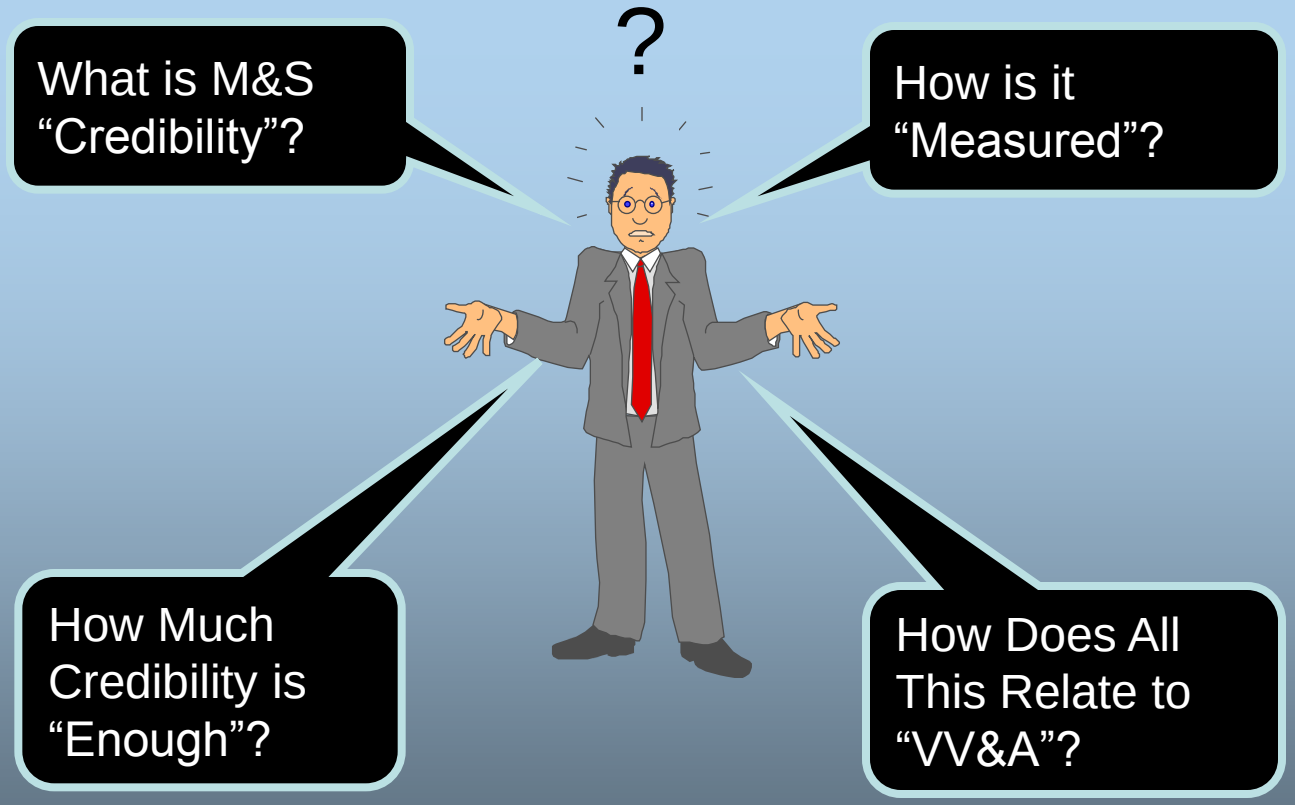
DETERMINING M&S CREDIBILITY: What The Accreditor Needs To Know

James N. Elele, PhD
Department of The Navy M&S Verification Validation & Accreditation Lead
James.Elele@navy.mil
Ph: 301-342-4154

THE ISSUE:
M&S CREDIBILITY AND HOW TO SHOW IT



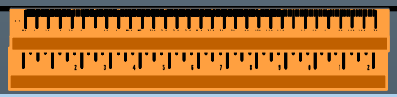
WHERE CAN I GET HELP?

KEY QUESTION

What Makes A Simulation "Credible"?

- **Most people think "validation" is the hallmark of simulation credibility. But is it?**
- ***Validation has well-known limitations:***
  - **Limited scope of validation tests**
    - **You *cannot validate* *over the whole domain* of the M&S**
  - **Validation data are *difficult and costly* to obtain**
    - **Moreover "Real World" *always contains factors* *not accounted for* in the simulation.**
    - **Obtaining *sufficient validation test data* can be costly**
  - **Some simulations simply *cannot be validated* in the conventional sense of the word.**
    - **Wars are not experiments designed for data collection**
      - **e.g., how can we validate mission and campaign level warfare M&S?**

Fortunately, there are other measures of simulation credibility



CREDIBILITY

Definition: A model or simulation, its data, and its results have credibility if the decision-maker and other key project personnel accept them as "correct." (RPG Reference Document, 8/15/01)

NOTE:

- **A credible simulation is *not necessarily* valid, and vice versa.**
- **A model or simulation that is *both valid and credible* is more likely to be formally accredited for use in a particular application.**

- **The following factors help establish credibility for a model or simulation:**
  - Decision-maker's understanding and agreement with the simulation's assumptions
  - Demonstration that the simulation has been *validated and verified*
  - Decision-maker's ownership of and involvement with the project
  - Reputation of the simulation developers and analysts
  - History of previous use by other organizations or agencies.

Important:

- **This Tutorial will discuss an approach for making a simulation valid and credible based on the M&S capability, Accuracy and Usability**

KEY QUESTION

Why Is M&S Credibility So Important ?

Because

Policy Mandates M&S Use:

- DoD 5000.2-R (Paragraph 3.4.4: "PMs ***shall*** integrate the use of modeling and simulation within program planning activities, plan for life-cycle application, support, capitalizing on reuse of models and simulations, and integrate modeling and simulation across the functional areas."

M&S Have Become Ubiquitous:

- Demand For M&S Applications Keeps Increasing (For Scientific Studies, For Acquisition, For Testing &Training, etc.)
- Budget: Resources Keep Shrinking
- M&S Is Considered More Economical Than Other Tools and Methods
- Requirements To Represent Very Complex Phenomena In Realistic Battlefield Environment Keep Increasing

Simulations Are Being Used To Support Very Many High Value Decisions:

- Warfare (Scenarios; Equipments' Performances & Effectiveness) Simulations
- Acquisition/Technology Development
- Risk Determination, Mitigation/Reduction
- Playing "What if" investigations for extremely hazardous conditions.
- Medical, Scientific, Training & Testing
- **HOW MUCH RISK CAN I ACCEPT IF M&S RESULTS TURN OUT TO BE WRONG?**

VV&A: Why All The Fuss ?

