NAVAIR

NAVAL AVIATION TECHNOLOGIES

A Methodology for Designing M&S

That Integrates VV&A Processes and Documentation

14th Annual NDIA Systems Engineering Conference
San Diego, Ca. – October 24-27, 2011

BATTLESPACE
modeling and simulation

James N. Elele Ph.D.
48150 Shaw Rd., Bldg. 2109
Patuxent River, Md. 20670
(301)-342-4154
james.elele@navy.mil

Nancy M. Gould
48150 Shaw Rd., Bldg. 2109
Patuxent River, Md. 20670
(301)-342-8328
nancy.gould@navy.mil

October 2011 - B700D0082
NAVAIR Public Release 11-1378
"Approved for public release; distribution is unlimited"

Introduction

- In the past few models developed with VV&A as part of design process
- Declining resources have resulted in a growing reliance on M&S to support major decisions
- DoD policies have been written requiring VV&A to be integrated into M&S design / development process
  - Instruction 5000.61 requires that M&S used to support major DoD decisions shall undergo V&V throughout their lifecycle and be accredited for a specific purpose

Risk of Not Using VV&A

- Model may fail to support intended use
- Model may fail to meet requirements
- Model may be difficult, if not impossible, to use
- Risks can be quantified in a way that allows optimal decisions to be made
- M&S must be credible in order to be used as a tool for decision-making

Incorporating VV&A into the design process early, reduces the risk of developing an M&S that does not meet requirements or of using an inappropriate simulation to support a decision.

Capability and Risks

- Credibility is a function of three components
  - Capability
  - Accuracy
  - Usability
- Failure to meet any of these components results in its own particular risks
- Capability
  - Answers question: "Does the M&S do what I need it to do?"
  - M&S requirements flow from Intended Use Statement
  - VV&A reduces risk that M&S does not meet requirements

