)	5	5			5					1	1			
Execute Target Acquisition Unaided (Day)	4		5							3	4		3	3
Execute Target Acquisition Aided (Day-Vector/DAGR)	4	4	5	5	4					3	3		4	3
Determine Friendly Location via Map Plot (100m accuracy)										1	1		2	2
Determine Friendly Location via coupled GPS/LRF (100m accuracy)	4	4		5	5									
Determine Target Location via Map Plot (100m accuracy)			5							1	1		2	2
Determine Target Location via coupled GPS/LRF (80m accuracy at 1km)	4	4	5	5	5								4	4
Develop Situation Update (or Battlefield Handover)			5			5	3			4	4	4	4	3
Transmit Situation Update Verbally	5	5		5	5				5					
Operate Communication Equipment (Single Channel Clear)	5	5		5	5				5					
Transmit CAS Brief (9-Line) to Single Aircraft	5	5		5	5				5					
Operate Communication Equipment (Data)	3	3		3	3				5					
Receive CAS Brief (9-Line) Readback from Single Aircraft	5	5		5	5				5					
Mark LZ (landing zone) (DAY/ M203 smoke)	4	4	5	4	4	3	1	3	5	3	4		4	3
Determine Weather and Atmospherics (Visibility, Ceiling, Winds on Deck)			5			3				3	2		4	3
Mark Target with Surface-based Indirect Fires (DAY)			5			3	1		5	3	3		4	3
Mark Target with Direct Fire Weapon (eg. .50 cal tracer, 40mm grenade) (DAY)			5	3	4	1	1	2	5	3	3		4	3

Tasks

Capability Rating

How capable system is at providing attribute in support of that task.

Recording of Validation Results

V&V Report

- Validation of M&S to perform tasks
  - Presented at "task level"
  - Result is inclusive of sub-task level for applicable conditions and standards
- Provide recommendation of Validation

Optional to Include:

- Engineering fixes/upgrades needed to perform additional tasks
- Costs for recommended fixes/upgrades to perform tasks

Record for Each Sub-task

Sample record of results for performance steps related to starting a vehicle.

Requirement Source Motor Transport T&R event 3531-OPER-1002 Performance Steps	Validation Type	Validation Results	Recommendation*
1) Perform PMCS.	SME Assessment, Physical Observation	O	
2) Prepare operational forms and records.	SME Assessment, Physical Observation	O	
3) Start the engine.	SME Assessment, Physical Observation	P	B2
4) Select transmission gear.	SME Assessment, Physical Observation	V	
5) Select transfer case gear.	SME Assessment, Physical Observation	V	
6) Operate vehicle forward.	SME Assessment, Physical Observation	P	B1, B4, B5, B6
7) Operate vehicle in reverse.	SME Assessment, Physical Observation	P	B1, B4, B5, B6

Three "Buckets" for Validation Recommendation

Fully Validated: Training system produces results that are sufficiently credible to support the application

Limited/Conditionally Validated: Constraints are placed on how the simulation can be used based upon the evidence assessed, the need for additional information to be provided, or modifications required to the training system.

