

Systems Modelling and Simulation (Lab session 2)

After this session you should be able to

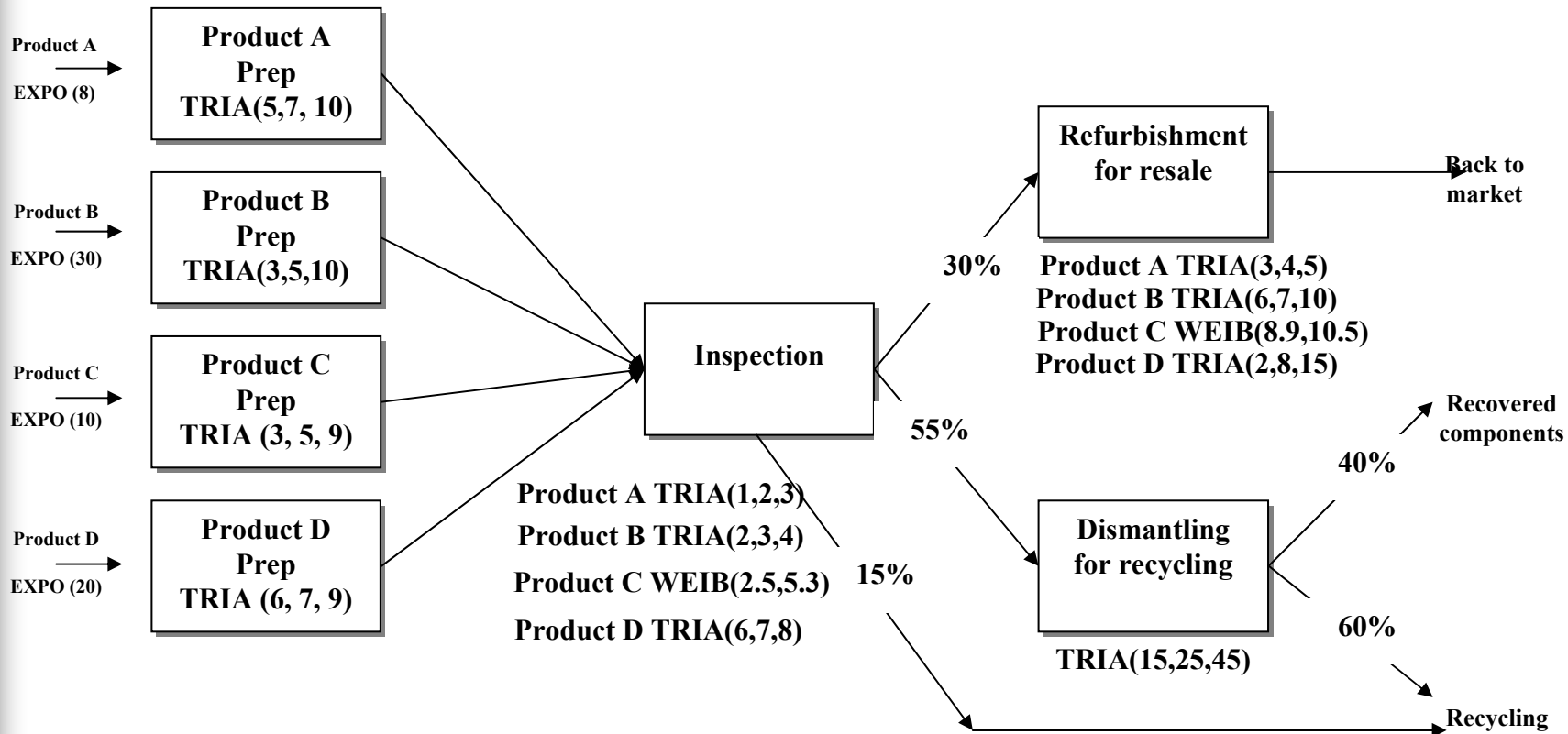
1. Develop a modelling approach for a typical simulation problem.
2. Build and run a complete simulation model.
3. Understand and interpret the results of a simulation run.