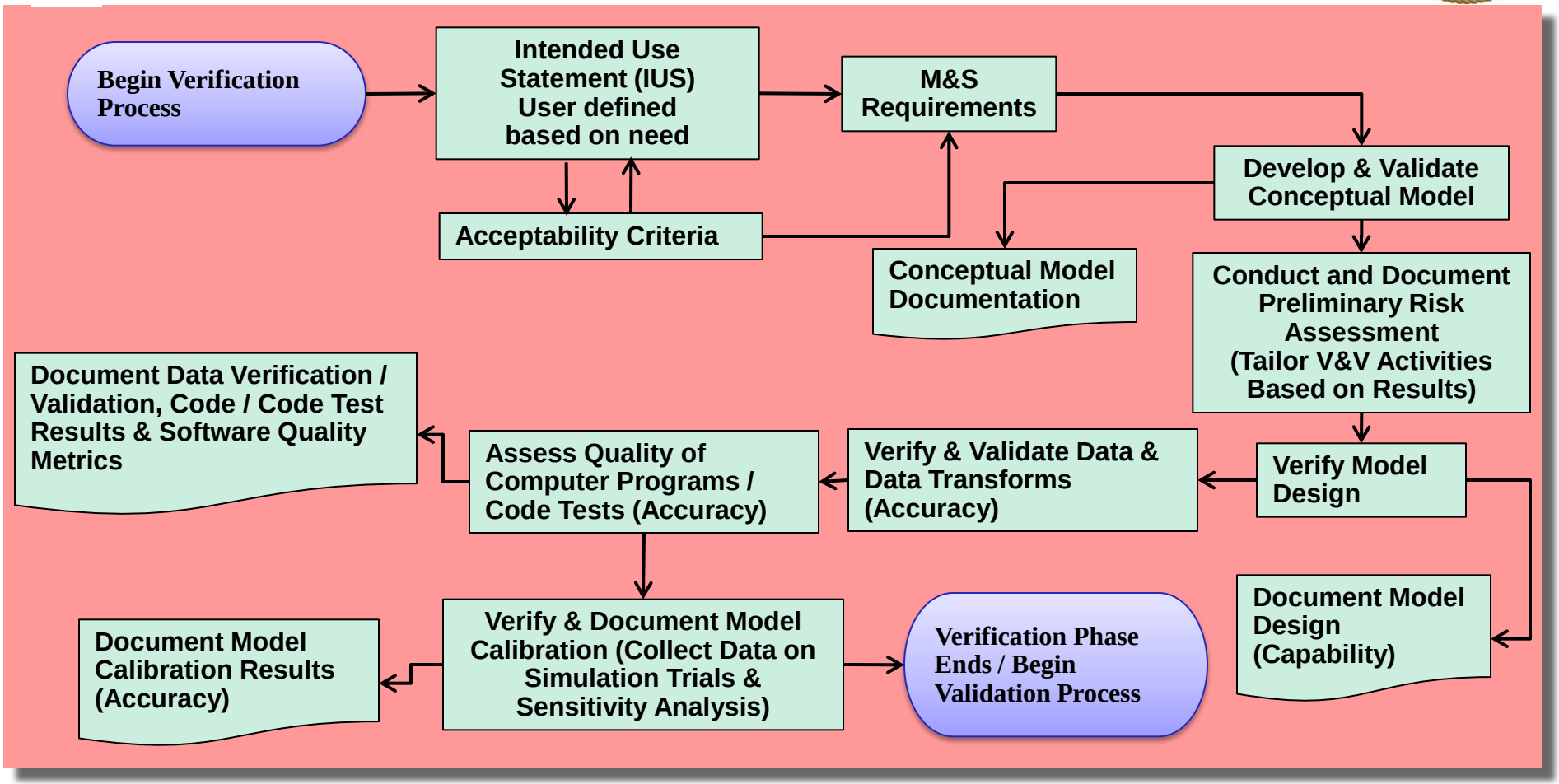
Capability and Risks

- Accuracy
  - Answers question: "How well does the M&S do what I need it to do?"
  - Three types of Accuracy
    - Software Accuracy - reduces risk that M&S doesn't performed as designed
    - Data Accuracy – reduces risks that data used are inappropriate for application, of poor quality, or improperly transformed
    - Output Accuracy – reduces risk that outputs from M&S do not match the "real world"
- Usability
  - Answers question: "How easy is it to use M&S correctly?"
  - Reduces risk that M&S will be misused

V&V Process: Verification

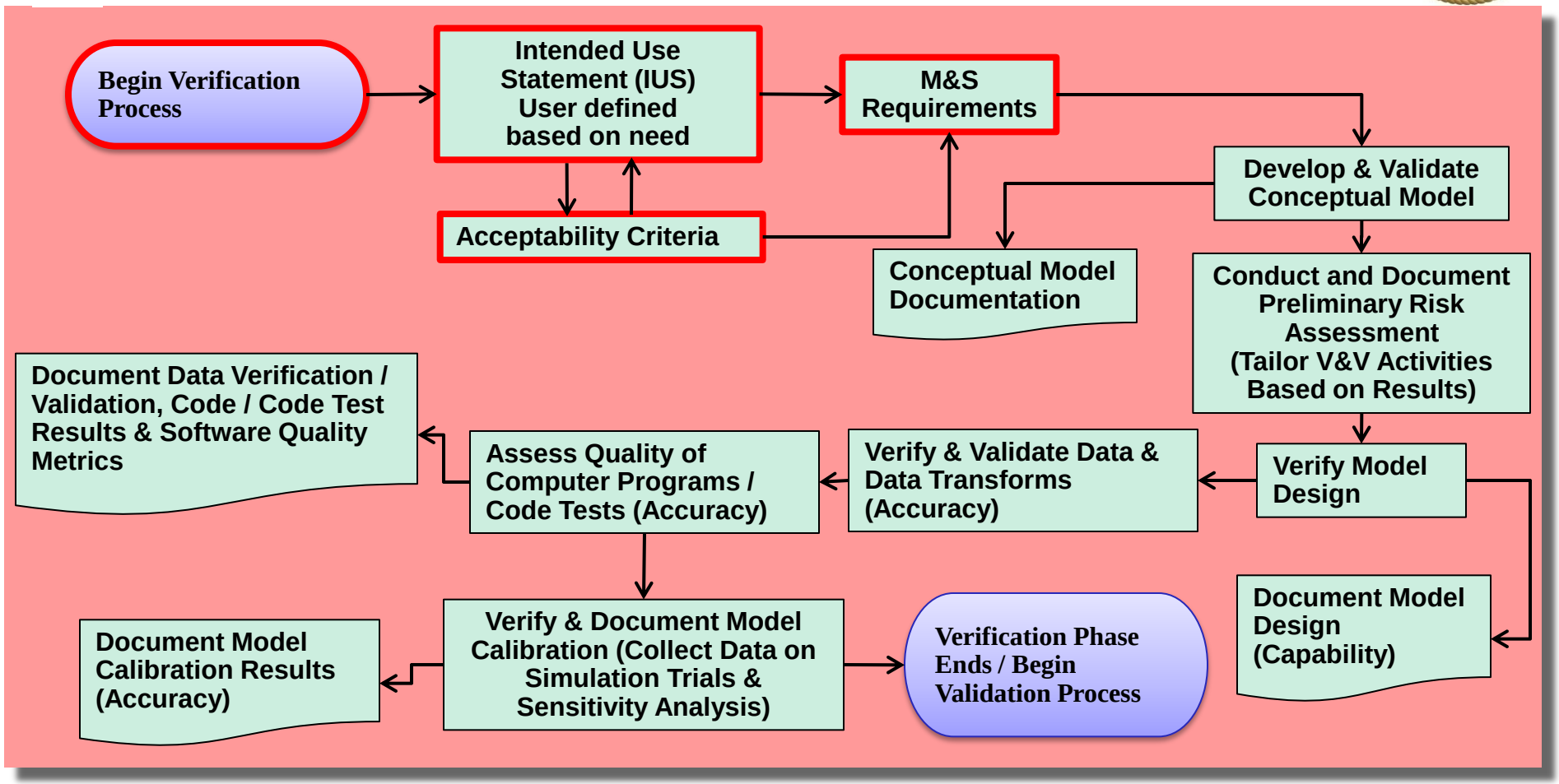
- DoD Instruction 5000.61 defines verification as *"the process of determining that a model or simulation implementation and its associated data accurately represent the developer's conceptual description and specifications."*
- Verification answers the question: "Did I build the model right?"
- Used to demonstrate software accuracy

