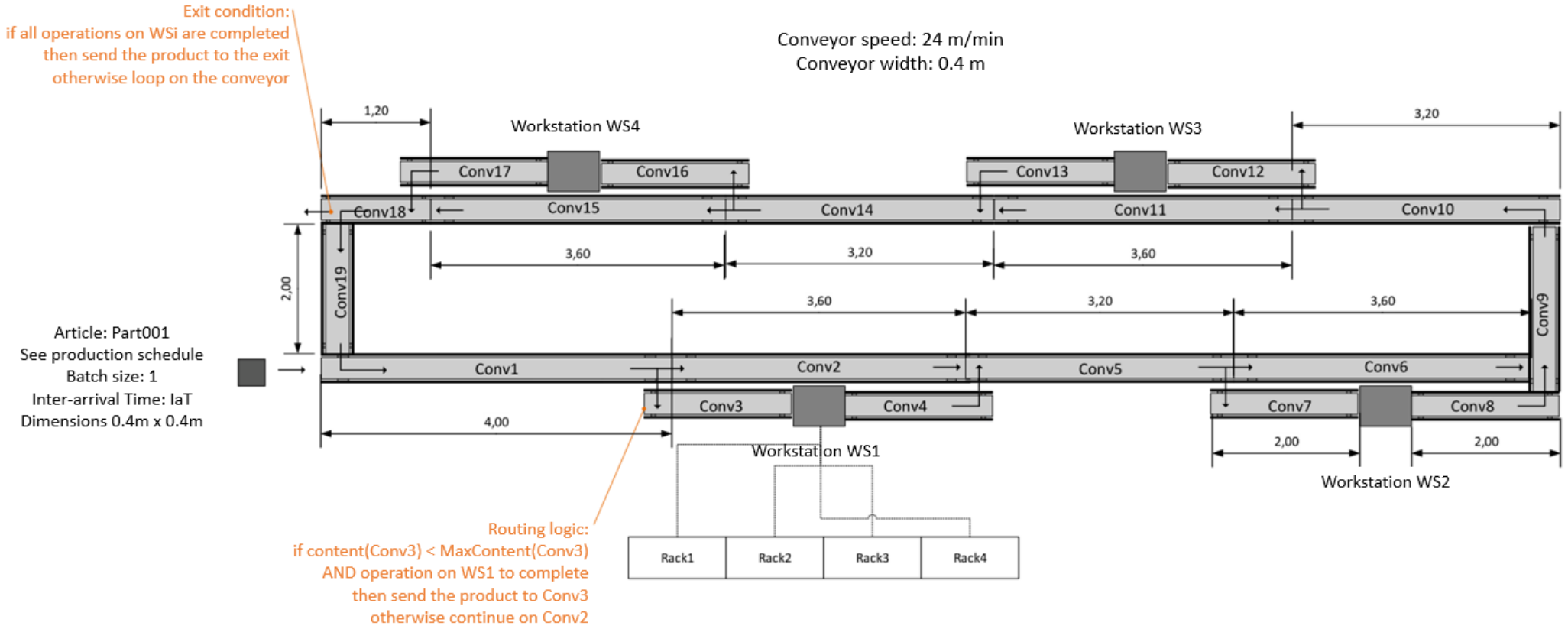
Simulation study case

The goal is to build a model which simulates a conveying line for order preparation, with several workstations.

The drawing below shows the layout of this conveying line with 4 workstations (WS1 to WS4).



Specifications

- each workstation has 4 picking racks (Rack 1 to Rack 4 like on the layout for workstation 1), where the products to pick are stored. When a tote arrives at the workstation, the cycle time includes the travel time of the operator to the racks and between the racks, then the time to pick all product references, and the time to walk to the package. The process is quite similar to the one shown in this video: https://www.youtube.com/watch?v=yOwWNPDfPj4.
- empty totes (article Part001) are launched following a production schedule with several purchase orders (PO), which require one or several stops at the workstations, in a specific order or not, to be filled with the references picked in the racks by an operator. The following table shows the production schedule. There are 10 purchase orders for a total of 330 packages to prepare:

	Step #1		Step #2		Step #3		Step #4		Qty	Total Ref.	TiA	Rank	Required sequence
PO#	WS	Picking Qty	WS	Picking Qty	WS	Picking Qty	WS	Picking Qty					
1	WS1	35	WS2	49	WS3	8			48	92	IaT_OP(1)	1	yes
2	WS2	19	WS3	30					15	49	IaT_OP(2)	2	yes
3	WS2	20	WS3	34	WS4	18			50	72	IaT_OP(3)	3	no
4	WS1	4	WS2	31	WS3	17	WS4	9	44	61	IaT_OP(4)	4	no
5	WS1	8	WS2	47	WS3	33	WS4	17	31	105	IaT_OP(5)	5	yes
6	WS3	25	WS4	50					39	75	IaT_OP(6)	6	yes
7	WS1	35	WS3	13	WS4	24			29	72	IaT_OP(7)	7	yes
8	WS2	26	WS4	21					31	47	IaT_OP(8)	8	no
9	WS1	31	WS3	35	WS4	5			21	71	IaT_OP(9)	9	yes
10	WS1	19	WS2	37	WS3	42	WS4	30	22	128	IaT_OP(10)	10	no

For example, the PO#5 has 31 packages which need to go to WS1, WS2, WS3, and WS4 with this required sequence order. 8 references are picked on WS1, 47 references on WS2, 33 references on WS3 and 17 references on WS4. Each package of this PO must contain 105 references before exiting the conveying line.

Data

		Val.
Inter-arrival time (in seconds) on the conveying line of each package for each PO	IaT_PO(1)	3
	IaT_PO(2)	3
	IaT_PO(3)	3
	IaT_PO(4)	3
	IaT_PO(5)	3
	IaT_PO(6)	3
	IaT_PO(7)	3
	IaT_PO(8)	3
	IaT_PO(9)	3
	IaT_PO(10)	3
Maximum number of packages which can accumulate on the upstream conveyor of each station	Accu(Upstream_Conv)_WS1	3
	Accu(Upstream_Conv)_WS2	3
	Accu(Upstream_Conv)_WS3	3
	Accu(Upstream_Conv)_WS4	3
Maximum number of packages on the conveying line	Max packages	20
number of operators (1 per workstation)	Nr operators	4

	travel time	picking time	filling time
Phase 1	1	0	0
Phase 2	14	2	3
Phase 3	uniform(8,20)	triangular(1,4,2)	triangular(1,8,3)

The project should follow 3 main phases:

- Phase 1 is building the model with fake times to first validate the routing of packages. It should only include the PO#5: 31 packages to fill by stopping at every workstation in a required sequence (yellow line in the production schedule). Once PO#5 is validate, test each PO individually to check that the routing of totes is correct.
- Phase 2 is using constant values for all time settings. It should include all POs.
- Phase 3 is using statistical distributions for time settings.

Objectives

- Choose and set the correct modeling objects to simulate this line
- Verify and validate how the simulation runs to meet the requirements from the specifications and provided data
- Check how many packages have been prepared on each workstation, and the total number of packages which exited the conveying line
- Measure the utilization of each workstation
- Analyse the staytime of packages on the conveying line
- Count how many times the packages are looping on the conveying line
- Determine what is the total time to complete all purchase orders, and propose improvement solutions to minimize this delay
- Record videos of your model for your presentation