Chap. 7

Building Valid, Credible, and Appropriately Detailed Simulation Models

5.1 Introduction and Definitions (1)

- *Verification* is concerned with determining whether the conceptual simulation model (model assumptions) has been correctly translated into a computer program, i.e., debugging the simulation computer program.

7.1 Introduction and Definitions(2)

- *Validation* is the *process* of determining whether a simulation model (as opposed to the computer program) is an accurate representation of the system, *for the particular objectives of the study.*

Validation

- A valid model can be used to make decisions.
- A validation process depends on the complexity of the system and on *whether a version of the system currently exists*.
- A model can only be an *approximation*.
- A model is valid for *one* purpose.
- The measures of performance used to validate the model should include those that the decision maker will actually use for evaluating system design.

7.1 Introduction and Definitions(3)

- A simulation model and its results have *credibility* if the manager and other project personnel accept them as "correct“.

- A credible model is not necessarily valid, and vice versa.

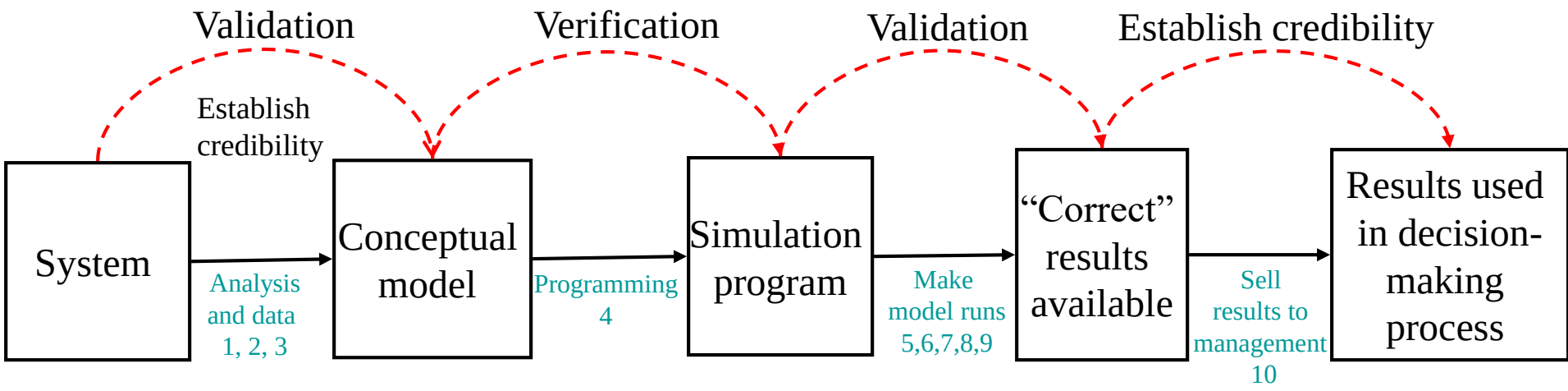

Figure 7.1
Timing and relationships of validation, verification, and establishing credibility

7.2 Guidelines for Determining the Level of Model Detail (1)

- Carefully define the specific issues to be investigated by the study and the measures of performance that will be used for evaluation.
- The entity moving through the simulation model does not always have to be the same as the entity moving through the corresponding system.
- Use subject-matter experts (SMEs) and sensitivity analyses.
- “Moderately detailed“ model.
- Regular interaction.

7.2 Guidelines for Determining the Level of Model Detail (2)

- Do not have more detail in the model than is necessary to address the issues of interest, subject to the proviso that the model must have enough detail to be credible.
- The level of model detail should be consistent with the type of data available.
- In all simulation studies, time and money constraints are a major factor in determining the amount of model detail.
- If the number of factors (aspects of interest) for the study is large, then use a "coarse" simulation model or analytic model to identify what factors have a significant impact on system performance.

7.3 Verification of Simulation Computer Program

Tech 1: Write and debug the computer program on modules or subprograms.

Tech 2: More than one person review the computer program *(structured walk through of the program).*

Tech 3: Run the simulation under a variety of settings of input parameters, and check to see that the output is reasonable.

Tech 4: "trace", interactive debugger.

Tech 5: The model should be run under simplifying assumptions for which its true characteristics are known or can easily be computed.

Tech 6: Observe an animation of the simulation output.

Tech 7: Compute the sample mean and variance for each simulation input probability distribution and compare them with the desired mean and variance.

Tech 8: Use a commercial simulation package to reduce the amount of programming required.

7.4 Techniques for Increasing Model Validity and Credibility (1)

- Collect high-quality information and data on the system
  - Conversation with subject matter experts

    in MS, machine operators, engineers, maintenance personnel, schedulers, managers, vendors, …
  - Observation of the system
    - Data are not representative of what one really wants to model
    - Data are not of the appropriate type or format
    - Data may contain measurement, recording, or rounding errors
    - Data may be biased because of self interest
    - Data may be inconsistent
  - Existing theory IID exponential random variables
  - Relevant results from similar simulation study
  - Experience and intuition of the modelers

7.4 Techniques for Increasing Model Validity and Credibility (2)

- Interact with the manager on a regular basis
  - There may not be a clear idea of the problem to be solved at initiation of the study.
  - The manager's interest and involvement in the study are maintained.
  - The manager's knowledge of the system contributes to the actual validity of the model
  - The model is credible since the manager understands and accepts the model's assumptions.
- Maintain an assumptions document and perform a structured walk-through
- Validate components of the model by using quantitative techniques.
- Validate the output from the overall simulation model
- Animation

7.5. Management's Role in the Simulation Process

- Formulating problem objectives.
- Directing personnel to provide information and data to the simulation modeler and to attend the structured walk-through.
- Interacting with the simulation modeler ona regular basis.
- Using the simulation results as an aid in the decision-making process.