Verification Process



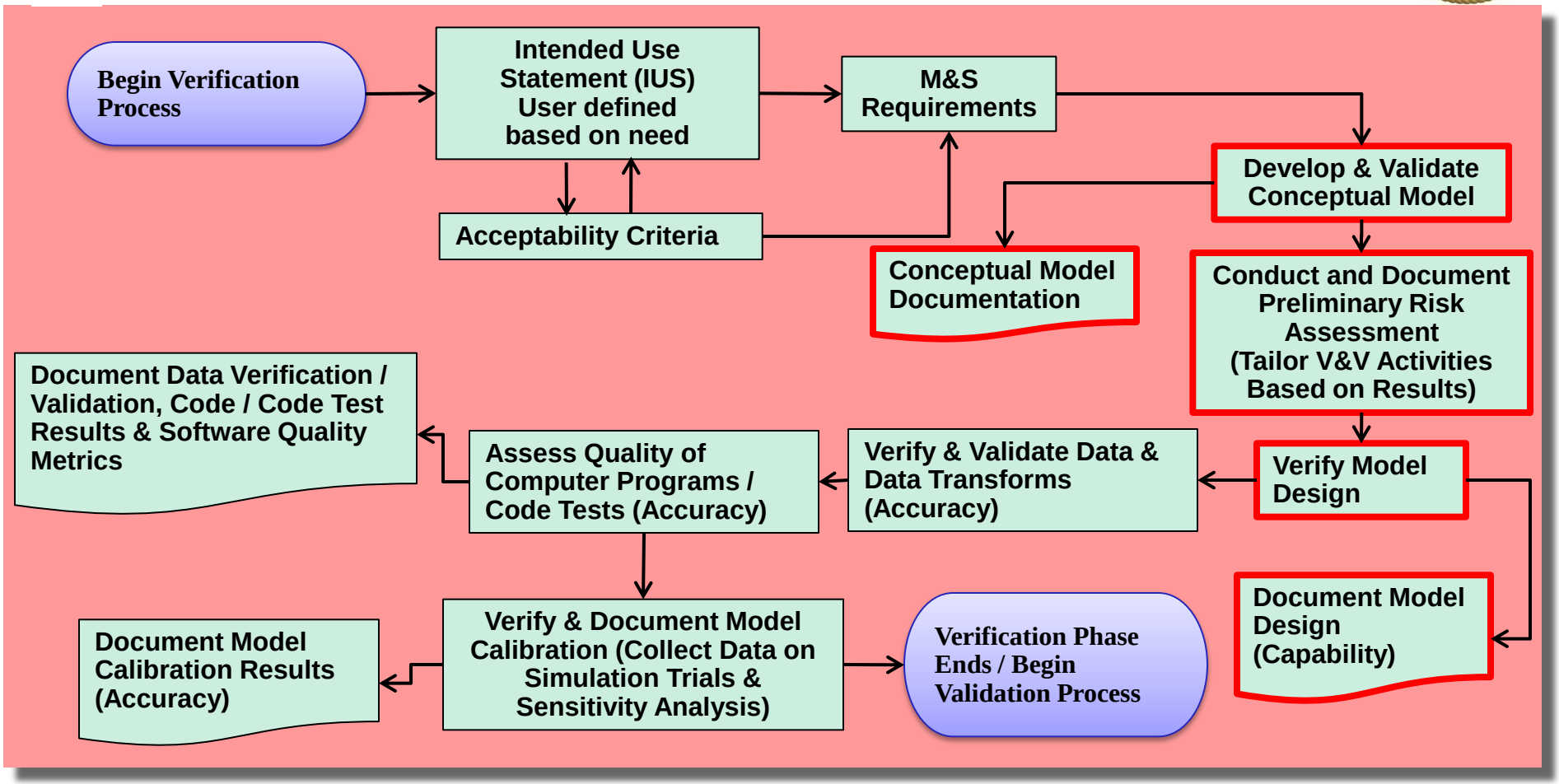
All model/design and code must be documented and placed under Configuration Management.

