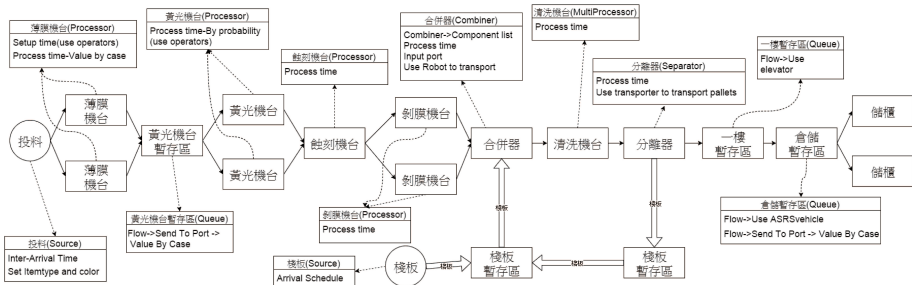


Flexsim: LCD with more Objects

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Tsing Hua Univ. 清華大學

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LCD Model



- “Queue” is needed before “Processor”. To save space, some “Queue” objects are not shown in the figure.

LCD (liquid crystal display, 液晶顯示)

- Goal: Evaluate the **bottlenecks** of the system
- LCD : Description

- Source; Item: (1) Inter-arrival time follows Normal(mean 5, std 2); (2) set Itemtype and color.
- Processor
 - Thin Film (薄膜): Setup time: 3 min, need operator; Process times (ItemType-1: 2; ItemType-2: 4)
 - Photolithography (黃光): (1) Process time: 40% of parts: 3, and 60%: 4; (2) need operator.
 - Etching (蝕刻): (1) Process time: 10. Max items in the same process: 3,
 - Strip (剝膜): (1) Process time: uniform (5, 8). ; (2) at the end of this process combine 5 items with 1 pallet (CombinedParts).
- MultiProcessor: Wash (清洗); (1) 2 Process times: 1st ~ uniform(2,6), 2nd ~ uniform(10,20); (2) Separate CombinedParts after Wash process.
- Combiner (合併器): (1) Process time: 2; (2) Combine 5 items with 1 pallet. (3) need Robot to move
- Separator (分離器): Process time 3 min.
- Operators (作業員): There are 3 operators.
- Dispatcher (派工器): Using first available to dispatch jobs for operators.
- Source; Pallets: There are only 25 pallets in the system, so pallets should be reused.
- Transporter (搬運器): To transport pallets, 5 pallets at a time.
- Racks (儲櫃): On second floor, and use ASRSvehicle to move ItemType- i to Rack i , $i = 1, 2, ..$
- Robot: Help to transport items from Combiner to wash.
- Elevator, Recorder, Visual Tool, Network Node
- Note: (1) Setup or process times listed above is for each item. (2) Time unit: minutes.
(3) New objects learned today are marked in red.

