0405324: Stochastic System Simulation

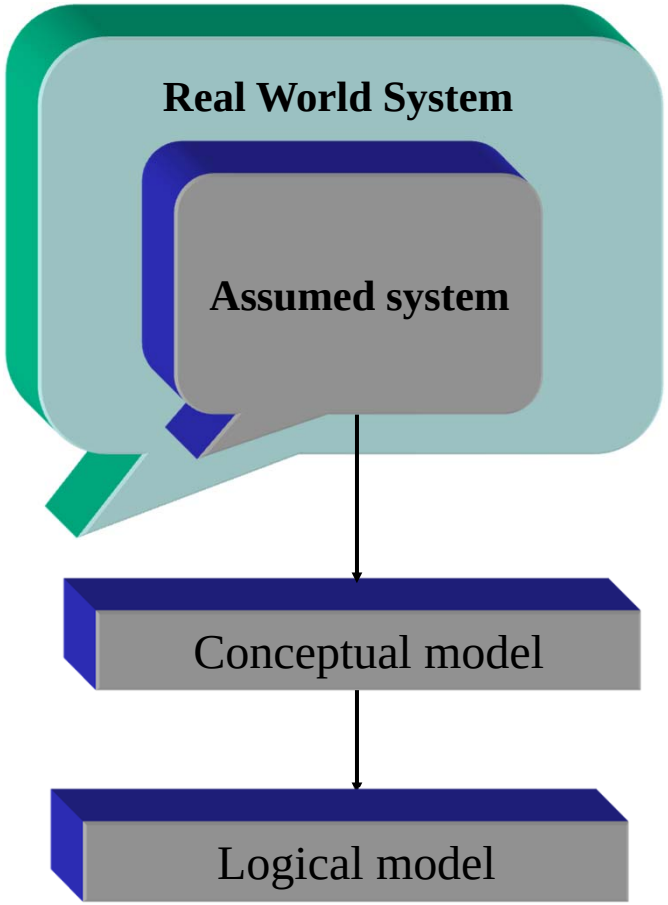
Lecture 2-1: Building Conceptual Model (Also see Lecture-4)

Last revision June 21, 2009

Overview of a simulation study

- Understand the system
- Be clear about the goal
- Develop conceptual model
- Translate into modelling software
- Verify program
- Validate model
- Design experiments
- Make runs
- Analyze, get insight, document result

Model conceptualization



- **Abstract essential features**
  - ***Events, activities, entities, attributes, resources, variables*, and their relationships**
  - **Build process flow diagram**
  - **Performance measures**
  - **Data requirements**

Electronic Assembly/Test System (Model 4-1)

The system to be modeled represents the final operations of the production of two different electronic units. The arriving parts are cast metal cases for the units that have already been machined to accept the electronic parts.

The first units, named Part A, are produced in an adjacent department, outside the bounds of this model, with inter-arrival times (to our model) being exponentially distributed with a mean of 5 minutes. Upon arrival, they are transferred to the Part A preparation area, with a transit time of 2 minutes. At the Part A preparation area, the mating faces of the cases are machined to ensure a good seal, and the part is then deburred and cleaned; the process time for the combined operation follows a triangular (1, 4, 8) distribution. The part is then transferred to the sealer, with a transit time of 2 minutes.

The second units, named Part B, are produced in a different building, outside this model's bounds, where they are held until a batch of four units is available; the batch is then sent to the final production area we are modeling. The time between the arrivals of successive batches of Part B to our model is exponential with a mean of 30 minutes. Upon arrival at the Part B preparation area, the batch is separated into the four units, which are processed individually.

Electronic Assembly/Test System (Model 4-1)

The processing for Part B preparation has the same three steps as at the Part A preparation area; the process time at this preparation area follow a triangular (3, 5, 10) distribution. The part is then sent to the sealer with a transit time of 2 minutes.

At the sealer operation, the electronic parts are inserted, the case is assembled and sealed, and the sealed unit is tested. The total process time for these operations depends on the part type: triangular (1, 3, 4) for Part A and normal (2.4, 0.5) for Part B. Ninety-one percent of the parts pass the inspection and are transferred directly to the shipping department. The remaining parts are transferred to the rework area where they are disassembled, repaired, cleaned, assembled again and re-tested. Eighty percent of the parts here are salvaged and transferred to the shipping department as reworked parts.

The remaining parts are transferred to the scrap area. The time to rework follows an exponential distribution with mean of 45 minutes, and is independent of the part type, or status. Assume all transfer times are 2 minutes.

Electronic Assembly/Test System (Model 4-1)

Questions:

(i) For the problem description, pick out the elements (resources, entities, arrivals, etc.) and system parameters necessary for modeling the system (synopsis of the problem).