MANDATED: DoD 5000.2-R

DoD and Service Directives require the appropriate use of models and simulations throughout the life cycle of major acquisition programs

- **"The PM *shall* use verified, validated, and accredited (VV&A) models and simulations, and ensure credible applicability for each proposed use."** (Para 2.6.7)

- "The acquisition strategy **shall** describe the integration and interoperability of M&S efforts ***throughout*** requirements definition; program management; engineering, manufacturing, and design trade studies; and developmental, operational and live fire testing applications." (Para 2.6.7)

- "The PM **shall** use M&S during program planning, system design, system modifications and upgrades, and system T&E. M&S shall support all life-cycle activities of the system. . . In collaboration with industry, *PMs shall* integrate M&S into program planning activities; shall plan for life-cycle application, support, documentation, and reuse of models and simulations; and shall integrate M&S across the functional disciplines. PMs shall plan for M&S and make necessary investments early in the acquisition life cycle.

- **Improvement to the VV&A process is one of the key contributions of this approach**
  - BY HELPING PMS AND ACCREDITORS MEET THIS DIRECTIVE

VV&A IN M&S CREDIBILITY

What Are The Issues?

ISSUES : M&S Credibility And The Evidence Needed To Show Credibility

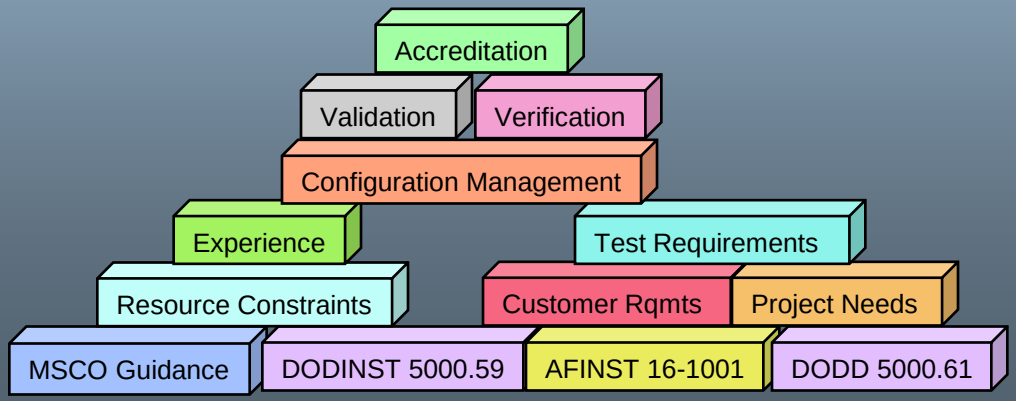
- **VV&A are used to establish the Credibility of M&S by testing (verifying & validating), proving and documenting core M&S characteristics:**
  - **CAPABILITY**
    - What the M&S can do
  - **ACCURACY**
    - How well it does it
  - **USABILITY**
    - How easy it is to use the M&S correctly
  - **FIT FOR PURPOSE**
    - Assessing the Risk associated with using erroneous M&S results
- **VV&A Provides Confidence to decision makers; and**
- **VV&A are Risk reduction processes**
- ***GOAL OF VV&A: To define, determine, generate and document information needed to assess the M&S credibility and justify using the M&S for the specified application***

"The What And The Why"

- **ISSUE: The Risk Associated With Decisions Supported With Erroneous M&S Results.**
- Sources Of Risk
  - M&S may solve the wrong problem/ Poor problem and Intended Use definitions.
  - Invalid/Not-credible M&S may be accepted.
  - Erroneous M&S output/results may be accepted and used.
- VV&A is a Risk-reduction/mitigation process
- VV&A reduces/mitigates risks by ensuring that M&S:
  - address the correct problem.
  - produce, valid, accurate, consistent, and reproducible results.
  - provide confidence that decisions supported with M&S are credible and reliable
- VV&A provide documented evidence/proof for supporting acquisition decisions

WHAT IS NEEDED

- A Practical and Cost-Effective Approach for fulfilling the M&S User's Intended application needs (and Service policies) while meeting the specific M&S credibility requirements for that Intended Use (IU)
  - Identifying M&S Credibility Requirements That Make Sense
  - Planning and Executing Cost-Effective VV&A Programs
  - Conducting Accreditation Assessments
  - Making VV&A Decisions Based On Risks Associated With M&S Use
    - Most efficient and effective implementation approach
  - Documenting Results of VV&A Activities AND Lessons Learned



SEEKING FOR ANSWERS

OUR AIM:
To provide the M&S Community & Industry with a COST-EFFECTIVE pathway to defining and meeting simulation credibility requirements.

HOW CAN I DETERMINE THE CREDIBILITY OF MY M&S AND THE ASSOCIATED DATA?

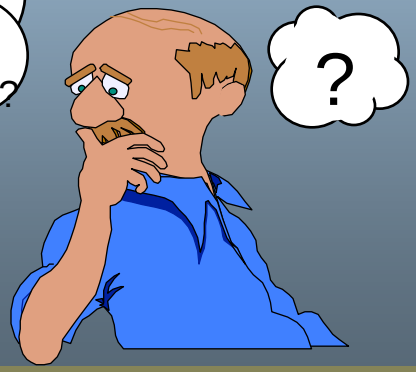
WHAT MAKES M&S CREDIBLE?

HOW MUCH VV&A IS ENOUGH?

HOW DOES VV&A FIT IN ALL OF THESE?

HOW DO I BALANCE COST AND CREDIBILITY?

ARE THERE SOME COST OPTIMUM APPROACHES?



PM & THE M&S USER

WHAT ARE MY RISKS WHEN M&S OUTPUTS ARE WRONG & USING THEM LEADS TO WRONG DECISION OUTCOMES?

- **Battlefield Operational Outcomes?**
- **Personnel Losses?**
- **Financial Loses?**
- **Other Resources (Schedule, Facilities etc.)?**

TOO MANY QUESTIONS! SOMEBODY DO SOMETHING!!