Verification Process (cont.)



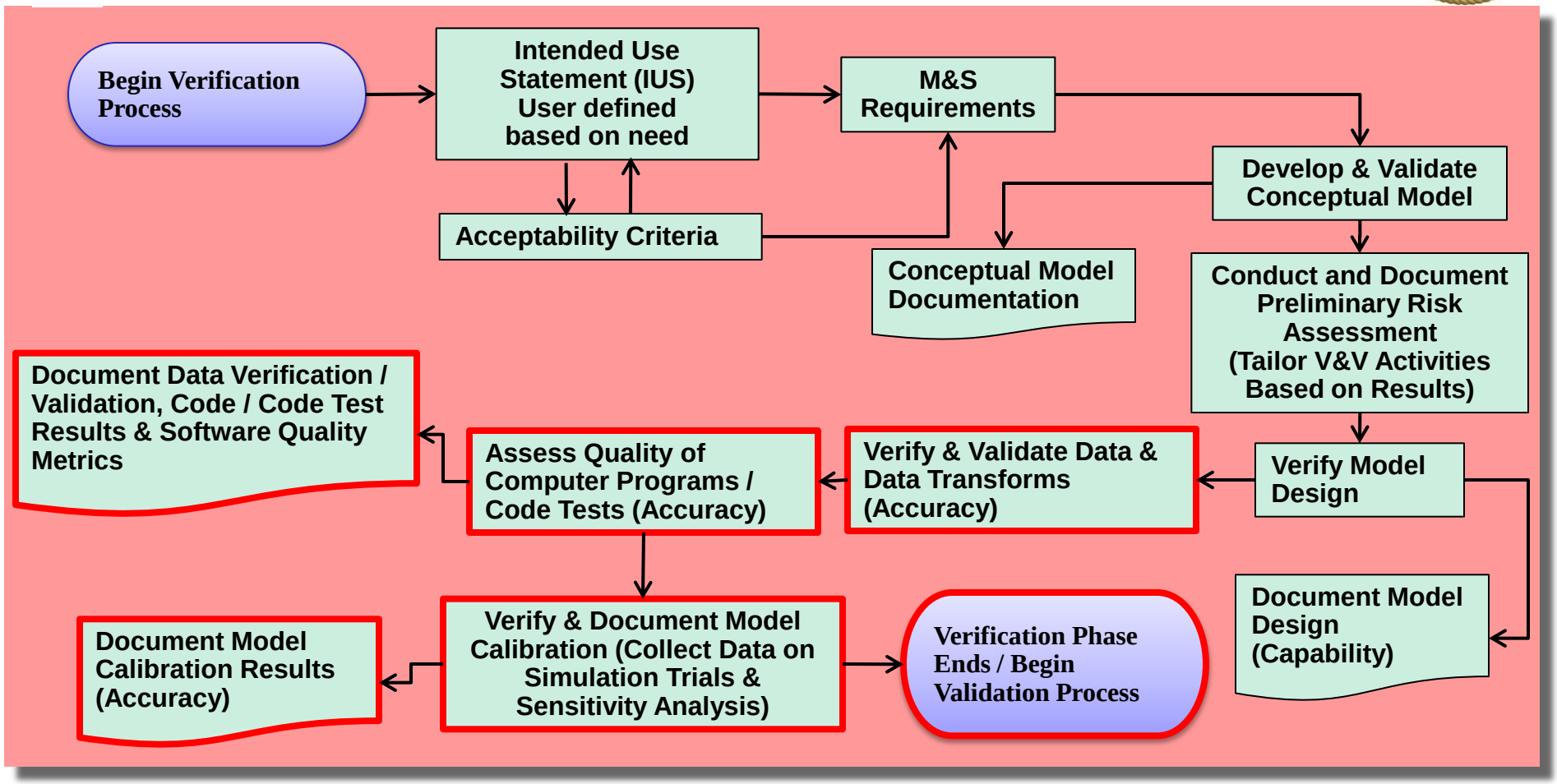
All model/design and code must be documented and placed under Configuration Management.

