

Consistent Credibility Criteria



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CONSTELLATION



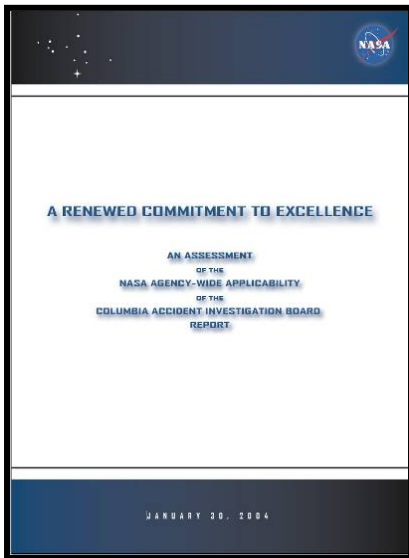
Drivers for NASA-STD-7009 and M&S VV&A



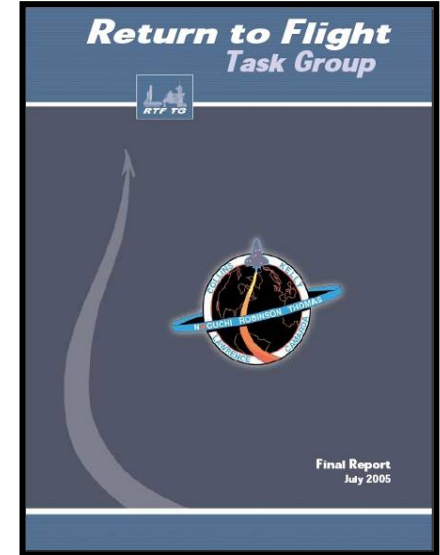
Columbia Accident Investigation Board (CAIB)



A Renewed Commitment to Excellence (Diaz Report)



Return-to-Flight Task Group (Stafford-Covey Report)



NASA Chief Engineer Memo, Sept. 2006

Office of the Chief Engineer

TO: Distribution

FROM: Chief Engineer

MEMO: NASA Standard for Models and Simulations (SMS)

The NASA Engineering and Safety Center (NESC) is conducting the development of a NASA Standard which will provide criteria for use of SMS. Addressing the findings and recommendations from the Columbia Accident Investigation Board, we need a standard that will improve our ability to develop, validate, and maintain computer models. The Chief Engineer has an active and critical Agency SMS requirements by the end of fiscal year 2006.

The SMS standard will:

- Ensure that the availability of SMS meets the project requirements.
- Specify that the availability of SMS meet the project requirements.
- Establish SMS requirements and recommendations that will form a strong foundation for disciplined construction, management, control, development, validation and use of SMS within NASA and its contractor community.
- Include a standard method to assess the availability of the SMS presented to the decision maker when making critical decisions (i.e., decisions that affect human safety, or mission success using models from SMS).
- Establish a common set of terms and a uniform way for SMS practitioners to communicate the availability of SMS.
- Be responsive to Plan Action 14.

The standard development is in the final stages, with only a few, but critical, issues left to be resolved. In response to the standard to date output - it is not done that it be completed before the end of September 2006. It is anticipated that the Engineering Management Board members make their own decisions for the rest of this fiscal year. In practice this means that they participate fully in the review of all developed models. I anticipate that there will be weekly decisional meetings about all existing Engineering Management Board members to ensure that their own decisions are fully understood and that the standard, and, if not, to identify an