Define **bottlenecks** of the system

- The largest queue length

Define **bottlenecks** of the system

- The largest queue length
- The largest wait time

Define **bottlenecks** of the system

- The largest queue length
- The largest wait time
- The largest utilization

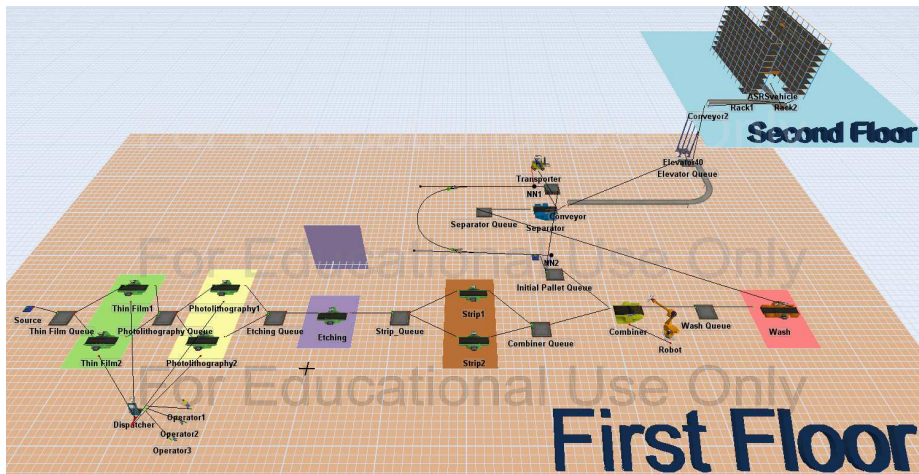
Define **bottlenecks** of the system

- The largest queue length
- The largest wait time
- The largest utilization
- Others...

Define **bottlenecks** of the system

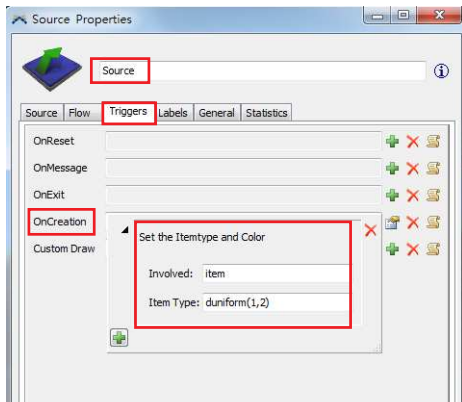
- The largest queue length
- The largest wait time
- The largest utilization
- Others...

LCD Model in Flexsim



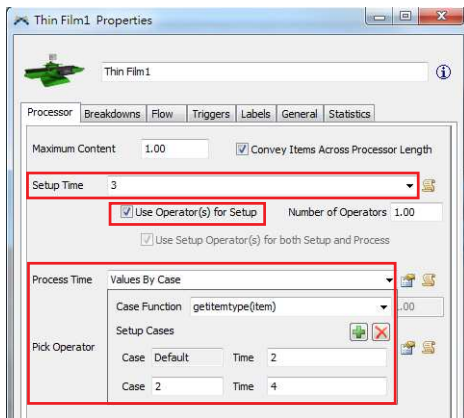
Source

- Source → Triggers → OnCreation → Set Item Type and Color



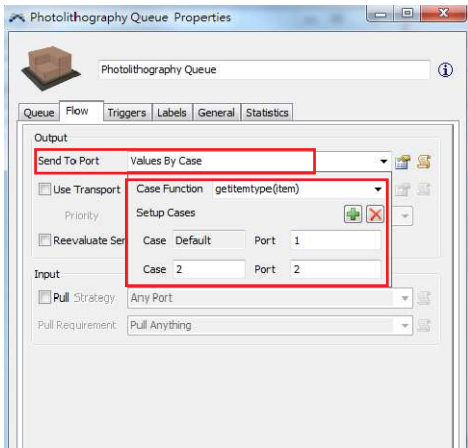
Thin Film

- Setup Time: 3 (Use Operators for Setup)
- Process Time : Case 1: 2 ; Case 2: 4

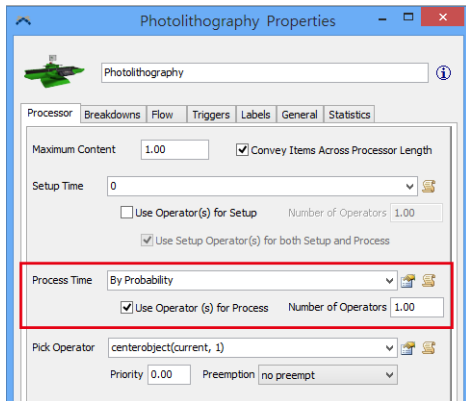


Photolithography Queue

- Type 1 item goes to Photolithography1 machine.
- Type 2 item goes to Photolithography2 machine.