Verification Process (cont.)



All model/design and code must be documented and placed under Configuration Management.

Verification Process (cont.)

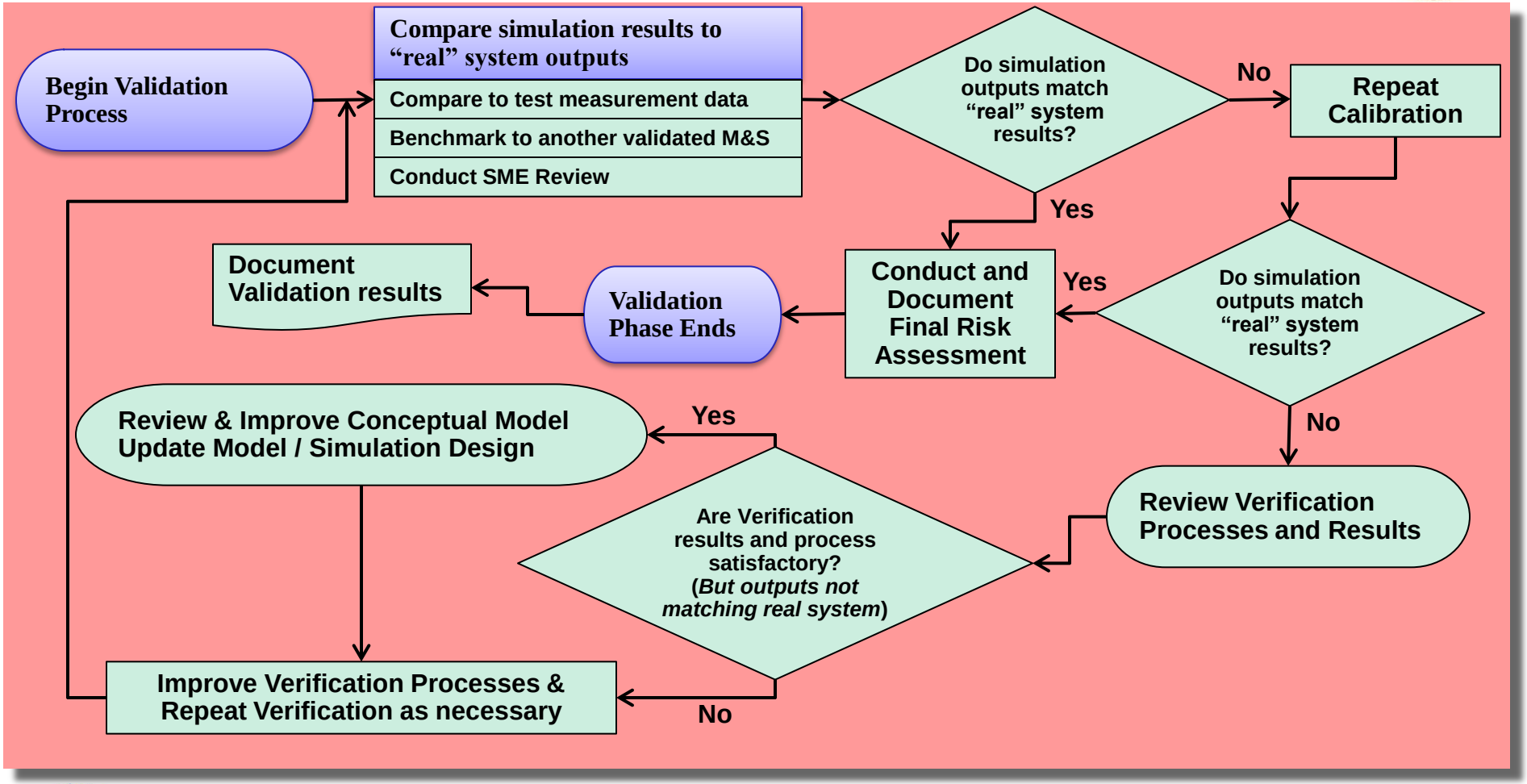


All model/design and code must be documented and placed under Configuration Management.