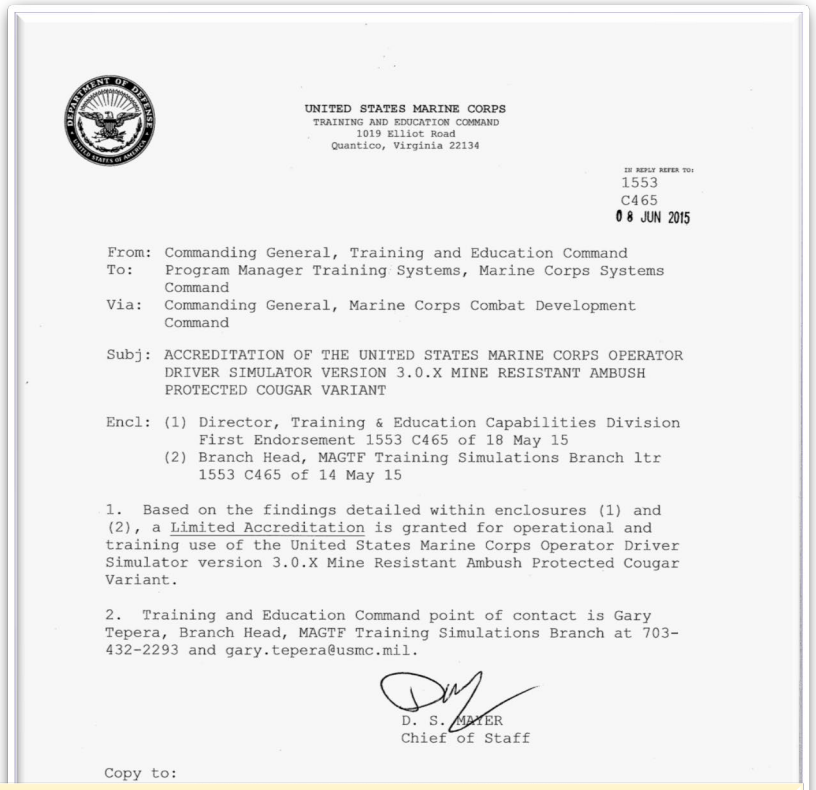
Not Validated: Results of the assessment show that the simulation is not fit to support the intended use.

Task Roll-up / "Stop Light Chart"

T&R Event	Validation Recommendation	T&R Event	Validation Recommendation
FSCC-SIM-7001	Full	FSCC-SIM-3002	Full
FSCC-SIM-7002	Full	FSCC-SIM-3004	Full
FSCC-FSPT-7003	Full	FSCC-SIM-3006	Full
FSCC-SIM-7006	Full	FSCC-FSPT-6003	Full
FSCC-FSPT-7007	Full	FSCC-FSPT-6005	Full
FSCC-MAN-7010	Full	FSCC-FSPT-6007	Full
FSCC-MAN-7011	Full	FSCC-MAN-6010	Full
FSCC-MAN-7012	Full	FSCC-MAN-6011	Full
FSCC-MAN-7013	Full	FSCC-MAN-6012	Full
FSCC-MAN-7014	Full	FSCC-MAN-6013	Full
FSCC-SIM-3001	Full	FSCC-MAN-6014	Full
TAC-SSUP-1100	Limited	TAC-SOAS-1115	Limited by Restriction
TAC-SSUP-1101	None	TAC-SOAS-1116	None
TAC-SOAS-1110	None	TAC-SOAS-1117	None
TAC-SOAS-1111	None	TAC-SOAS-1118	None

Accreditation Letter

"Accreditation (or Limited Accreditation) is granted for operational and training use of training system version # for stated intended use."



UNITED STATES MARINE CORPS
TRAINING AND EDUCATION COMMAND
1019 Elliot Road
Quantico, Virginia 22134

IN REPLY REFER TO:
1553
C465
0 8 JUN 2015

From: Commanding General, Training and Education Command
To: Program Manager Training Systems, Marine Corps Systems Command
Via: Commanding General, Marine Corps Combat Development Command

Subj: ACCREDITATION OF THE UNITED STATES MARINE CORPS OPERATOR DRIVER SIMULATOR VERSION 3.0.X MINE RESISTANT AMBUSH PROTECTED COUGAR VARIANT

Encl: (1) Director, Training & Education Capabilities Division First Endorsement 1553 C465 of 18 May 15
(2) Branch Head, MAGTF Training Simulations Branch ltr 1553 C465 of 14 May 15

1. Based on the findings detailed within enclosures (1) and (2), a Limited Accreditation is granted for operational and training use of the United States Marine Corps Operator Driver Simulator version 3.0.X Mine Resistant Ambush Protected Cougar Variant.

2. Training and Education Command point of contact is Gary Tepera, Branch Head, MAGTF Training Simulations Branch at 703-432-2293 and gary.tepera@usmc.mil.

