If you can't do, simulate

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If you can't DO, SIMULATE

Brownbag Talk

By

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Today's discussion

- Introduction to Simulation
- Types of Simulation
- Some benefits of Simulation
- Introduction to Model
- Aspects of a Successful Simulations
- Simulation and Modeling Tools (Arena)

Simulation (What? Why?)

- Simulation involves the modelling of a process or system in such a way that the model mimics the response of an actual system to events that take place over time. (Schriber 1987).
- Simulation is the process of designing a model of a real system and conducting experiments with this model for the purpose of understanding the behaviour of the system and evaluating various strategies for the operation of systems.
- Simulation reflects the behaviour of the real world in a small and simple way.

Classification of Simulation

- Iconic

  Flight or driving simulators,

  NFS / Flight Simulator

- **Symbolic**

  Symbolic simulation models are those which the properties and characteristics of the real system are captured in mathematical and/or symbolic form.

Symbolic Simulation

- This simulation can include:
  - Detailed information about system components
  - Closely conform to the unique aspects of each system
  - Evaluate time-variant behaviour
  - Provide system specific quantities to measure performance

Applications of Symbolic Simulation

- Manufacturing
- Banks and ATMs
- Transportation/logistics/distribution operation
- Health Services (Hospitals, A&E, Ambulance, etc)
- Computer networks
- Business process (insurance office)
- Chemical plant
- Fast-food restaurant
- Supermarket
- Emergency Services
- Supply chain

Some benefits of Simulation

- Improves decision making with minimal cost
- Compress and expand time (allows speeding up or slowing down specified conditions)
- Reasons behind specific system conditions
- Explore possibilities with minimal expenses
- Diagnose problems (understand the complex interactions between elements of the system)
- Identify system constraints and limitations
- Develop a general understanding of the behaviour of the system

Some more benefits of Simulation

- Visualise the plan
- Build consensus by creating objective opinion
- Prepare for change
- Prudent investment
- Training the project team
- Specify system requirements at design stage
- Capture complexity

Simulation Modeling

- **Model** – set of assumptions/approximations about how the system works
  - **Study the model instead of the real system … usually much easier, faster, cheaper, safer**
  - **Can try wide-ranging ideas with the model**
    - **Model *validity* (any kind of model … not just simulation)** *Care in building to mimic reality properly*
    - *Level of detail*
    - *Get same conclusions from the model as you would from system*

Principles of Simulation Modelling

- **Conceptualization:** a model requires knowledge, engineering judgment and model building tools
- **Reconfigurable:** models should be accurate and flexible enough to reflect the changes to the system (i.e. updating should be seamless)
- **Evolutionary:** information fed and extracted from the model should represent real system behaviour
- **Problem statement as controlling factor:** problem formulation and objective definition
- **Dynamism:** Dynamic systems change in time the model should be capable of reflecting system dynamics

Aspects of a Successful Simulation

- **Problem definition:** Clearly defining the goals of the study. (why are we studying this problem and what questions do we hope to answer).
- **Project planning:** being sure that we have the sufficient resources to do the job.
- **System definition:** determining the boundaries and restrictions to be used in defining the system (or process) and investigating how the system works.
- **Conceptual model formulation:** developing a preliminary model either graphically (e.g. block diagram) to define the components, descriptive variables, and interactions (logic) that constitutes the system.

Aspects of a Successful Simulation contd…

- **Preliminary experimental design:** what data need to be gathered from the model, in what form, and to what extent.
- **Input data preparation:** identifying and collecting the data required by the model.
- **Model translation:** formatting the model in an appropriate simulation language.
- **Verification and validation:** confirming that the model operates the way the analyst intended (debugging) and that the output of the model is believable and represents the output of the real system.

Aspects of a Successful Simulation contd…

- **Final experiment design:** designing an experiment that will yield the desired information and determining how each of the test runs.
- **Experimentation:** executing the simulation to generate the desired data and perform a sensitivity analysis.
- **Analysis & interpretation:** drawing inferences from the data generated by the simulation.
- **Implementation and documentation:** putting the results to use, recording the findings, and documenting the model and its use.