V&V Process: Validation

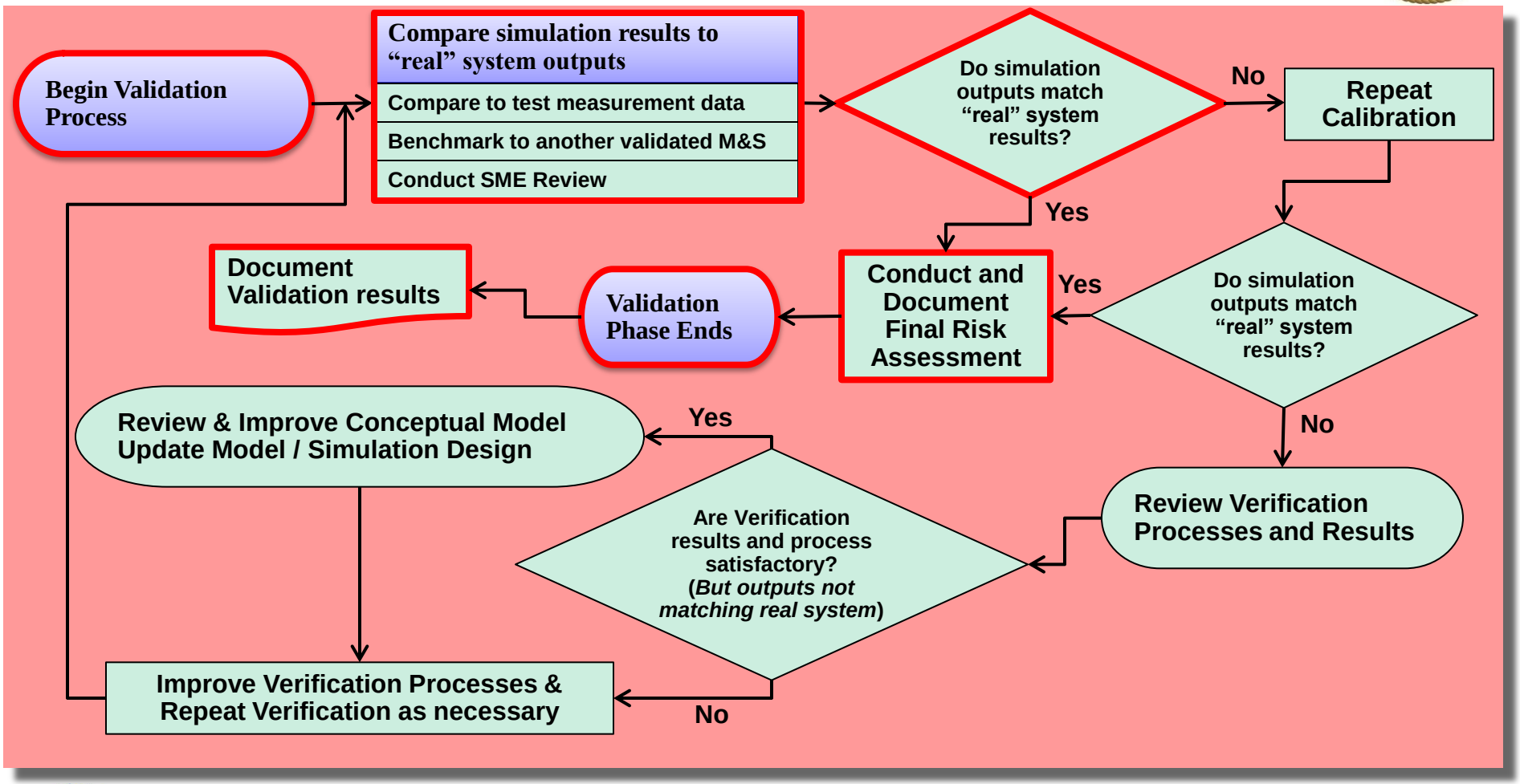
- DoD Instruction 5000.61 defines validation as “the process of determining the degree to which a model or simulation and its associated data are an accurate representation of the real world from the perspective of the intended uses of the model.”
- Verification answers the question: “Did I build the right model?”
- Used to demonstrate output accuracy