THE PROCESS

OUR VV&A APPROACH:

- **It all starts with a "*well-articulated Intended Use Statement*"**
  - *This is **absolutely critical**; for valid requirements definition*
  - *Without a clearly stated intended use, you **CANNOT** prove your M&S is credible (and can meet the defined need)*
  - *This Is What VV&A Needs To Prove (That This M&S Can Do)!*
- **What Makes *A Good* Intended Use Statement?**
- ***A Good Intended Use Statement (IUS) shall define:***
  - *What you are trying to model (General intended application description).*
  - *The Key Questions you are trying to find answers to (Critical Problem Statements/Descriptions).*
  - *How you are planning to use the results (e.g. T&E, Training, Usage Environs)*
  - *The Key Outputs (results) you are looking for (MOPs, MOEs, KPPs, etc.)*
- **NOTE:** ***This is what the M&S is going to be accredited for!!***

EXAMPLE OF AN IUS FOR A TRAFFIC FLOW M&S

Intended Use for Traffic Flow Model (TFM)

The Traffic Flow Model (TFM) will simulate a standard 4-way intersection in order to provide analysis of traffic flow control and provide support for implementing improvements in congestion redirect.

The TFM will be applied for the following uses:

- To estimate the performance level of current traffic control systems to efficiently dissipate high density traffic congestion.
- To simulate variations of traffic flow situations in a base environment.
- To determine the effect of altering traffic control systems.

TFM will be further developed in the future with increased complexity and fidelity to represent the entire traffic system of PAX NAS.

Intended Use	Key Questions to Be Addressed by M&S	Application	Model Outputs/Data
The Model & Simulation (M&S) will be used to simulate traffic flow at a standard 4-way intersection on PAX NAS.	What is the efficiency of the current traffic control system at a single intersection of PAX NAS?	Determine the necessity of further management of high traffic density at this single intersection.	▪ Traffic queue lengths ▪ Queue wait times ▪ Traffic flow rates (Based on time of day and present traffic light settings)
	What is the current representative traffic density at the designated intersection?	Determine the baseline for traffic improvement.	▪ Traffic queue lengths ▪ Queue wait times ▪ Traffic flow rates (Based on time of day) and present traffic conditions)
	What is the effectiveness of the current traffic light cycle and timing at representative intersection?	Determine effectiveness of traffic light function when compared to present traffic congestion.	▪ Present traffic light timing, and cycle patterns
The M&S will be used to support improvement of traffic flow at single intersection of PAX NAS.	How can optimal traffic flow be maintained through control of traffic light functions at a given intersection?	Determine optimal light cycle timing to efficiently dissipate high density traffic.	▪ *Independent/ User Controlled Variable* o Adjustable light cycle time intervals ▪ *Dependent Variables* o Traffic queue lengths o Queue wait times o Traffic flow rates.
The M&S will be used to support future modeling and evaluation of the entirety of PAX NAS traffic congestion.	How can the modeling of a single intersection of PAX NAS be expanded to model all traffic lights on base?	Determine how traffic lights on base intersections can be managed to work both independently and as a system to optimize traffic flow.	▪ Multiple representative traffic intersections ▪ Traffic light cycle timing capable of acting as independent elements or as a part of a system.

*Created By NAVAIR 5.4.2.3 (BMVVB) Employees and Interns as part of a study project on "How to Build a Credible Simulation"

From The IUS Determine The VV&A Requirements

Requirements Are Determined/Categorized According To The Three Pillars Of M&S/Tool Credibility

Intended Use

What the M&S shall do…

- Requirement #1
- Requirement #2
- …
- …
- Requirement # (*n*- 1)
- Requirement *#n*

ACCEPTABILITY CRITERIA

CAPABILITY REQUIREMENTS

What can the M&S/Tool do (the functions) and to what level of detail (Fidelity Level)?*

Detailed Functional Decomposition

ACCURACY REQUIREMENTS

How well does the facility/M&S/Tool do what it is designed to do and is it relatively error-free?

- ***Software Accuracy***
- ***Data Accuracy***
- ***Output Accuracy***

USABILITY REQUIREMENTS

What do users need to operate the Facility/M&S/Tool correctly and without introducing errors?

***RISK ASSESSMENT**: How fit is the Facility/M&S/Tool to satisfy the intended use with respect to the specified Capability and Accuracy?*