D. S. MAIER
Chief of Staff

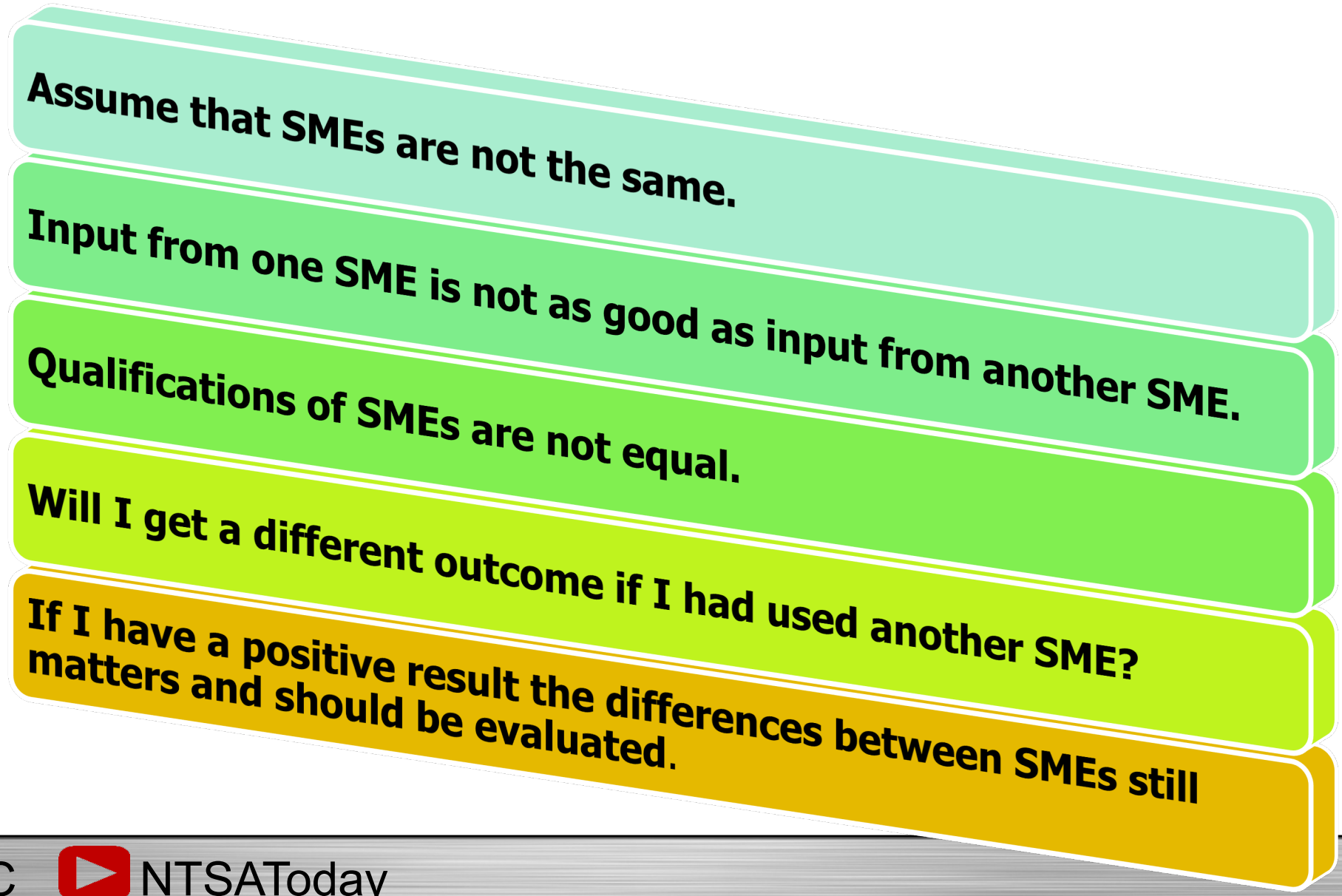
Copy to:

Don't Forget: An update to Accreditation is needed when there are changes to training requirements or changes to training system.