M&S VV&A Team Initiated October 2005

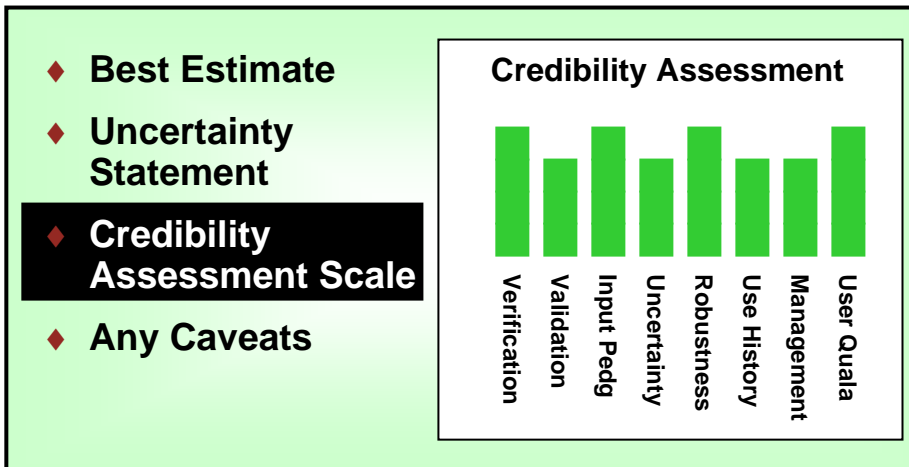
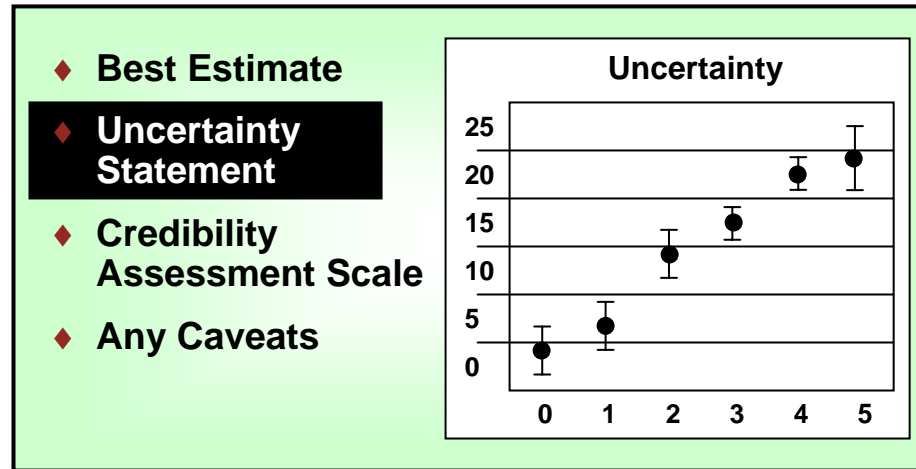
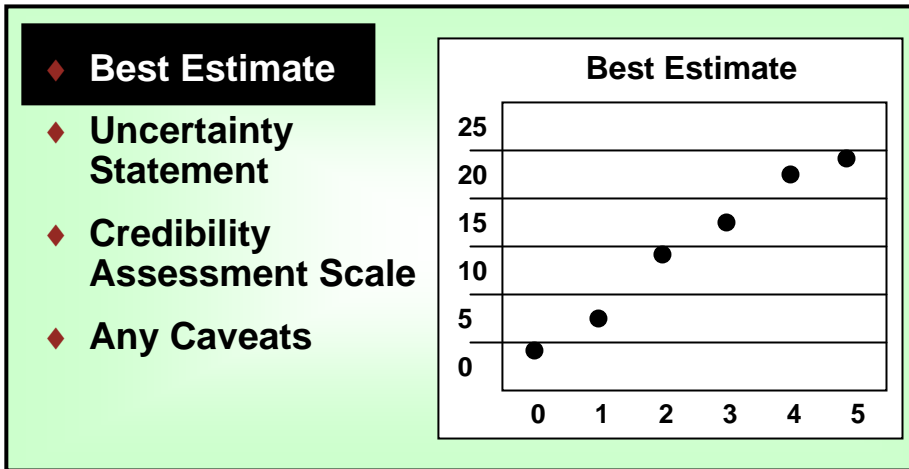


Credibility Assessment Approach - Final



NASA-STD-7009 Section 4.7: Assessing the Credibility of M&S Results

"The operational concept of the credibility assessment scale is that the presentation of any results from M&S to a decision maker include (1) the best estimate of the results, (2) a statement on the uncertainty in the results, (3) the evaluation of the results on the credibility assessment scale, and (4) any explicit caveats that accompany the results."