ACCEPTABILITY CRITERIA

From The IUS Determine The M&S/VV&A Requirements

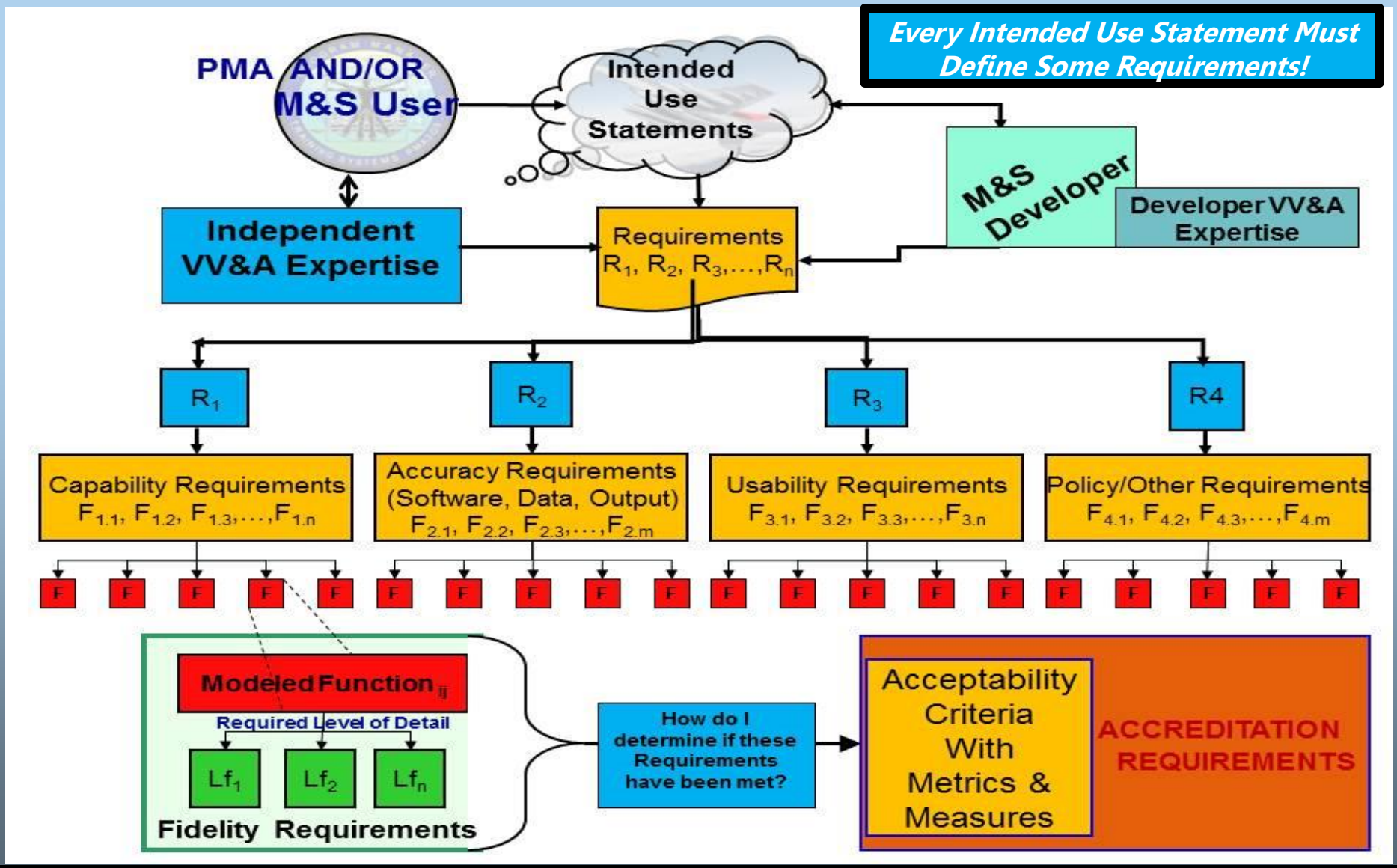
THE PROCESS

Using The Requirements Determine The Acceptability Criteria With Associated Metrics & Measures

Defining Requirements and Acceptability Criteria is as important as having a good intended use statement; otherwise, V&V cannot be accomplished.

- **Requirements:** Features and ***characteristics*** a model and/or simulation must have to be able ***to meet its intended use***
- **Acceptability Criteria:** Quantitative or qualitative properties a model or simulation must ***demonstrate to meet requirements*** for the intended use
- **Metrics/Measure:** ***How to determine*** whether or not the ***acceptability criteria has been met***

DETERMINING ACCEPTABILITY CRITERIA



NOTE:

VV&A Tailoring For What Level Of Risk Is Acceptable Based On Available Resources Is Usually Done Using Acceptability Criteria

THE PROCESS

Conducting Credible Simulation Studies

*From RPG Reference Document, 8/15/01

- Formulate the Problem Precisely
- Interview Subject Matter Experts
- Interact with the Decision-maker Regularly
- Use Quantitative Techniques to Validate Components of the Simulation
- Document the Conceptual Model
- Perform Structured Walk-through of the Conceptual Model
- Perform Sensitivity Analyses to Determine Important Simulation Factors
- Validate the Output from the Overall Simulation
- Use Graphical Plots and Animations of the Simulation Output Data
- Use Statistical Techniques for Comparing Simulation and System Output Data

ISSUE/QUESTION:

Where does VERIFICATION figure in this process?

- Define *credibility in terms of Capability, Accuracy and Usability* of M&S
- Focus on both verification and validation in terms of the above attributes
- Thus bridge the gap often left when much emphasis is placed on validation at the expense of verification

MORE DETAILS ON

CAPABILITY
ACCURACY
USABILITY
M&S Use Risk Assessment

What Functions Are Modeled And To What Level Of Detail (Fidelity)?

The Conceptual Model Description

- Descriptions of simulation capability should include:
  - *Purpose:* Clear description of the specific purpose for which the simulation was developed and the phenomena being simulated
  - *Modeled elements:* Listing of the physical entities represented in the simulation, the **functions modeled** or **interactions** they have with other entities, and the level of detail (degree of fidelity) to which each entity is modeled. **Functional decomposition diagrams** that call out the level of details modeled (Fidelity of Representations)
  - *Environment:* Description of the physical environment in which the entities interact within the simulation ; data exchanged and their formats
  - *Relationships:* Description of I/O relationships between elements and the rules governing interactions among elements and the environment
  - *Assumptions and Limitations:* Description of any aspect of the design or implementation that limits the scope of potential uses
    - Summary of Assumptions, Limitations, and Errors (SALE) allows a model User to quickly identify all known model characteristics that might limit its applicability to a particular problem.

VERIFICATION: SIMULATION ACCURACY

M&S ACCURACY*: The Error-freeness of the simulation*

- **Most People think of Simulation Accuracy in terms of Output Accuracy. *But simulations are very complex systems!***
- **Simulation accuracy is *influenced by many factors*.**
- **Assuming "correct" conceptual definitions of functional Capability (both scientific and heuristic):**
  - **The most important factors influencing accuracy are:**
    - **Software Accuracy**
    - **Data Accuracy**
    - **Output Accuracy.**

VERIFICATION: SOFTWARE ACCURACY

The Quality and "Error-freeness" of the software

- **"Good" SW Accuracy Verification Is Characterized by:**
- Verifying both logical implementation of the Capability specifications and code requirement specifications (programming language rules, syntaxes and logic)
- Documenting description of techniques, tools, and test conditions used
  - The variety of possible techniques precludes a detailed listing here
- Documenting how acceptance criteria for software tests and quality metrics were met (Reliability, Maintainability, Security, Efficiency, Size and Complexity)
  - For subjective criteria, qualifications of evaluators should be documented
- Documenting configuration management process, and test standards, including:
  - Technical (dynamic and static test results),requirement coverage, etc.
  - Any limitations or errors identified through the verification efforts
  - Implications for simulation use
- Confidence in software accuracy is a function of:
  - Development environment: Verification evidence (activities and results), & Any S/W quality assessments done and ***documented*** on the software
  - User must be able to answer the question: "How much confidence do I have that the simulation is well-constructed and good enough for my use?"