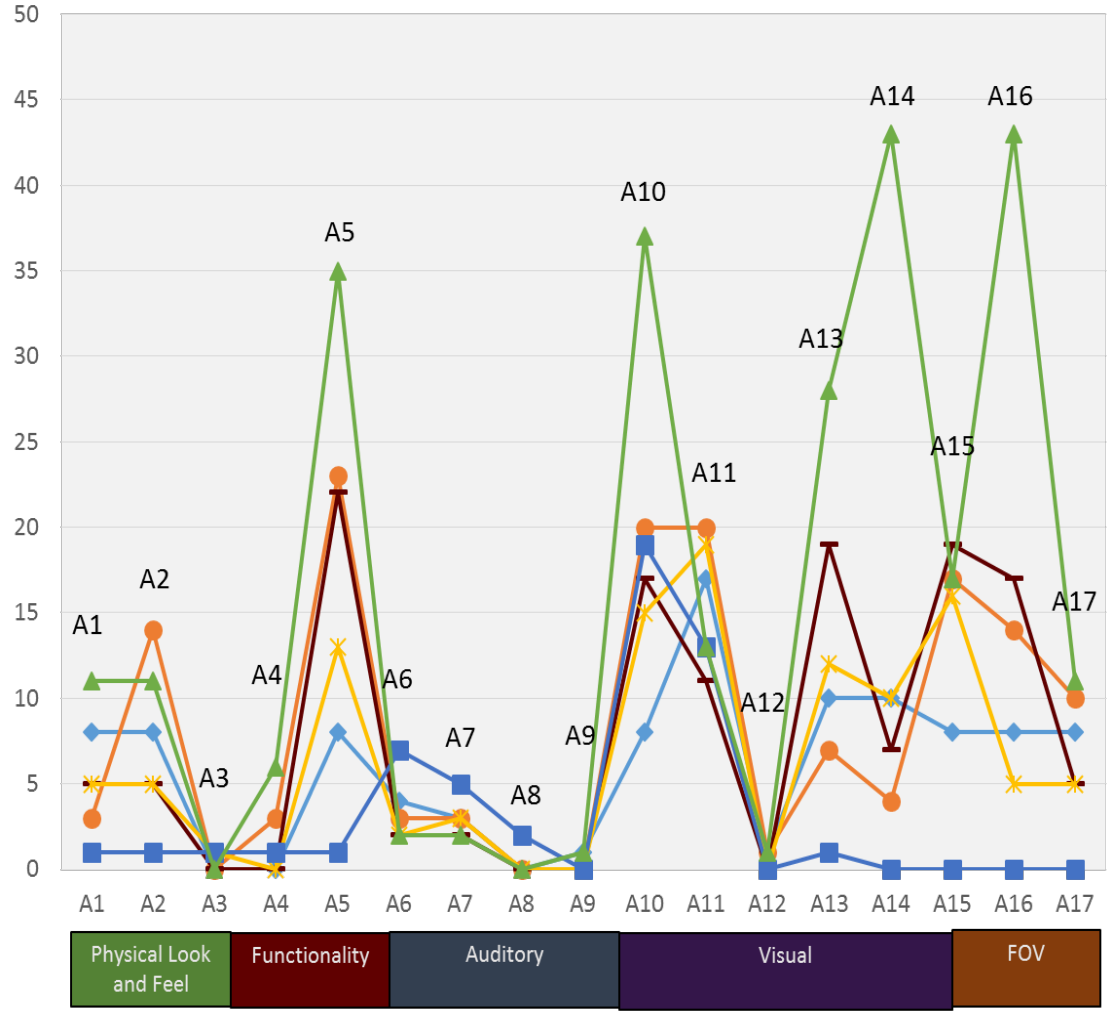
Selecting the right Subject Matter Experts (SMEs)