(ii) For the modeling elements identified, draw a complete process flow diagram so that it can easily be converted into a simulation language like ARENA

Electronic Assembly/Test System (Model 4-1)

Solution:

(i) Synopsis of the problem:

- **Produce two different sealed electronic units (A, B)**
- **Arriving parts: cast metal cases machined to accept electronic parts**
- **Part A, Part B – separate prep areas**
- **Both go to Sealer for assembly, testing – then to Shipping (out) if OK, or else to Rework**
- **Rework – Salvaged (and Shipped), or Scrapped**

Electronic Assembly/Test System (Model 4-1)

Part A

- **Interarrivals: expo (5) min.**
- **From arrival point, go immediately to Part A Prep**
  - Process = (machine + deburr + clean) ~ tria (1,4,8) min.
- **Go immediately to Sealer**
  - Process = (assemble + test) ~ tria (1,3,4) min.
  - 91% pass, go to Shipped; Else go to Rework
- **Rework: (re-process + testing) ~ expo (45) min.**
  - 80% pass, go to Salvaged; Else go to Scrapped

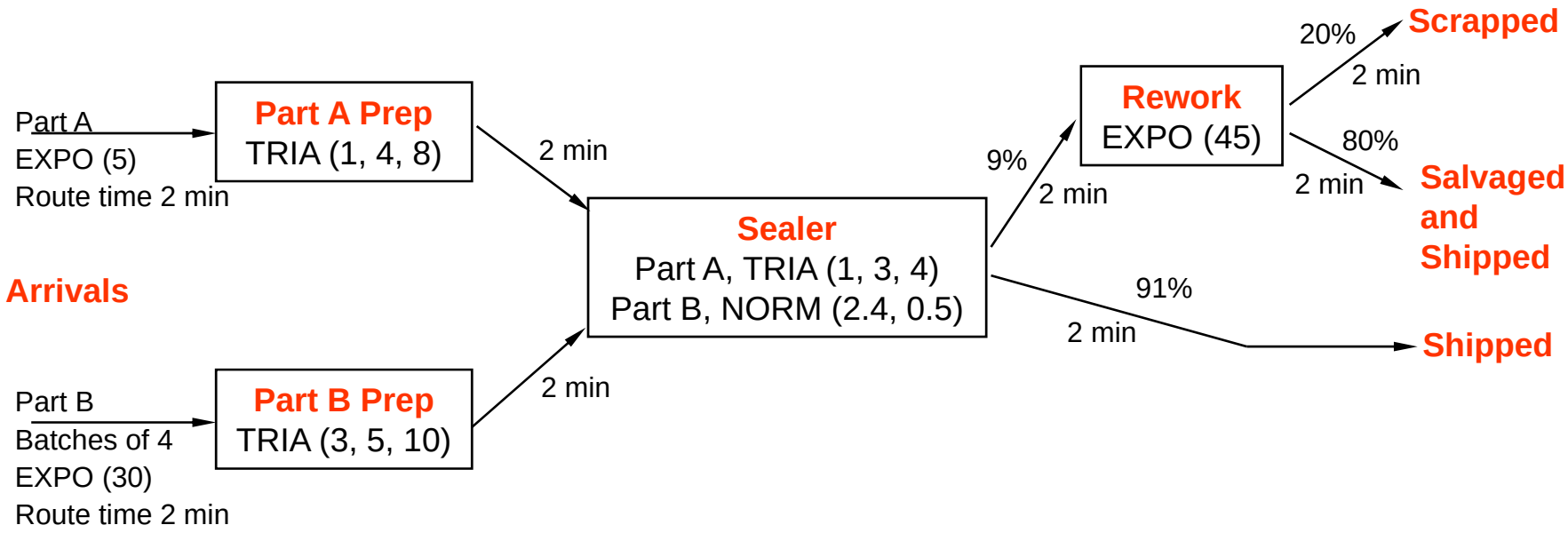
Electronic Assembly/Test System (Model 4-1)

Part B

- **Interarrivals: *batches* of 4, expo (30) min.**
- **Upon arrival, batch breaks into 4 individual parts**
- **Proceed immediately to Part B Prep area**
  - Process = (machine + deburr +clean) ~ tria (3,5,10)
- **Go to Sealer**
  - Process = (assemble + test) ~ NORM(2.4, 0.5) , *different* from Part A, though at same station
  - 91% pass, go to Shipped; Else go to Rework
- **Rework: (re-process + test) = expo (45) min.**
  - 80% pass, go to Salvaged; Else go to Scrapped

Electronic Assembly/Test System (Model 4-1)

(ii) The system can be represented by the following process flow diagram:



Next step is to model the system in ARENA to be covered in lab classes)

See Case Study-HW 1-- Lecture 2-1

Continued in Lecture 3