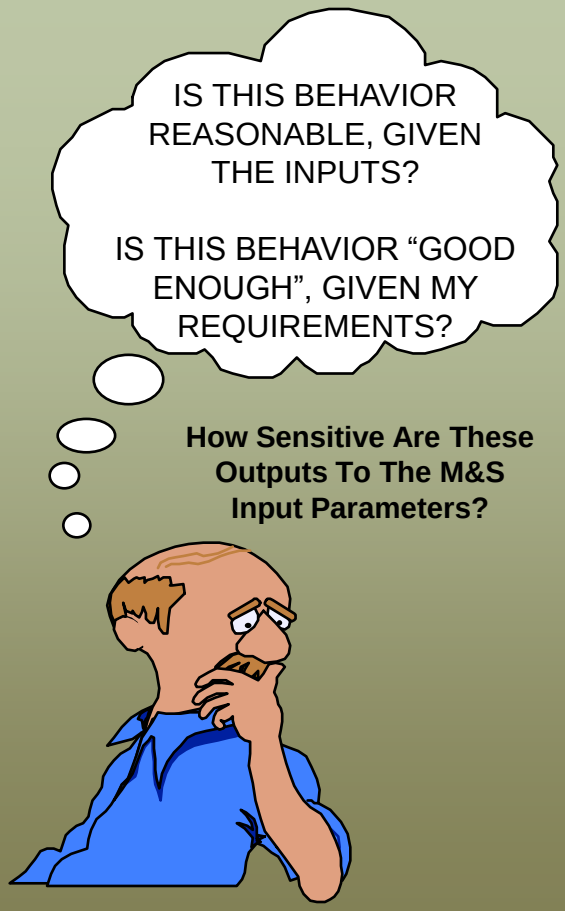
OUTPUT ACCURACY

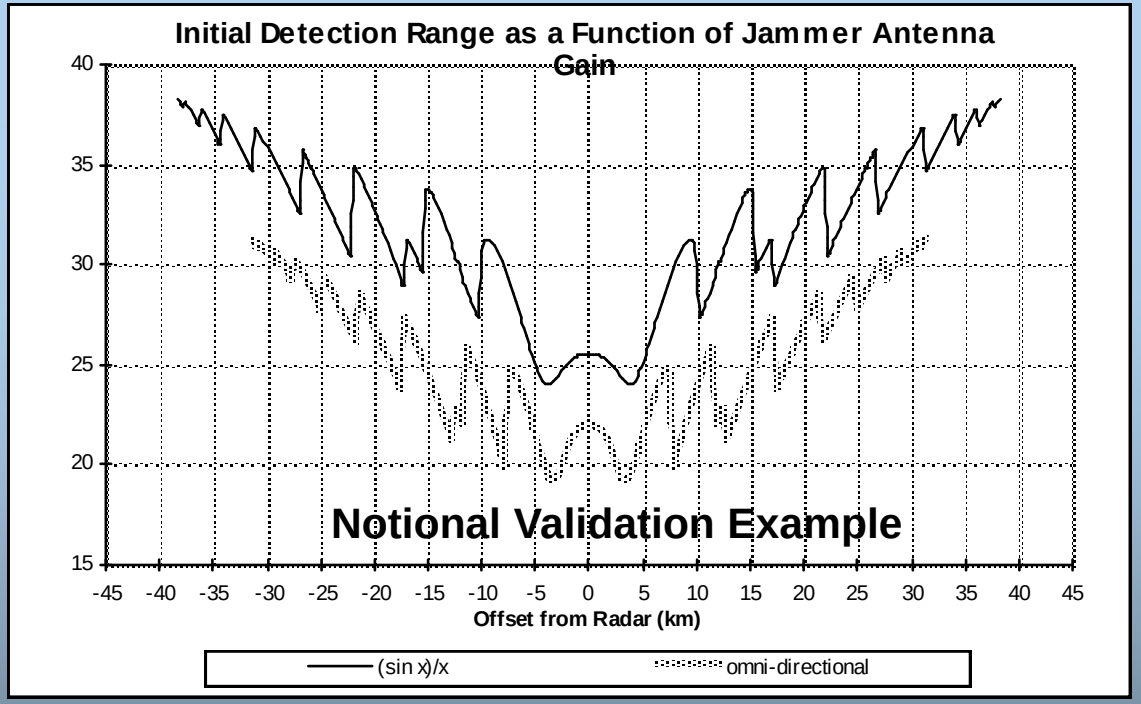
DEFINITION: **The Degree To Which The Simulation Outputs Match The "*Real World*."**

- **THIS IS WHAT IS COMMONLY CALLED "VALIDATION"**
- Validation always comes down to a ***comparison*** between simulation predictions and some representation of the ***"Real World"***
- There are ***three*** ways to define the "***Real World"*** :
  - **Test Data (Range/Lab/Field measured data)**
  - **Another "Valid" simulation (Benchmarking)**
  - **Subject Matter Expert (SME) Review (Face Validation)**
- For Validation "**Good enough"** is determined by how the simulation will be used.

OUTPUT ACCURACY ISSUES

Sensitivity Analysis





Antenna Pattern	Mean (m)	s (m)	Normalized Mean Difference	% Change
Omni-directional (baseline)	25.26	3.38	-	-
(sin X)/X	30.67	4.00	0.05	9.67

OUTPUT ACCURACY ISSUES

THE NEED FOR

"FIELD MEASURED M&S VALIDATION DATA"

Simulation Credibility

Output Accuracy Issues: Is There An Overemphasis On Validation?

- **Validation Short of Verification is a serious problem because:**
  - A good programmer can tweak a simulation to match any given "Real Measured Validation Data"
  - Natural variability and susceptibility to experimental errors in data
  - It is probably as important (if not more) to verify concepts, logic and error-free software implementation
- **Passive acceptance of benchmark simulation suitability can become an issue**
  - Wide use or Service "blessings" ***are indicators, not proofs,*** of simulation suitability
- **Face validation (SME Review) is a subjective evaluation, BUT there are objective criteria for a "good" face validation:**
  - The right people (SMEs, with)
  - The right experience (looking at)
  - The right data (in)
  - The right context (is necessary for good Face validation)

- **The main value of "Real Measured Validation Data"** is to **provide confidence** about when to stop "**Tweaking**" the Simulation. This provides confidence that the simulation agrees **with "This One Real Measured Instance Of Data!"** The number of **Instances Of agreements may or may not** be critical :Actual system operations may never encounter these scenarios.

SOMETHING TO CONSIDER:

How much measured data does NASA require to validate simulations used for the design of satellites that land on the surface of an orbiting COMET in space?