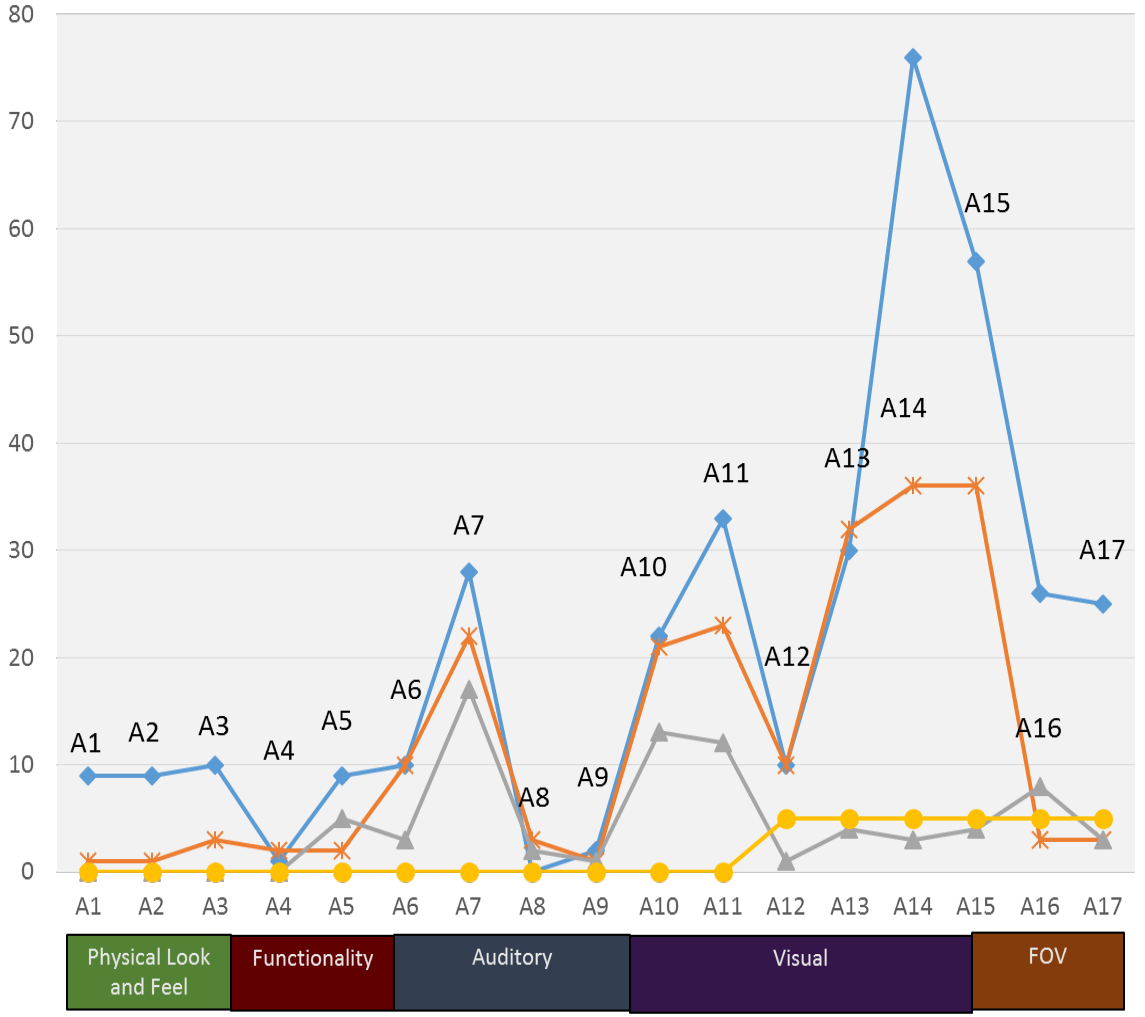
Is this Fidelity Sufficient?

Rules of Thumb for Subject Matter Experts (SMEs)



Sample Attributes with Different Results





Same tasks, same conditions, but different capability ratings.