Modelling a reverse supply chain problem

- Problem formulation
- Modelling approach
- Building the model
- Running the model
- Viewing the results

Problem formulation (1)



Problem formulation (2)

- There are four types of products; A,B,C and D
- Arrival rates are;
 - A: Exp(8), B: Exp(30), C: Exp(10), D: Exp(20)
- Prep area service times;
 - A: TRIA(5,7,10), B: TRIA(3,5,10), C: TRIA(3,5,9), D: TRIA(6,7,9)
- Inspection area service times:
 - A: TRIA(1,2,3), B: TRIA(2,3,4), C: WEIB(2.5,5.3), D: TRIA(6,7,8)
- Refurbishment area service times
 - A: TRIA(3,4,5), B: TRIA(6,7,10), C: WEIB(8.9,10.5), D: TRIA(2,8,15)
- Dismantling area service times
 - TRIA(15,25,45)



Problem formulation (3)

- After inspection,
 - 15% of products are sent to recycle
 - 55% are sent for dismantling
 - 30% for refurbishment
- 60% of dismantled production go to recycle
- 40% of dismantled products are recovered components for reuse.



Modelling objective

- Collect statistics in each area on:
 - Resource utilization
 - Number in queue
 - Time in queue
 - Cycle time for refurbished products, dismantled components and recycled products
- Run setup
 - Warm-up period = 0
 - Replication length = 4 x 8hr shifts
 - Number of replications = 1
 - Initialize between replications; System=yes, Statistics=yes



Modelling approach (1)

- We can break our system down into the following;
 - Create arrival of products
 - Send products through prep process
 - Send products through inspection process
 - Decide where each product goes after inspection
 - Send part to refurbishment
 - Send other parts to Dismantling
 - Dispose remaining part to Recycling
 - Dispose to market after refurbishment
 - Split products into components after dismantling
 - Dispose recovered components after dismantling
 - Dispose after dismantling to recycling



Modelling approach (2)

- We will need the following modules
 - *Create* (4)
 - *Assign* (4)
 - *Process* (7)
 - *Decide* (2)
 - *Record* (3)
 - *Separate* (1)
 - *Dispose* (3)



Modelling approach (3)