DATA ACCURACY

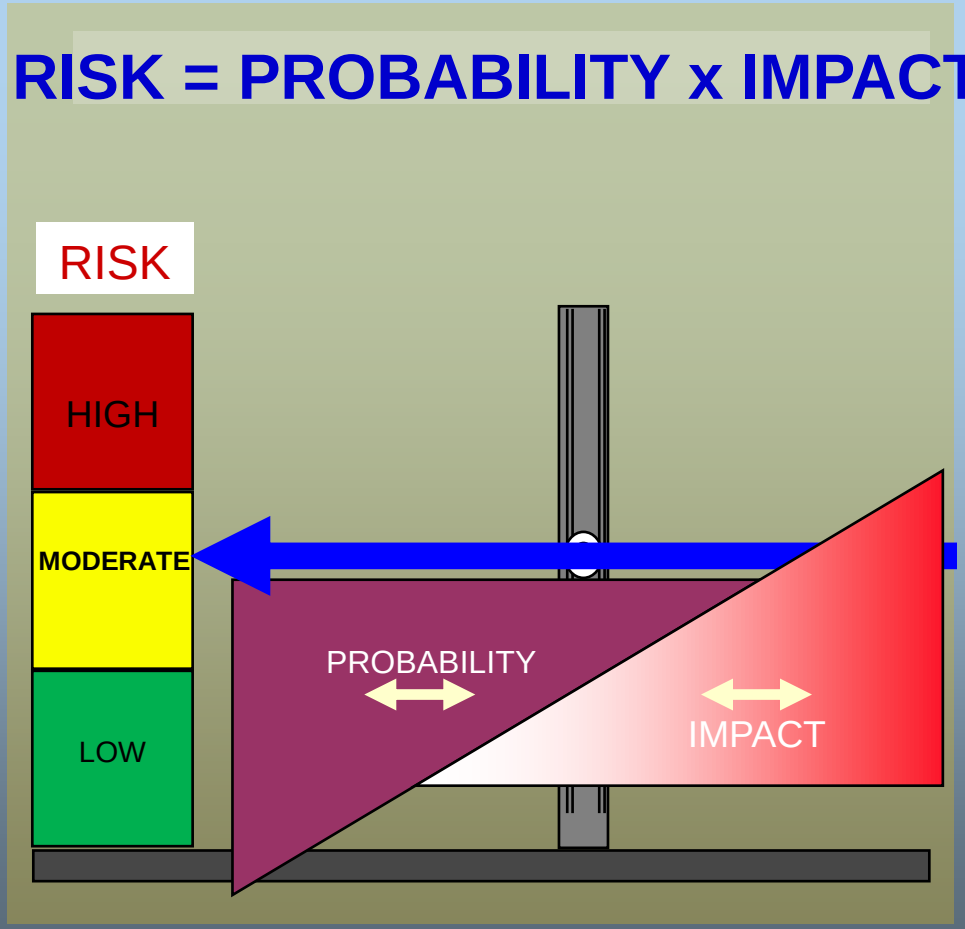
Conducting Data Quality Assurance

Everyone Says: Garbage In Garbage Out, but…

- **Here Is What To Do:**
- **Verification:**
  - **Data Pedigree:** Ensure that input data sources and appropriate classifications are identified, documented and maintained
  - **Data Collection:** Ensure that data collection conditions and their limitations are identified and documented
  - **Embedded Data :**Verify internal embedded data and data transformations via computations are consistent and correct (*desk audits, simplified table top computations/simulation etc*.)
  - Verify that input /output data handling and usage in the model are defined
- **Validation:** Ensure that input and embedded data/constants are consistent with the best or accepted values/estimates by ***comparing and confirming*** with known values
- **Certification:** Formal approval of the validity and pedigree of a data set for use for a specific purpose including appropriateness of classification by appropriate authority
- **Why Do It?**
  - Builds confidence that input data sets are acceptable for use
  - Gives the user confidence that key input parameters used by the model are as accurate as best estimates permit
  - Certifies that input data are acceptable for use in the given application
- **Various Techniques Used:**
  - Data Analysis, semantic analysis, data interface testing, and data flow testing
  - Check and verify input data values precision and bounds
- **Example: The value of the data T *shall* satisfy: $T \neq t$; $T \leq t$; $T = \bar{T} \pm t$; $T \geq t$**

How Much Is Enough?

- ***It Depends On Risk***
  - Risk means something bad happens because you believed an incorrect simulation result
    - **Decisions based on M&S results can incur risks if M&S results are in error**
  - BMVVB Process is a way to plan V&V activities based on risk
    - It has been used to support many ACAT I programs for the Navy; for the Air Force (High Energy Laser) and the Army (Underbody Blast M&S)



Risk Defined

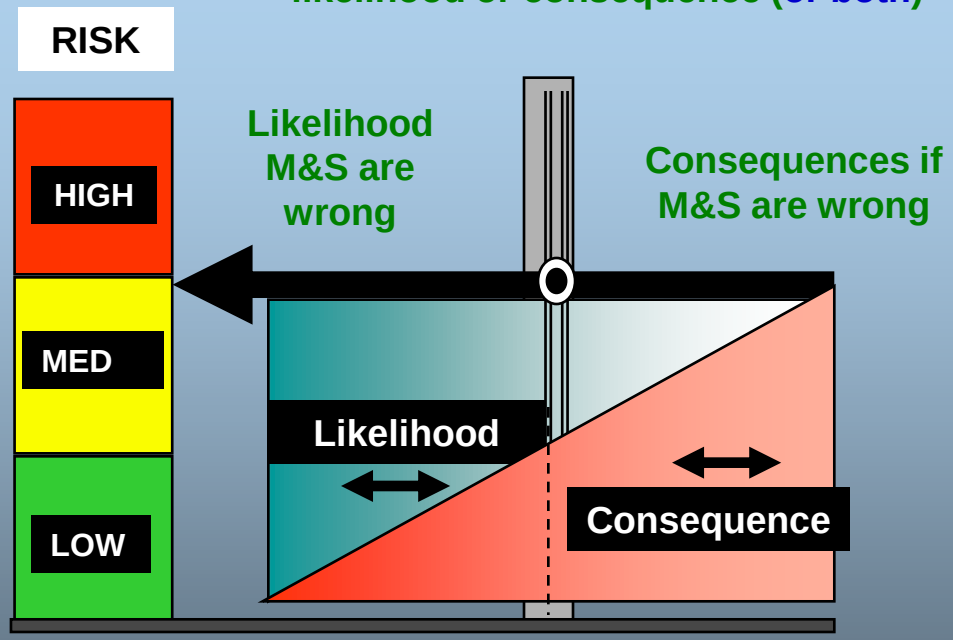
Risk Associated with M&S Use

RISK = LIKELIHOOD X CONSEQUENCE

- ***Here, the risk of interest is the risk associated with using M&S results***
  - M&S includes the models and simulations as well as the necessary input data
- ***Likelihood is the odds that the M&S and/or their input data are incorrect or inappropriate for the intended use***
- ***Consequence is the impact if the M&S output is wrong but you believe it and act on it***

Note: The risk associated with model development – will it be done on time and within budget—is an important but separate issue. Here we focus on operational risk.