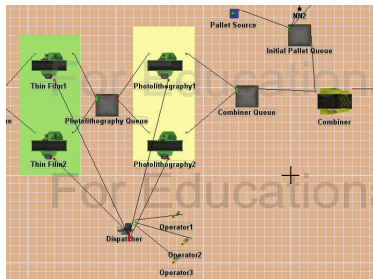
Photolithography



- Flexsim 的 By Probability 後續會加以討論

Dispatcher

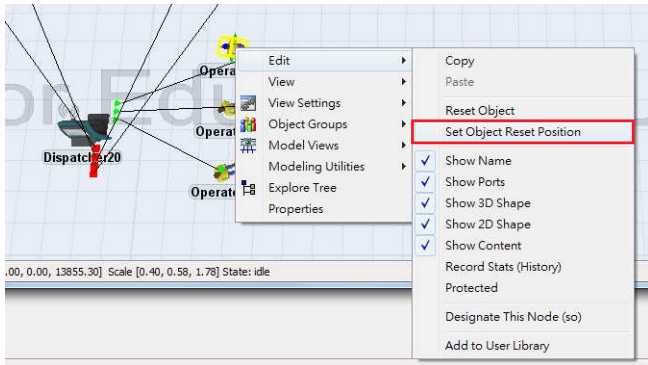
- Use "A" to connect Dispatcher → operators.(順序不能相反)
- Use "S" to connect Dispatcher and Thin Film. (for setup)
- Use "S" to connect Dispatcher and Photolithography. (for process)



- Check "General → Ports" to see input, output, and central ports.

Operator

- Click 滑鼠右鍵 → Edit → Set Object Reset position



Recorder

Library

Discrete Objects | Lab

- Source
- Queue
- Processor
- Sink
- Combiner
- Separator
- MultiProcessor
- Conveyor
- MergeSort
- FlowNode
- Rack
- Reservoir
- Dispatcher
- TaskExecuter
- Operator
- Transporter
- Elevator
- Robot
- Crane
- ASRSvehicle
- NetworkNode
- TrafficControl
- VisualTool
- Recorder

Recorder36 Properties

Recorder36

Recorder | Output | Labels | General

Type of Data: Standard Data Display background

Capture Standard Data

Object Name: Etching

Data to capture: State

Idle : 31.5%
processing : 23.2%
waiting for transporter : 45.3%

Pallet Source

- Source → FlowItem Class → Pallet
- Source → Arrival Style → Arrival Schedule

Pallet Source Properties

Pallet Source

Source | Flow | Triggers | Labels | General | Statistics

Arrival Style: Arrival Schedule

FlowItem Class: Pallet

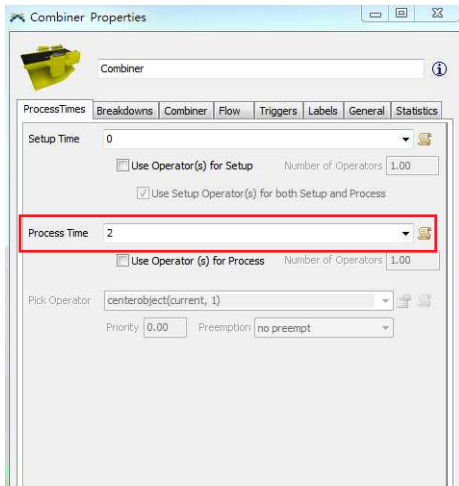
Number of Arrivals: 1 | Refresh Arrivals | Repeat Schedule/Sequence

Number of Labels: 0 | Refresh Labels | Add Table to MTEI

| ArrivalTime | ItemName | ItemType | Quantity |
|-------------|--------------|----------|----------|
| Arrival1 | 0.00 Product | 1.00 | 25.00 |

