# UNIT-6

## Verification and Validation

One of the most important and difficult task for a model developer is the verification and validation of simulation model. It is the job of model developer to work closely with the end users throughout the period to increase the credibility. The verification and validation process consists of following components:

(i) Verification is concerned with building the model right. It is utilized in comparision of the conceptual model to the computer representation that implement that conception. It asks the question: Is the model implemented correctly in the computer? Are the input characters and logical structure of the model correctly represented?

ii) Validation is concerned with building the right model. It is utilized to determine that a model is an accurate representation of the real system. It is usually achieved through the calibration of the model.

## ⊛. Model Building:- [Imp]

The first step in model building consists of observing the real system and the interactions among it's various components and collecting data on it's behaviour. Operators, technicians, repair and maintenance personnel, engineers etc. understand certain aspects of the system which may be unfamiliar to others.

The second step in model building is the construction of a conceptual model: a collection of assumptions on the components and the structure of the system, plus hypotheses on the values of model input parameters.

The third step is the translation of the operational model into a computer recognizable form - the computerized model.

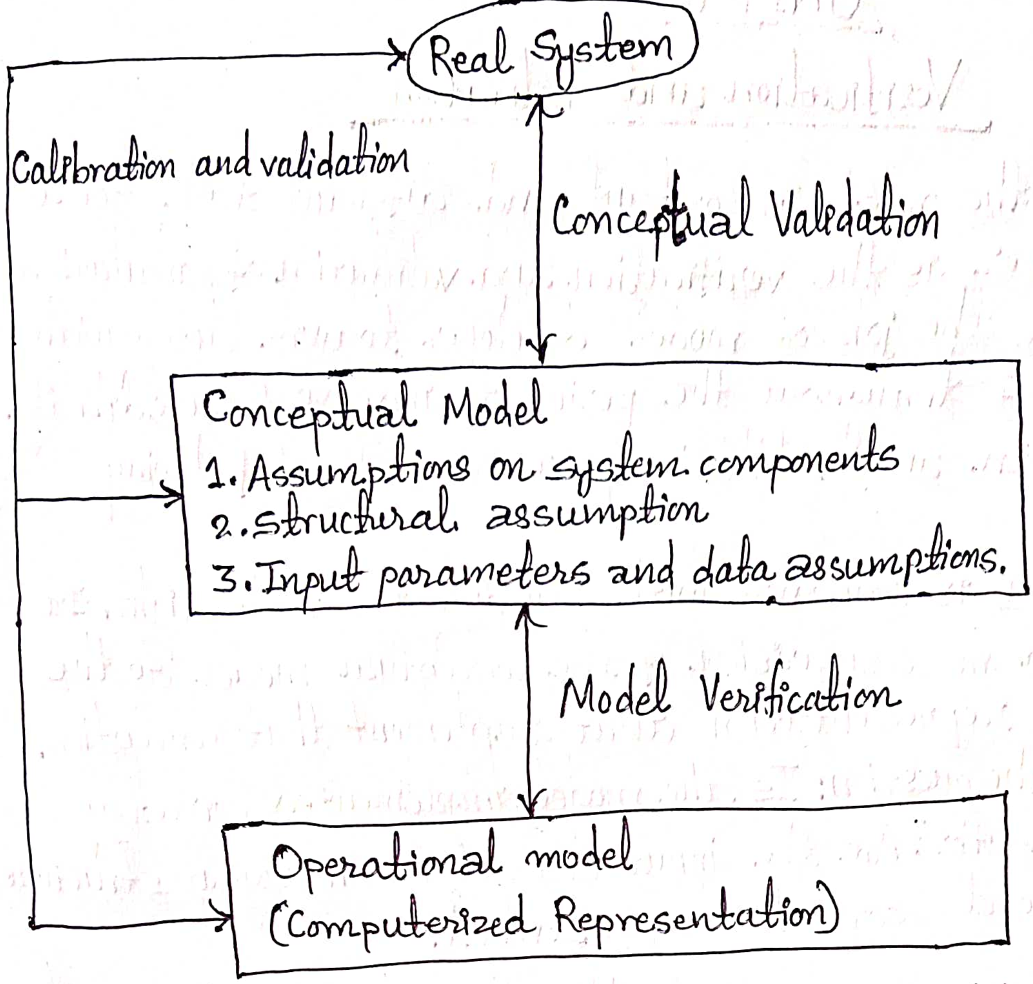


Fig: Model Building, Verification and Validation.

## ⊛ Verification of Simulation Models:

The purpose of model verification is to satisfy that the conceptual model is reflected accurately in the computerized representation. Many common-sense suggestions can be given for use in the verification process:

→ Have the computerized representation checked by someone other than it's developer.

→ Make a flow diagram which includes each logically possible action a system can take when an event occurs.

→ Closely examine the model output for reasonableness under a variety of settings of input characters.

→ Make the computerized representation of self-documenting as possible.

→ If the computerized representation is animated, verify that what is seen in the animation imitates the actual system.