To reduce risk, reduce either likelihood or consequence (or both)



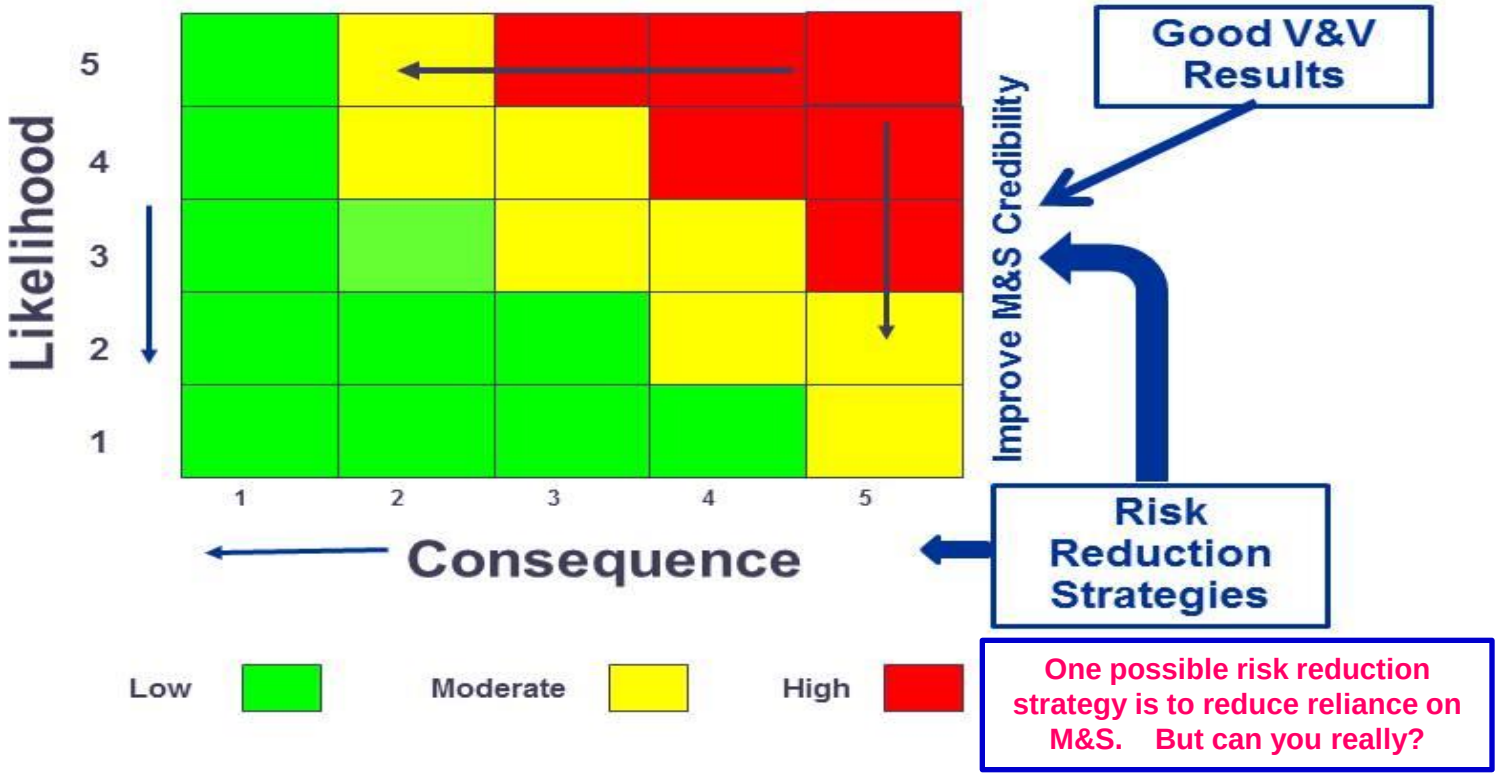
***PROBLEM:** How do you multiply two things (Likelihood and Consequences) you may not be able to define quantitatively?*
We Start by defining standardized scales for each element.

- BMVV has developed standardized scales for these elements with rules for associating them. These scales and association rules have been used successfully in many programs.

Risk-based VV&A

The Higher The Risk The More Rigorous The VV&A

Reducing Risk of M&S Results Error



Risk Assessment For M&S Characteristics

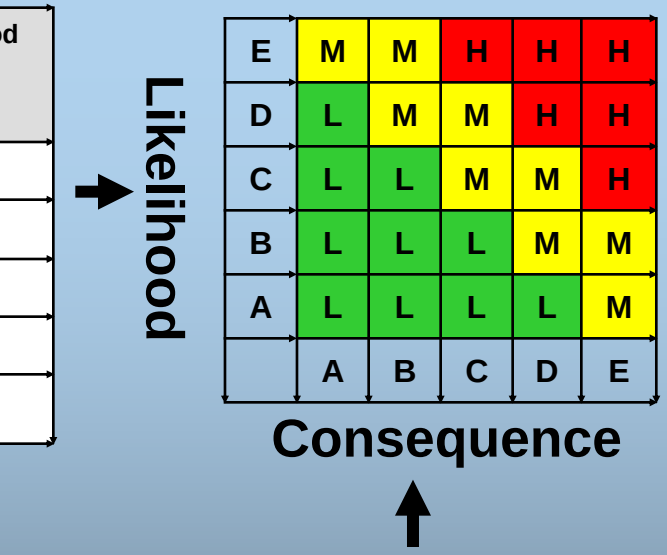
M&S CHARACTERISTICS	CRITERIA	RATING
CAPABILITY		
Intended Use	The specific intended use(s) of the model or simulation is/are clearly stated.	RED
Model Design	The model (framework, algorithms, data sources, and assumptions) produces credible results.	YELLOW
ACCURACY		
Input Data	For each model or simulation, input data are credible and subject to review and revision.	RED
System Verification	The model or simulation has been formally tested or reviewed and has been demonstrated to accurately represent the specific intended use(s) and requirements.	GREEN
Results Validation	The model's or simulation's responses have been compared with known or expected behavior from the subject it represents and has been demonstrated to be sufficiently accurate for the specific intended use(s).	YELLOW
USABILITY		
Configuration Management	For each model or simulation, modeled components are supported by a sound written Configuration Management (CM) Plan.	GREEN
User Community	For each model or simulation, the model is designed and developed for the level of competency for its intended purpose. The model is supported by documents such as user's manual, technical manual, and/or reference guide.	YELLOW

THE OVERALL M&S USE RISK

Conducting The Risk Assessment

Example Derived From Management Guide For DoD Acquisition

Level	What is the Likelihood the Risk Event will Happen?
E (High)	Near Certainty
D	Highly Likely
C	Likely
B	Unlikely
A	Remote



	Assigned Risk Level
R	**High** – Unacceptable. Major disruption likely. Different approach reqd. Priority mgmt attention reqd.
Y	**Moderate** – Some disruption. Different approach may be reqd. Addl mgmt attention may be needed
G	**Low** – Minimum impact. Minimum oversight needed to ensure risk remains low.