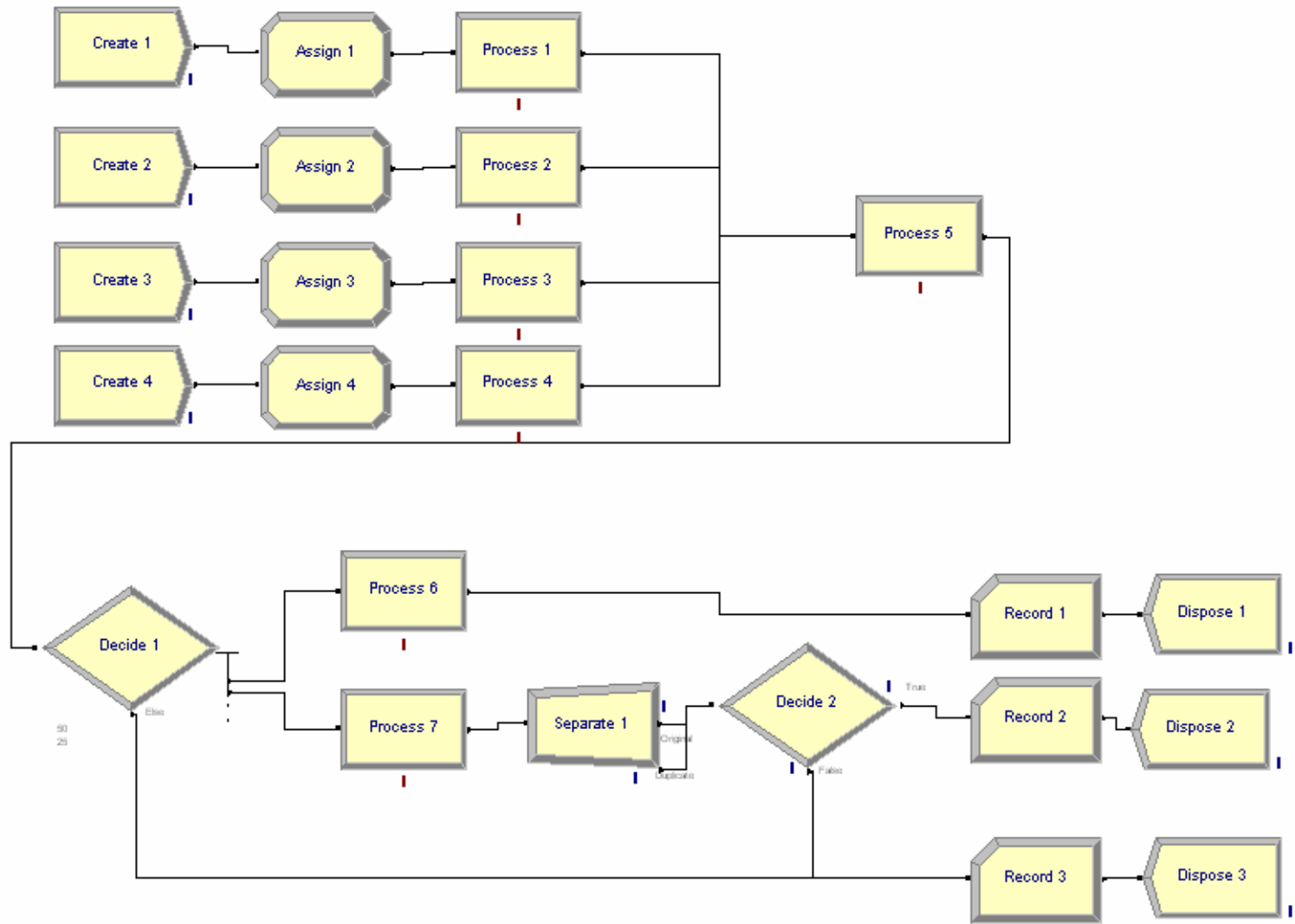
■ Entities in the model

- Product A
- Product B
- Product C
- Product D

■ Resources in the model

- Prep A
- Prep B
- Prep C
- Prep D
- Inspector
- RefTechnician
- DisTechnician

Our basic model



Building it yourself

■ Before you running the model

- Go to “Run” menu and select “setup”
- Set replication parameters as shown

Run Setup

Run Speed | Run Control | Reports

Project Parameters | Replication Parameters | Array Sizes

Number of Replications:

Initialize Between Replications

Statistics System

Start Date and Time:

Warm-up Period: Time Units:

Replication Length: Time Units:

Hours Per Day: Base Time Units:

Terminating Condition:

OK Cancel Apply Help

Viewing the results

- Select “yes” to view report at the end of the simulation run.

15:46:03

Category Overview

A Reverse Logistics System Model

Replications: 1 Time Units: Minutes

Queue

Time

Waiting Time	Average	Half Width	Minimum Value	Maximum Value
Dismantling Process.Queue	726.29	(Insufficient)	0.00	1476.05
Inspection Process.Queue	26.8915	(Correlated)	0.00	71.1417
Product A Process.Queue	14.8869	(Insufficient)	0.00	89.7732
Product B Process.Queue	0.7297	(Insufficient)	0.00	5.9013
Product C Process.Queue	4.4349	(Insufficient)	0.00	22.8193
Product D Process.Queue	1.9019	(Insufficient)	0.00	14.6856
Refurbishment Process.Queue	4.1091	(Insufficient)	0.00	31.7503

Other

Number Waiting	Average	Half Width	Minimum Value	Maximum Value
Dismantling Process.Queue	132.32	(Correlated)	0.00	263.00
Inspection Process.Queue	8.1541	(Correlated)	0.00	23.0000
Product A Process.Queue	2.1056	(Correlated)	0.00	14.0000
Product B Process.Queue	0.02584436	(Insufficient)	0.00	1.0000