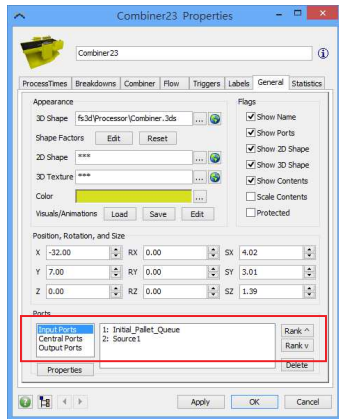
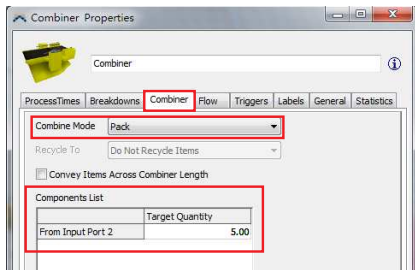
Combiner

- Combiner → ProcessTimes



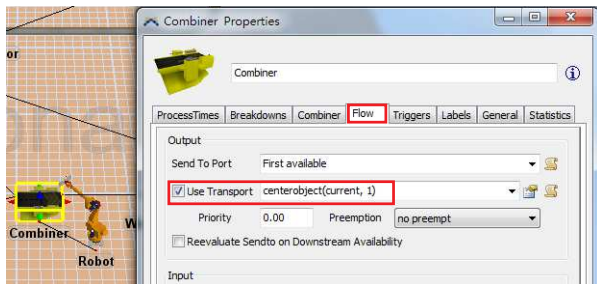
Combiner –Conti.

- Combiner → Components List → From Input Port 2
- Initial Pallet Queue 要在 Combiner 的 Input Port 1.



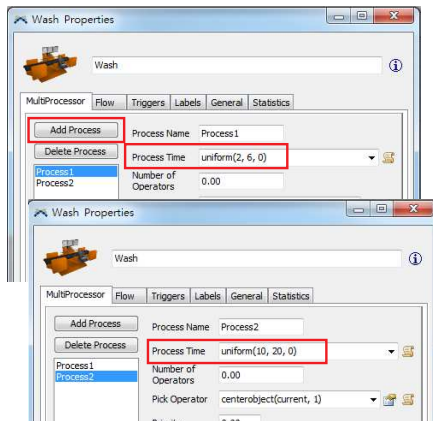
Combiner and Robot

Use Robot to transport items from Combiner.(Use "S" to connect Combiner and Robot.)

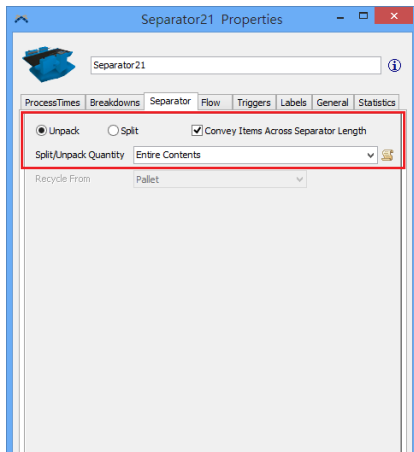
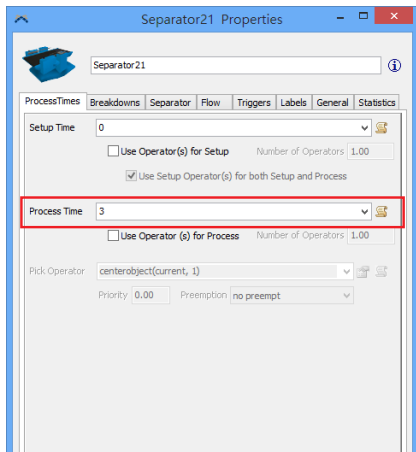


Wash

- Use MultiProcessor for Wash process.
 - Process 1: Process Time: $\text{uniform}(2, 6, 0)$
 - Process 2: Process Time: $\text{uniform}(10, 20, 0)$