Level	Technical Performance	And/ or	Schedule	And/ or	Cost	And/ or	Impact on Other Teams
A	Minimal or no impact		Minimal or no impact		Minimal or no impact		None
B	Acceptable, some reduction in margin		Additional resources reqd; able to meet need dates		<5%		Some impact
C	Acceptable; significant reduction in margin		Minor slip in key milestones; not able to meet need date		5 – 7%		Moderate impact
D	Acceptable; no remaining margin		Major slip in key milestones or critical path impacted		7-10%		Major impact
E (High)	Unacceptable		Can't achieve key team or major program milestones		>10%		Unacceptable

M&S RISK DETERMINATION PROCESS

Determine the "Importance of Technical Decision Supported by the Model/Simulation". Enter Importance rating.

Determine the "Level of Reliance on the Model/Simulation". Enter Reliance rating.

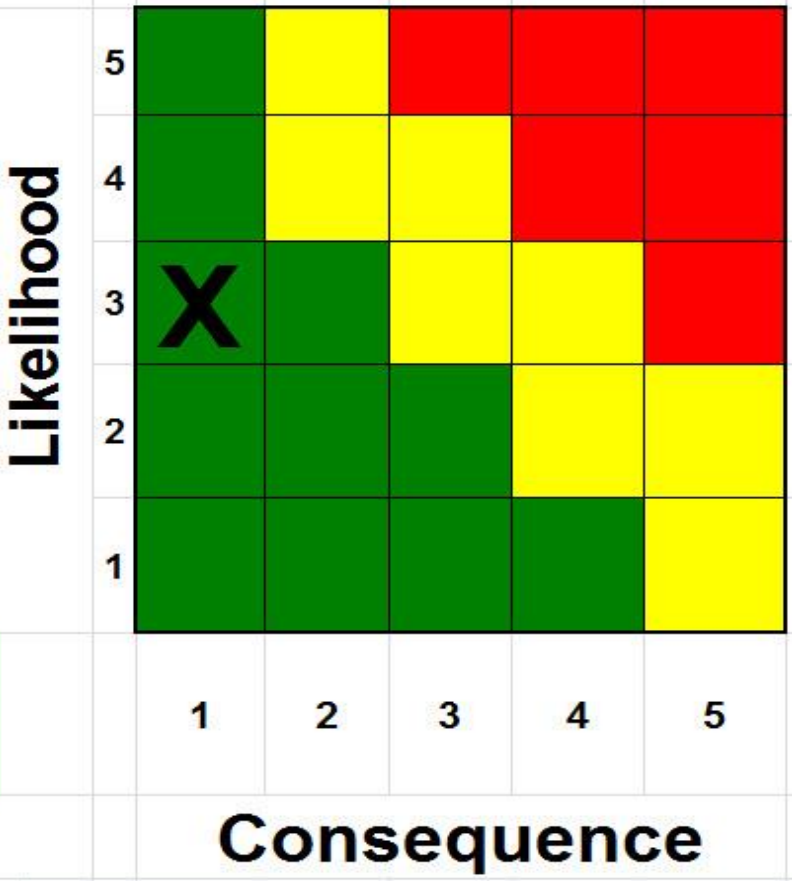
Consequence rating is automatically calculated from the Importance and Reliance ratings using the Combining Matrix.

Combining Matrix is shown in Table 2 for reference.

Risk is automatically calculated from the Likelihood and Consequence ratings.

RATINGS:

Likelihood (1 to 5)	3
Importance (1 to 4)	1
Reliance (1 to 4)	1
Consequence (1 to 5)	1
Overall Risk Level	Low



PROCESS SUMMARY

- **Start With "Well-defined" Intended Use Statement(s)**
- **Define Simulation Credibility (Requirements) :**
  - **Capability:** (Functions modeled and their level of detail (Fidelity))
    - Detailed function decomposition required
  - **Accuracy:** Software, Data, and Outputs (Validation)
    - Well defined/testable and documented requirements
  - **Usability:** User Facilities that facilitates operating the Simulation Correctly (User manuals, Help Desk, User websites, documentation)
    - Implemented Configuration management process that is followed
- **Define Acceptability Criteria And Their Measures**
  - Carefully determined processes with simulation outcome parameters
- **Conduct VV&A To Establish Simulation Credibility**
  - Verify, Validate And Accredit (determine, test, and document results of) Capability, Accuracy and Usability, then assess to complete the simulation credibility picture
- **Conduct Risk Assessment**
  - Determine the extent of V&V (and other information) needed to establish Simulation Credibility for the defined Intended Use
- **Summarize Assumptions, Limitations and Known Errors (SALE)**

SOMETHING TO REMEMBER

Start With A Well-articulated Intended Use Statement

THE M&S CREDIBILITY EQUATION

Credibility = f(Capability, Accuracy, Usability)

Well Defined ***Requirements***, **Acceptability Criteria** *and* ***Measures***

Capability: What Can This Simulation Do ?

Functions, Fidelity, and Operational Characteristics needed to meet the IUS

Accuracy: How well does it do it?

Software, Data, Outputs are tested under configuration management

Usability: Do I have what I need to use it correctly?

Training, Documentation, User Support

Appropriate Hardware & Software

- **Is This "Tool" Fit For This Purpose?**

Can We Assess The Risk If The Wrong Solution To The Credibility Equation Is Used? **SALE!**

These Are What The Accreditor Needs To Know!!

Conclusion

- This process provides decision makers a way to gauge and establish M&S credibility
- The process optimizes resources spent on VV&A based on the risk associated with using results of the M&S to support decision making
- The process is applicable to both Legacy and New M&S
- The process has been used successfully for various ACAT I programs such as CH-53K, Triton, P-8, etc.)
- Process incorporates the DoD MIL-STD 3022 (Tailored to the method and risk-based approach)