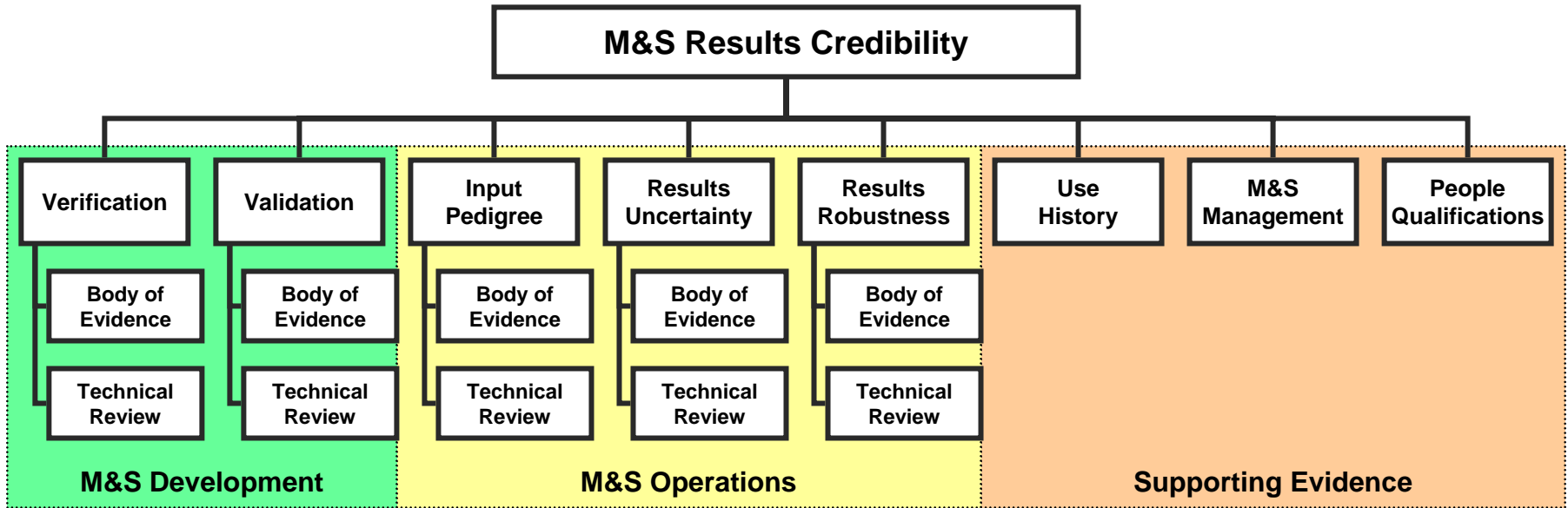
- ◆ Best Estimate
- ◆ Uncertainty Statement
- ◆ Credibility Assessment Scale
- ◆ Any Caveats

CAUTION

Validated for low earth orbit only



The Credibility Assessment Scale





Values of the Credibility Assessment Scale



Level	Verification	Validation	Input Pedigree	Results Uncertainty	Results Robustness	Use History	M&S Management	People Qualifications
4	Numerical errors small for all important features	Results agree with real-world data	Input data agree with real-world data	Non-deterministic and numerical analysis	Sensitivity known for most parameters; key sensitivities identified	De facto standard	Continual process improvement	Extensive experience in the use of and recommended practices for this particular M&S
3	Formal numerical error estimation	Results agree with experimental data for problems of interest	Input data agree with experimental data for problems of interest	Non-deterministic analysis	Sensitivity known for many parameters	Previous predications were later validated by mission data	Predictable process	Advanced degree or extensive M&S experience, and recommended practice knowledge
2	Unit and regression testing of key features	Results agree with experimental data or other M&S on unit problems	Input data traceable to formal documentation	Deterministic analysis or expert opinion	Sensitivity known for a few parameters	Used before for critical decisions	Established process	Formal M&S training and experience, and recommended practice training
1	Conceptual and mathematical models verified	Conceptual and mathematical models agree with simple referents	Input data agree traceable to informal documentation	Qualitative estimates	Qualitative estimates	Passes simple tests	Managed process	Engineering or science degree
0	Insufficient evidence	Insufficient evidence	Insufficient evidence	Insufficient evidence	Insufficient evidence	Insufficient evidence	Insufficient evidence	Insufficient evidence
	M&S Development		M&S Operations			Supporting Evidence		