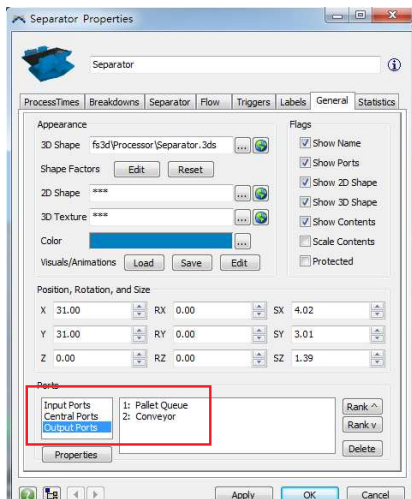


Separator



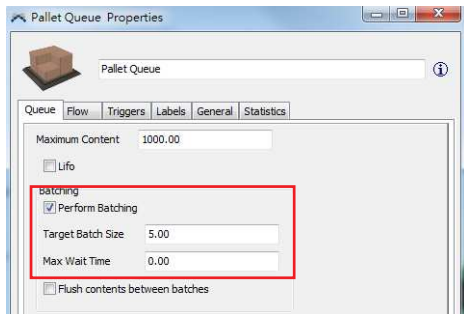
Separator

Pallet Queue 要在 Separator 的 Output Port 1.



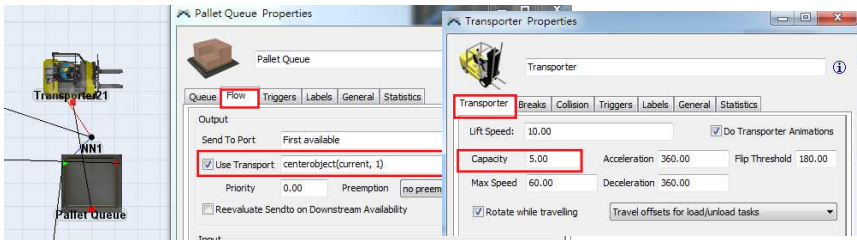
Pallet Queue

- Target Batch Size: 5
- Max Wait Time: 0 (no maximum wait time, queue will wait indefinitely)



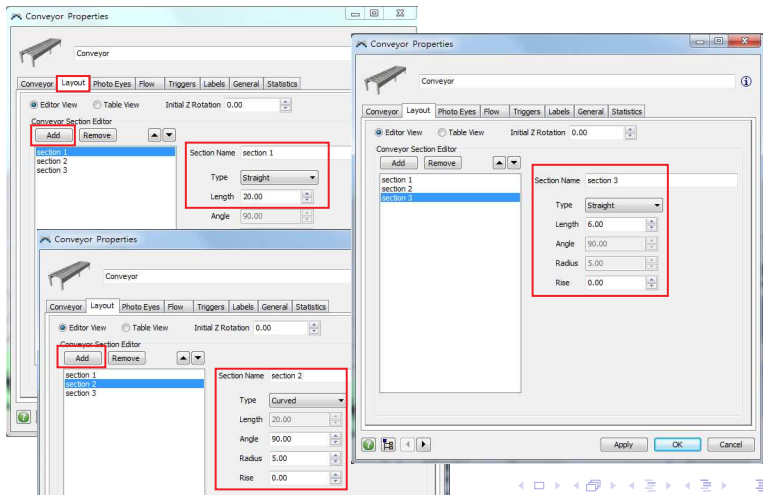
Pallet Queue and Transporter

- Use Transporter to transport items from Pallet Queue.(Use S to connect Pallet Queue and Transporter.)
- Transporter Capacity : 5



