Simulation:

- It is the imitation (duplication) of the operation of a real world process or system over time. It is acting out an actual or probable real life condition, event or situation to find a cause of a past occurrence or to forecast future effects of assumed circumstances or factors.
- It is used to describe and analyze the behavior of a system.
- e.g. flight simulator, driving simulator etc.
- *Simulation* is the application of a model with the objective to derive strategies that help solve a problem or answer a question pertaining to a system.
- Note that the term *simulation* originates from the Latin word ‘‘simulare’’, which means ‘‘to pretend’’: in a simulation, the model pretends to be the real system. A similar definition has been given by “Fritzson” who defined simulation as ‘‘an experiment performed on a model’’.
- The behavior of any system as it evolves over time is studied by developing a simulation model. This model usually takes the form of a set of assumptions concerning the operation of the system.
- Simulation is a quantitative procedure which describes a process by developing a model of that process and then conducting a series of organized experiments to predict the behaviour of the process over time.
- Observing the experiments is very much like observing the process in operation. To find out how the real process would react to certain changes, we can produce these changes in our model and simulate the reaction of the real process to them.
- In many business situations a model can be developed which is simple to solve by mathematical method, however many real world systems are so

complex that models of these system are virtually impossible to solve mathematically. In these instances numerical computer based simulation can be used to study the behavior of the system.

- The simulation generated data is used to estimate the measures of performance of the system.
- Simulation modeling is used both as an analysis tools for predicting the effect of changes to the existing systems and as a design tool to predict the performance of new system under varying sets of circumstances.
- We know that mathematical modeling is the process of representation of some real life situation or system in terms of mathematics. In this process we attempt to optimize the model or system under some given circumstances and study the effect of change of various input parameter of the system. Examples are inventory modeling,Queuing modeling etc. For model validation simulation is the most import is the most important tool.
- Simulation is a tool to evaluate the performance of a system under different configurations of interest over real time.
- Simulation is usually understood as the process of generating reality.

REASONS FOR USING SIMULATION

- In the case of number, of problems, we have been able to find through straight forward techniques, mathematical solutions to the situation. The economic order quantity inventory models and Simplex solution to a linear programming problem are some of the typical examples we can cite.
- However, in each of those cases the problem was simplified by certain assumptions so that the appropriate mathematical techniques could be employed.

- Some managerial situations are so complex that mathematical solution is impossible. In these cases, simulation offers a good alternative.
- If we insist that all managerial problems have to be solved mathematically, then we may find ourselves simplifying the situation so that it can he solved; sacrificing realism to solve the problem can get us in real trouble.
- While in some cases the solutions which result from simplifying assumptions are suitable for the decision-maker, in other cases, they simply are not.
- Simulation is an appropriate substitute for mathematical evaluation of a model in many situations. Although it also involves assumptions, they are manageable. The use of simulation enables us to provide insight into certain management problems where mathematical evaluation of a model is not possible.

Among the reasons why management scientists would consider using simulation to solve management problems are the following:

1. Simulation may be the only method available because it is difficult to observe the actual environment.
2. It is not possible to develop a mathematical solution.
3. Actual observation of a system may be too expensive.

4. There may not be sufficient time to allow the system to operate extensively. (If we were studying long-run trends in world population, for instance, we simply could not wait the required number of years to see results.)

5. Actual operation and observation of a system may be too disruptive.

6. **What if ?** Questions can be answered.

7. Benefit of investment is some business can be tested without actual investment.

8. Benefit of changing of modify some decision in business can be tested without actual apply.

LIMITATIONS OF' SIMULATION

Use of simulation in place of other techniques, like everything else, involves a tradeoff, and we should be mindful of the disadvantages involved in the simulation approach. These include the facts that

1. **Simulation is not precise. It is not optimization and does not yield an answer but merely provides a set of the system's responses to different operating conditions. In many cases, this lack of precision is difficult to measure.**
2. A good simulation model may-be very expensive. Often it takes years to develop a usable corporate planning model.
3. Not all situations can be evaluated using simulation
4. Simulation generates a way of evaluating solutions but does not generate solutions themselves. Managers must still generate the solutions they want to test.

STEPS IN THE SIMULATION

All effective simulations require a great deal of planning and organization. Although simulations vary in complexity from situation to situation, in general we will have to go through these steps:

1. Define the problem or system you intended to simulate.

2. Formulate the model you intend to use.

3. Test the model; compare its behaviour with the behaviour of the actual problem.

4. Identify and collect the data needed to test the model.

5. Run the simulation.

6. Analyze the results of the simulation and, if desired, change the solution you are evaluating.

7. Rerun the simulation to test the new solution.

8. Validate the simulation; this involves increasing the chances of the inferences you may draw about the real situation from running the simulation to become valid.

WHEN SIMULATION IS AN APPROPRIATE TOOL:

1. It enables one to study internal interactions of a complex system or of a subsystem within a complex system.
2. The effect of information, organization and environmental changes on the model's behavior can be simulated and observed.
3. The performance of the system under investigation can be improved by knowledge gained from simulations.
4. Simulation results can help to find which variables are the most important ones and how variables interact.
5. It can be used as a learning tool.
6. It can be used to verify analytical solutions.
7. Simulation in the form of animation can show the system in action, so that the plan can be visualized.
8. The interactions in modern complex system like factory, water fabrication, etc. can be treated only through simulation.

WHEN SIMULATION IS NOT APPROPRIATE

1. Problem is solvable by common sense.
2. Problem can be solved mathematically.
3. Direct experiments are easier.
4. Simulation costs exceed the savings.
5. Simulation requires time which is not available.
6. No input data is available and simulations need data.
7. Simulation cannot be verified and validated.
8. system behavior is too complex or unknown

PROBLEMS:

1. **What is simulation, explain simulation, short note etc**
2. **Reasons for using simulation**
3. **Limitations of' simulation**
4. **Steps in the simulation**
5. **When simulation is an appropriate tool and when not.**