Simulation Tools: Arena

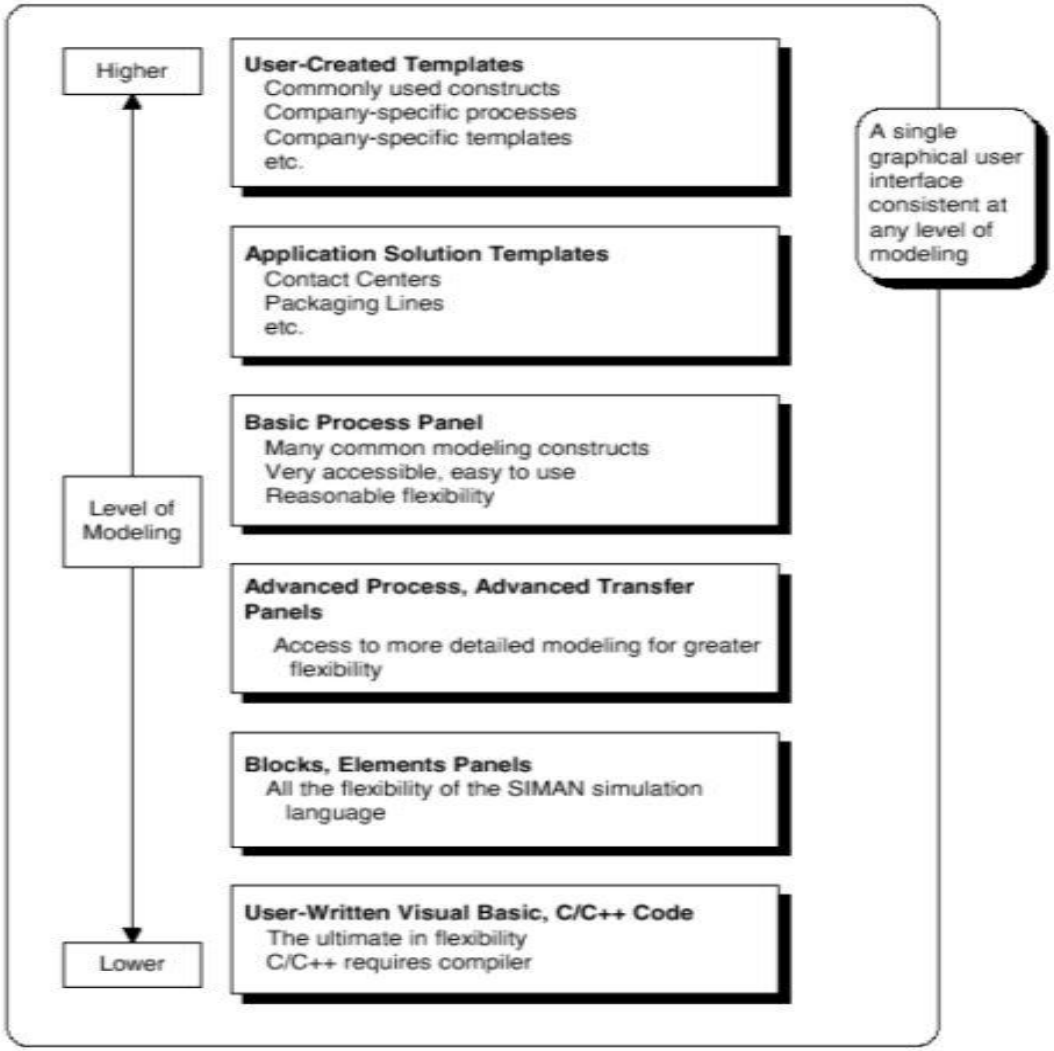
www.arenasimulation.com

Provides an integrated framework for building simulation models in a wide variety of applications. It integrates all the functions needed for a successful simulation including:

- 1) animation
- 2) analysis of inputs and outputs data
- 3) model verification

into one comprehensive environment.

Arena Hierarchical Structure



Basic Components of Arena

- **Queues :** explains waiting status of entities due to the status of the system.
- **Transporters :**Entities move in the system via transporters.
- **Conveyors :** Conveyors are devices that move entities form one station to another in one direction.
- **Variables :** Represent values that describe the characteristics of the system.
- **Statistical accumulators:** Variables that "watch" what's happening
  - **Depend on output performance measures desired**
  - **"Passive" in model — don't participate, just watch**
  - **Many are automatic in Arena, but some you may have to set up and maintain during the simulation**
  - **At end of simulation, used to compute final output performance measures**

Example

- The A&E of Hillingdon Hospital, UK
  - This is a simulation model designed using live data from the A&E of Hillingdon hospital to identify whether the patients are being attended to efficiently by the staff on hand at any given time.
  - Model by Dr. Alexander Komashie – Cambridge University, UK

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  - Dr. Alireza Mousavi – Brunel University, UK
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