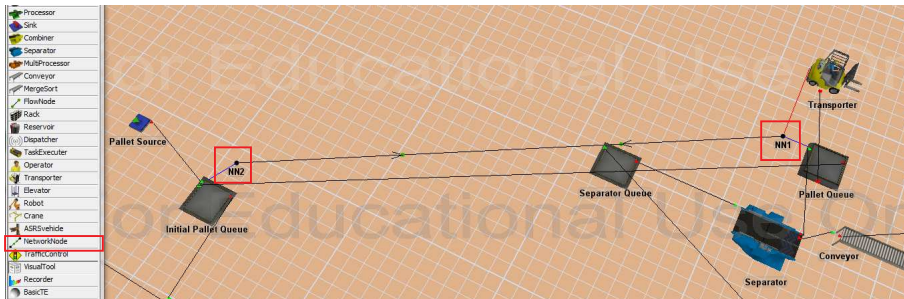
Conveyor

Conveyor → Layout



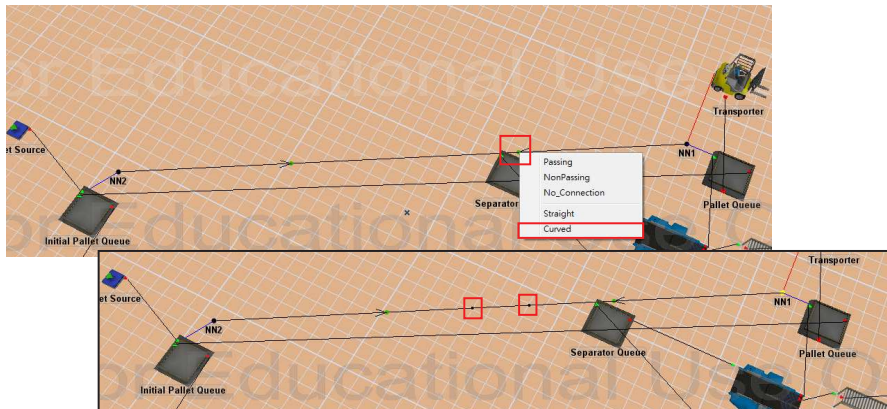
Transporter and NetworkNode

- Drag 2 NetworkNode near Pallet Queue(NN1) and Initial Pallet Queue(NN2).
- Use "A" to connect NN1 → NN2, NN1 → Pallet Queue, NN2 → Initial Pallet Queue, Transporter → NN1.



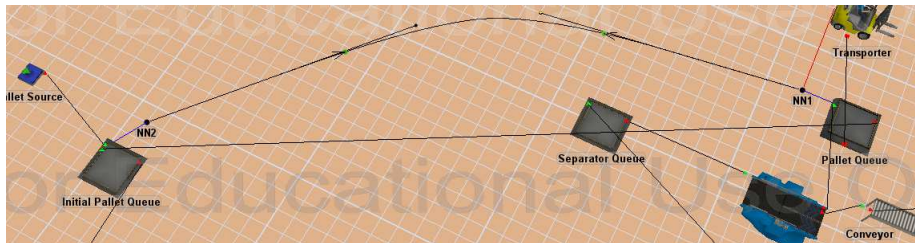
Transporter and NetworkNode

連線後, 會看到有兩個綠點, 點下後按右鍵選 Curved, 會出現兩個黑點。

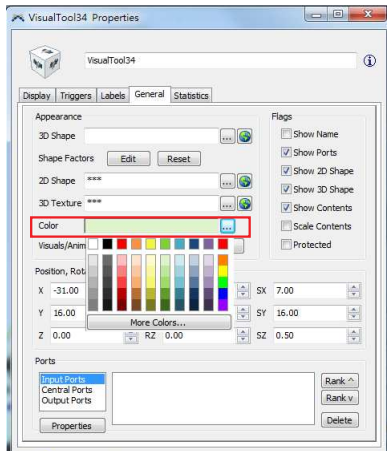
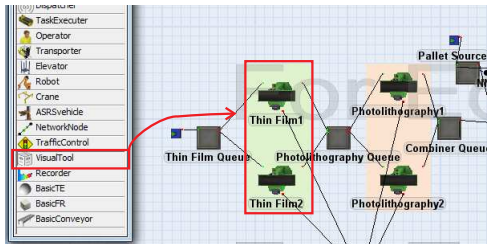


