|  | 從帰線の例示を含む受講者 |  | 
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If you can’t DO, SIMULATE

Brownbag Talk

By

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17th March 2010
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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**

- **User-Created Templates**
  - Commonly used constructs
  - Company-specific processes
  - Company-specific templates etc.

- **Application Solution Templates**
  - Contact Centers
  - Packaging Lines etc.

- **Basic Process Panel**
  - Many common modeling constructs
  - Very accessible, easy to use
  - Reasonable flexibility

- **Advanced Process, Advanced Transfer Panels**
  - Access to more detailed modeling for greater flexibility

- **Blocks, Elements Panels**
  - All the flexibility of the SIMAN simulation language

- **User-Written Visual Basic, C/C++ Code**
  - The ultimate in flexibility
  - C/C++ requires compiler

A single graphical user interface consistent at any level of modeling.
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 from 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
Thanks!

- Special Thanks to
  - Dr. Alireza Mousavi – Brunel University, UK
  - Dr. Alexander Komashie – Cambridge University, UK

- References


  - A. Mousavi, A. Komashie, A. Moeen Taghavi, and V. Pezeshki (2006); Introduction to Simulation Modelling and Value Chains; Course Book.