What to do with Face Validation Results

Upgrade Options "Money Chart"

Task	Current	Upgrade 1	Upgrade 2	Upgrade 3	Upgrade 4
FSCC-MAN-6010	Full				
FSCC-MAN-6011	Full				
FSCC-MAN-6012	Full				
FSCC-MAN-6013	Full	Full	Full	Full	Full
FSCC-MAN-6014	Full	Full	Full	Full	Full
TAC-SSUP-1100	None	Partial	Partial	Full	Full
TAC-SSUP-1101	None	Partial	Partial	Full	Full
TAC-SOAS-1110	Partial	Full	Full	Full	Full
TAC-SOAS-1111	Partial	Partial	Full	Full	Full
TAC-SOAS-1112	Partial	Full	Full	Full	Full
TAC-SOAS-1113	Partial	Partial	Partial	Full	Full
TAC-SOAS-1114	None	Partial	Partial	Full	Full
TAC-SOAS-1115	None	Partial	Partial	Full	Full
TAC-SOAS-1116	None	Partial	Partial	Partial	Full
TAC-SOAS-1117	None	Partial	Partial	Partial	Full
TAC-SOAS-1118	None	Partial	Partial	Full	Full

$ $$ $$$ $$$$

Supporting Arms Virtual Trainer (SAVT) Success Story

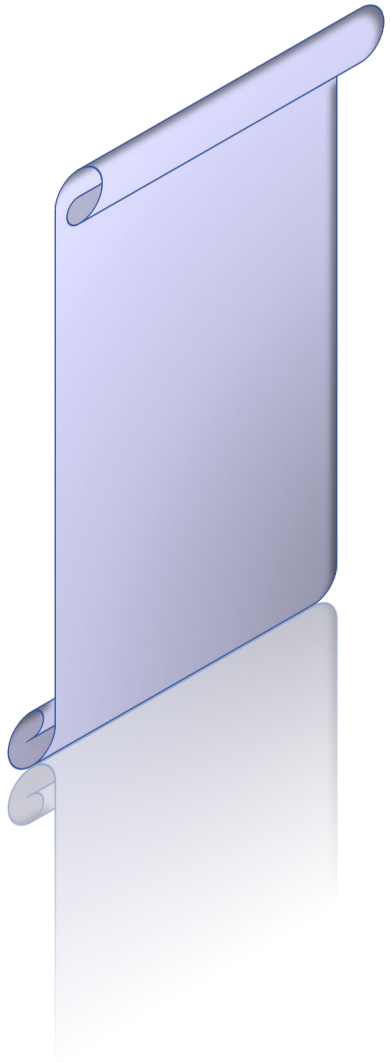
Knowledge Management

System settings that affect training are management items.

“Tweaks” or “Work-arounds” are indicators.

Refreshes/upgrades testing plans should include these settings

Goal: ensures delivery of capabilities are not impacted and the end user can use immediately without worries.



Review & References

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References

DoDI 5000.61, DoD Modeling and Simulation (M&S) Verification, Validation, and Accreditation (VV&A) http://www.msco.mil/documents/_1_500061p.pdf

DoD VV&A Recommended Practices Guide (RPG) http://vva.msco.mil/

Department of the Navy Modeling and Simulation (M&S) VV&A Handbook https://nmso.navy.mil/DesktopModules/Bring2mind/DMX/Download.aspx?Command=Core_Download&EntryId=3988&PortalId=0&TabId=368

IEEE Std. 1278.4 “Recommended Practice for Distributed Interactive Simulation (DIS) Verification, Validation and Accreditation (VV&A)”

MIL-HDBK-29612-2A Instructional Systems Development Systems Approach to Training and Education Part 2

MIL-STD-3022 DoD Standard Practice Documentation of VV&A for Models and Simulations

SECNAV Instruction 5200.40 VV&A of M&S https://nmso.navy.mil/VVA.aspx

Thank You

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