Validation Process



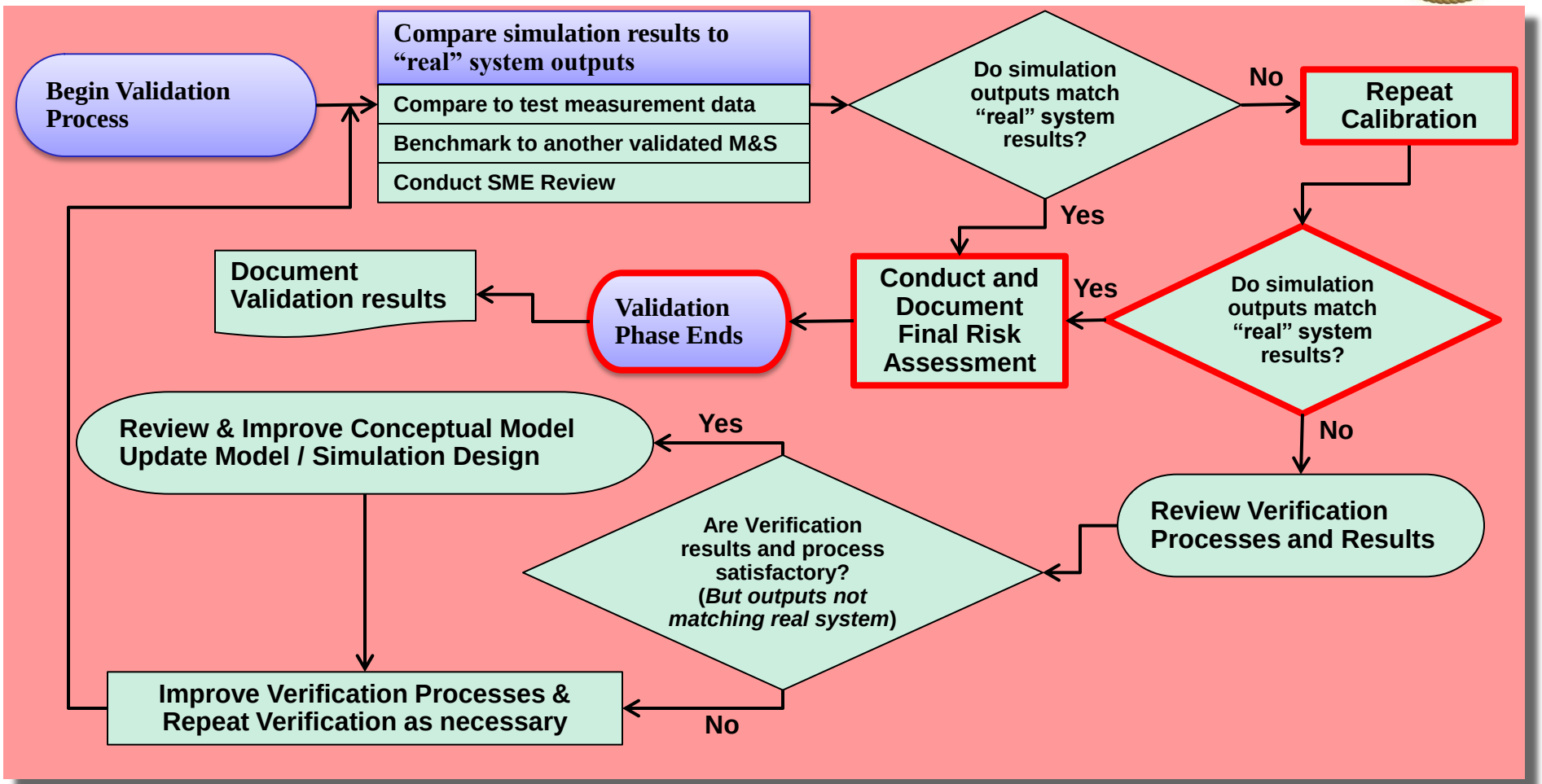
All model/design and code must be documented and placed under Configuration Management.

Validation Process (cont.)