Transporter and NetworkNode

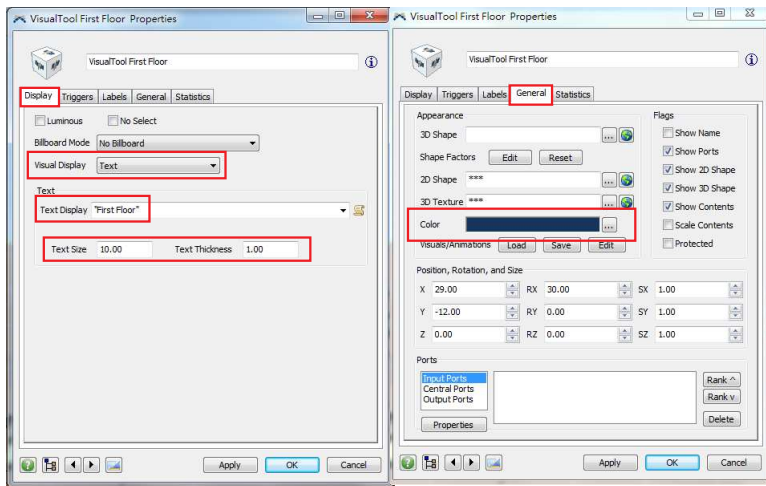
- 移動黑點調整路徑



VisualTool for Background Color

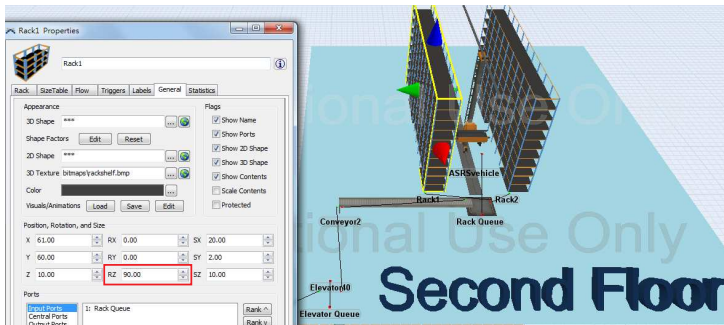


VisualTool for Text



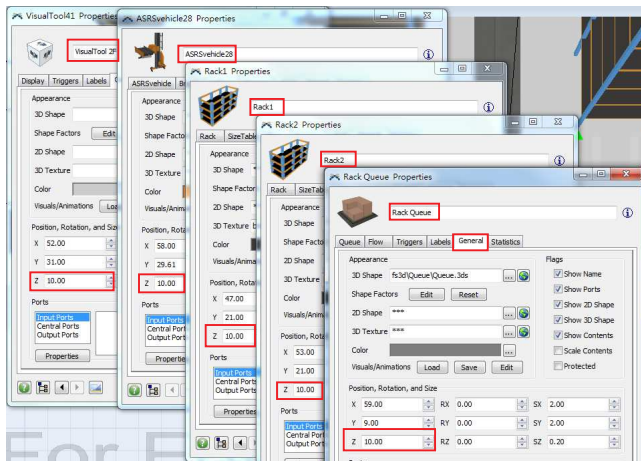
Rack

- Drag 2 Rack (for 2 itemtype), and put an ASRSvehicle between them.
- Drag 1 Queue(Rack Queue) nearby the ASRSvehicle, and connect them with "S"; then connect Rack Queue and Racks with "A".
- Drag 1 Queue(Elevator Queue) and 1 Conveyor, connect them with "A".
- Drag 1 Elevator between Elevator Queue and conveyor, connect Elevator and Elevator Queue with "S".



