# SYSTEM SIMULATION AND MODELLING

# LECTURE 4

Section D

**TOPIC COVERED :** Selecting Input Models with Data Verification & Validation of simulation Modeling: Model Building, Verification & Validation, Verification of simulation Models, Calibration & Validation of Models

# MODEL BUILDING, VERIFICATION AND VALIDATION

One of the most important and difficult tasks facing a model developer is the verification and validation of the simulation model. Block diagram for model building, verification and validation is shown in Fig. 2.8.
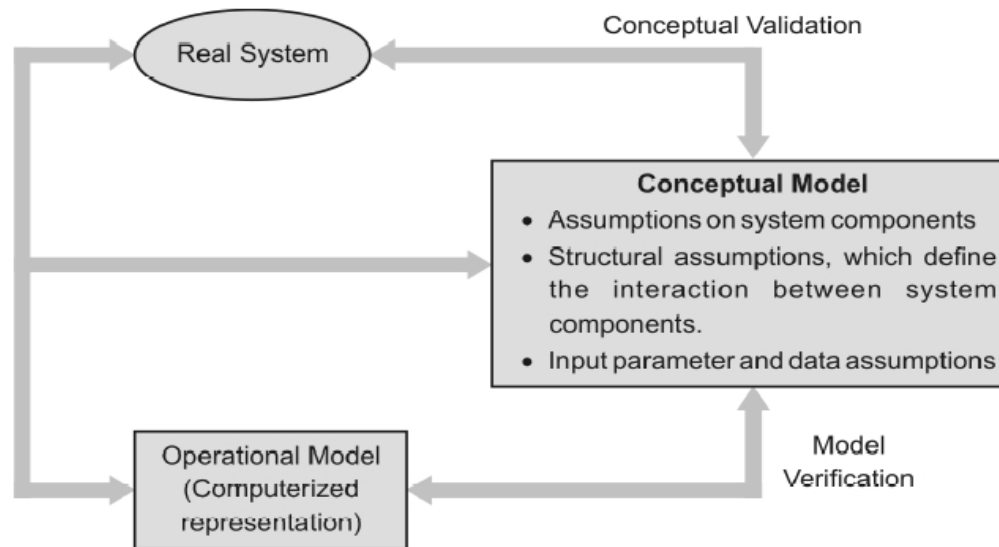


Fig. 2.8 Model building, verification and validation.

# Steps in System Model Building

- The first step in model building consists of observing the real system and the interactions among their various components and of collecting data on their behaviour.

- The second step in model building is the construction of a conceptual model—a collection of assumptions about the components and the structure of the system, plus hypotheses about the value of model input parameters.

- The third step is the implementation of an operational model, usually by using simulation software and incorporating the assumptions of the conceptual model into the world view and concepts of the simulation software.

- The validation of a simulation model is a concept that should be taken into account throughout the model building process.

- According to Law and Kelton, the key methodological steps for building valid and credible simulation models one the following:

**Verification:** Verification, which consists in determining that a computer simulation program performs as intended and is concerned with building the model properly.

**Validation:** Validation, which consist in determining whether the conceptual simulation model (as opposed to the computer program) is an accurate representation of the system under study, validation involves building the right model.

In validating a simulation model the analyst should not forget that.

- A simulation model should always be developed for a particular set of purposes.
- A simulation model of a complex system can only be an approximation to the actual system. There is no such thing as an absolutely valid model of a system.
- Model development and validation should be carried out alongside each other throughout the entire simulation study.
- A simulation model should be validated relative to those measures of performance that will actually be representative of these purposes.

# Calibration and Validation of Models

Calibration is the iterative process of comparing the model to the real system, making adjustments to the model, comparing the revised model to reality, making additional adjustments, comparing again and so on.

Verification and validation are conducted simultaneously by the modeler.

Validation means the process of testing the model to see if it does actually represent a viable and useful alternative means to real experimentation. This requires calibrating the model, that is, adjusting model parameters until the resulting output data agree closely with the observed system data.

- The comparison of the model to the reality is done by a variety of tests (some subjective and objective).
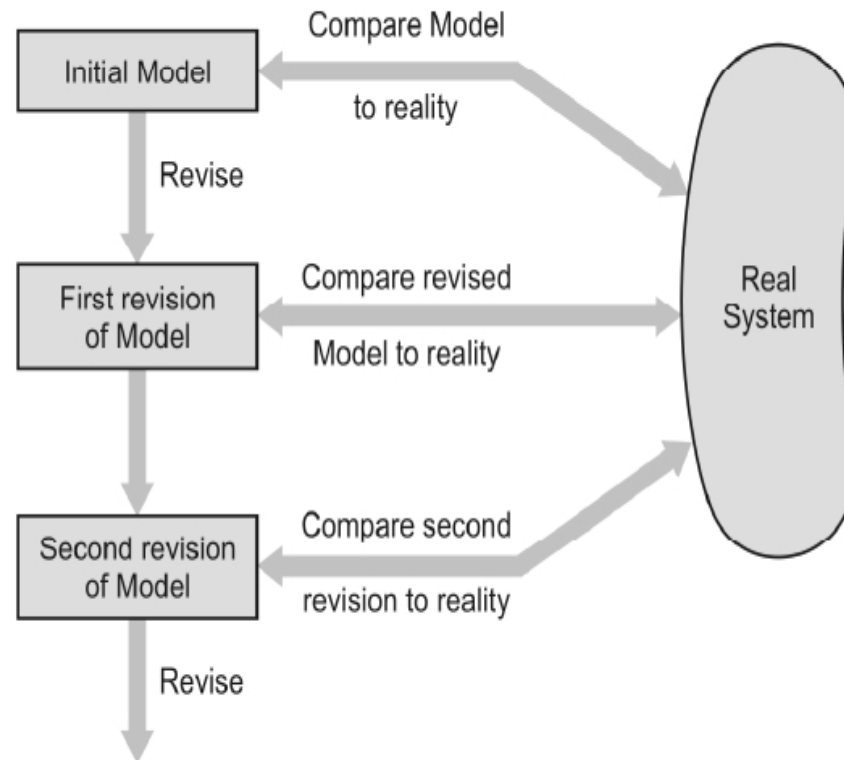


**Fig. 2.9** Iterative process of calibrating a model.