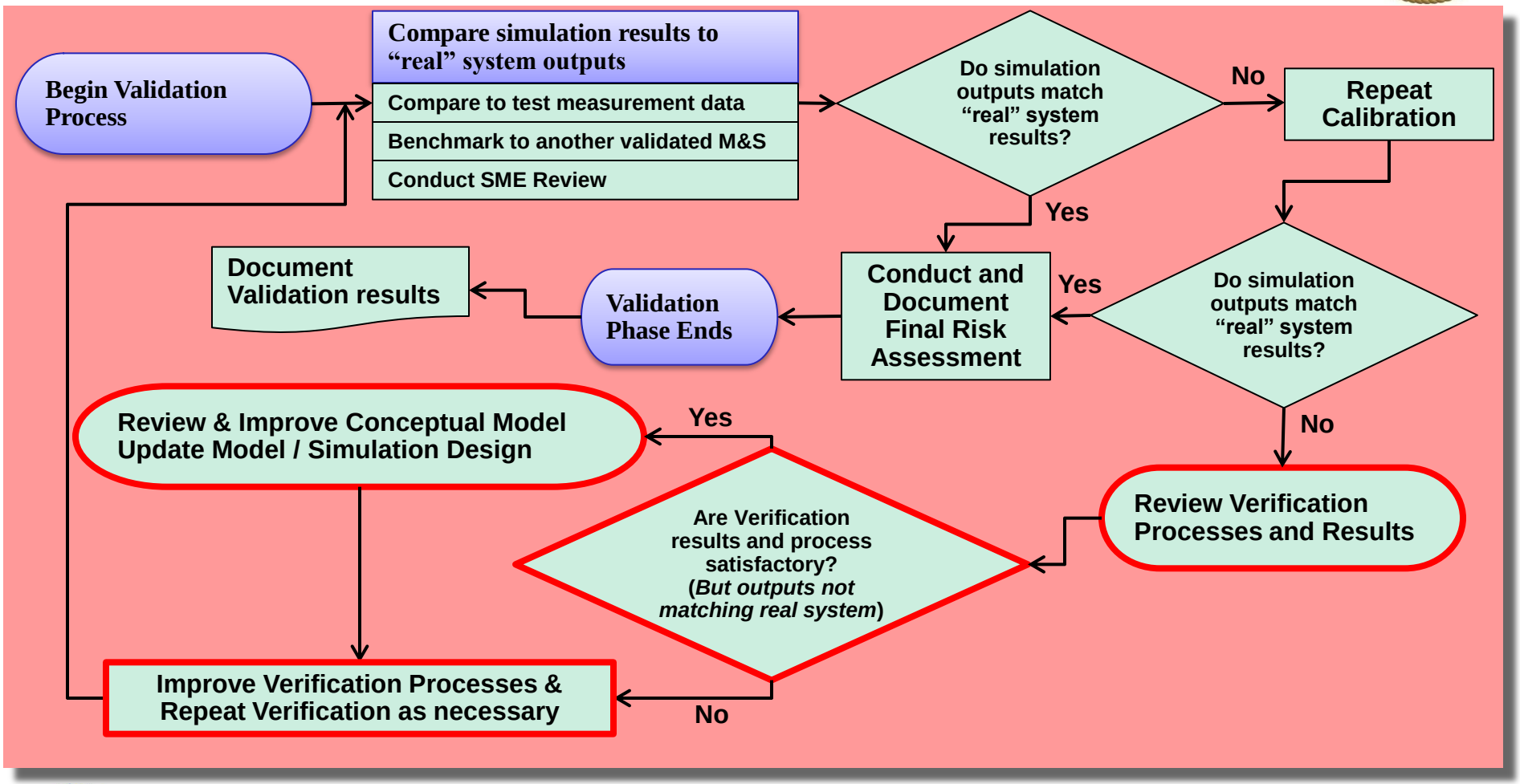
All model/design and code must be documented and placed under Configuration Management.

Validation Process (cont.)



All model/design and code must be documented and placed under Configuration Management.

Validation Process (cont.)



All model/design and code must be documented and placed under Configuration Management.

Conclusion / Take Away

- Many things can go wrong when an M&S is not properly accredited:
  - M&S may not be capable of meeting its requirements
  - M&S may not be right model for answering questions of interest
  - Data used may be inappropriate and inaccurate
  - Software could have bugs
  - Outputs may not match "real world"
  - Model may be difficult to use
- More reliance is being placed on M&S for decision-making as a result of declining resources
- Potential consequences of poor M&S design include schedule slips, cost overruns, and even death
- Only way to significantly reduce risk is to integrate VV&A processes into model design process ***from the very beginning***