The interactive run controller (IRC) or debugger is an essential component of successful simulation and model building. Even the best simulation analysts makes mistakes or logical errors when building a model. The IRC assists in finding and correcting those errors in following ways:

→ The simulation can be monitored as it progresses.
→ Attention can be focused on a particular line of logic or multiple lines of logic.
→ Values of selected model components can be observed.
→ The simulation can be temporarily paused, to view information, and to reassign values.

## ⊛. Calibration and validation of Models: [Imp]

Calibration is the iterative process of comparing the model to the real system, make adjustments to the model, comparing again and so on. The comparision of model to reality is carried out by variety of test.

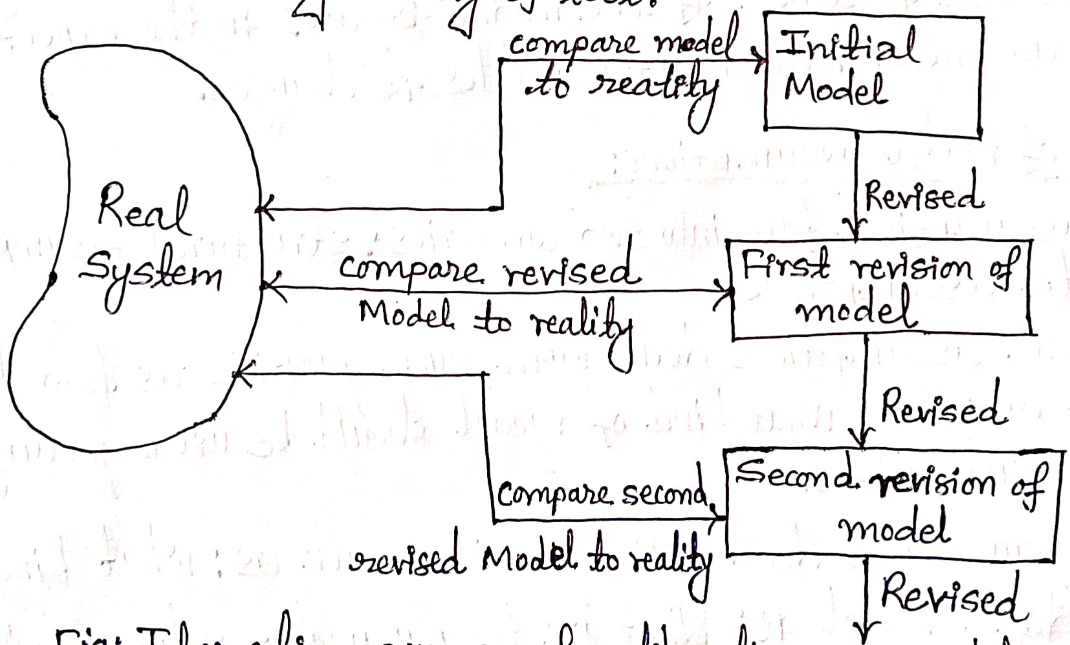


Fig: Iterative process of calibrating a model.

Tests are subjective and objective. Subjective test usually involve people who are knowledgeable about one or more aspect of the system making judgements about the model and its output. Objective tests always require data on the system's behaviour plus the corresponding data produced by the model.

[Imp] **Validation process:** For validation process, there are three steps approach which has been widely used:

i) Build a model that has high face validity.
ii) Validate model assumption
iii) Compare the model input-output transformations to corresponding input-output transformations for the real system.

**i) Face validity:**

- ↳ Build a "reasonable model" on it's face to model users who are knowledgeable about the real system being simulated.
- ↳ The users of a model should be involved in model construction from it's conceptualization to it's implementation to ensure that a high degree of realism is built into the model through reasonable assumptions regarding system structure and reliable data.

escape this point if felt hard

- ↳ Sensitivity model can also be used to check model's face validity.
- ↳ The model user is asked if the model behaves in the expected way when one or more input variables is changed.

**ii) Validation of model assumptions:**

- ↳ Model assumptions fall into two categories: structural assumptions and data assumptions.
- ↳ Structural assumptions deal with such questions as how the system operates, what kind of model should be used, queuing, reliability and others.
- ↳ Data assumptions deal with questions such as: what kind of input data model is? What are the parameter values to the input data model?

**iii) Validating Input-Output Transformations:**

- ↳ View the model as a black box and feed the input at one end and examine the output at other end.
- ↳ Use the same input for real system, compare the output with the model output.

↳ If they fit closely, the black box seems working fine, otherwise something is wrong.

## ⊛ Introduction to Accreditation of models:

Model accreditation is an official determination that a model is acceptable for a specific purpose. Accreditation certifies that the element being accredited meets given standards. For a model, accreditation must be done with respect to the models explicit specifications and the demonstration that the computer-based model does or does not meet the specifications.

This demonstration is the responsibility of the model developers, who must show that their work passes developer acceptance tests. If the modeling process was done properly and if appropriate documentation was done, then accreditation of model for its specified uses should follow.