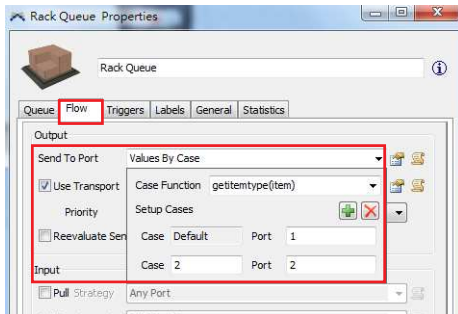
Rack

- Change the Z position to 10.(Second Floor)

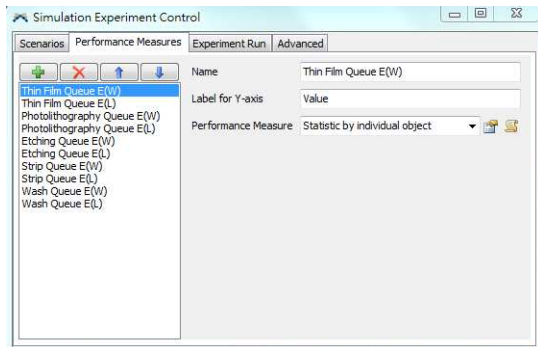


Rack Queue

- Rack Queue → Send to Port → Value By Case

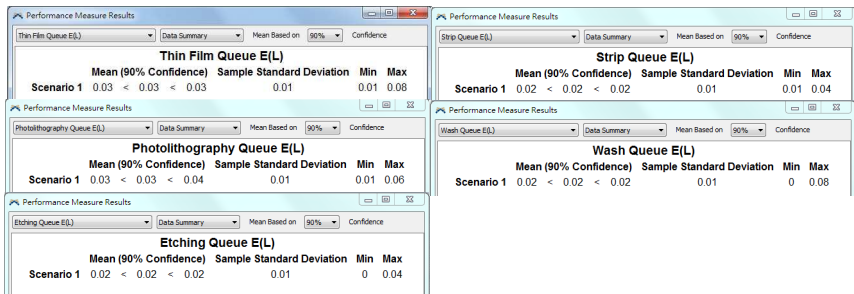


Experiment

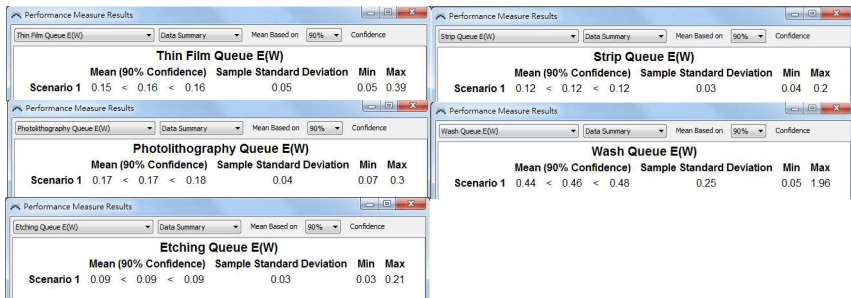


Experiment Results-E(LQ)

- Run **Experiment** to time 4000, warmup time: 3000, replication: 500



Experiment Results-E(WQ)

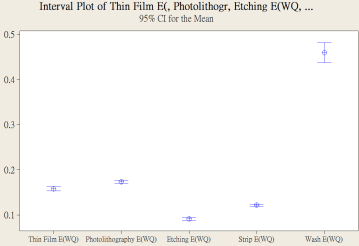


Bottlenecks

Queue Length: Photolithography

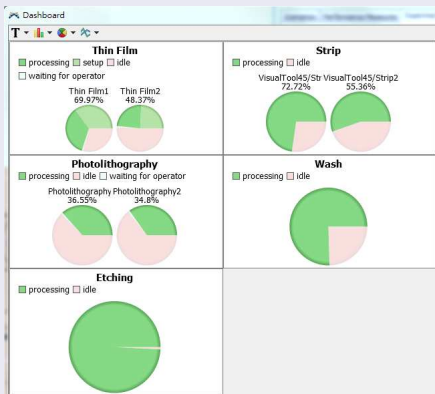


Queue Wait Time: Wash



Bottlenecks-conti

Utilization: Etching



Discussion

In this lecture note, we learn

- New Flexsim objects
- Performance measures to indicate bottlenecks
- Simulation output Analysis