

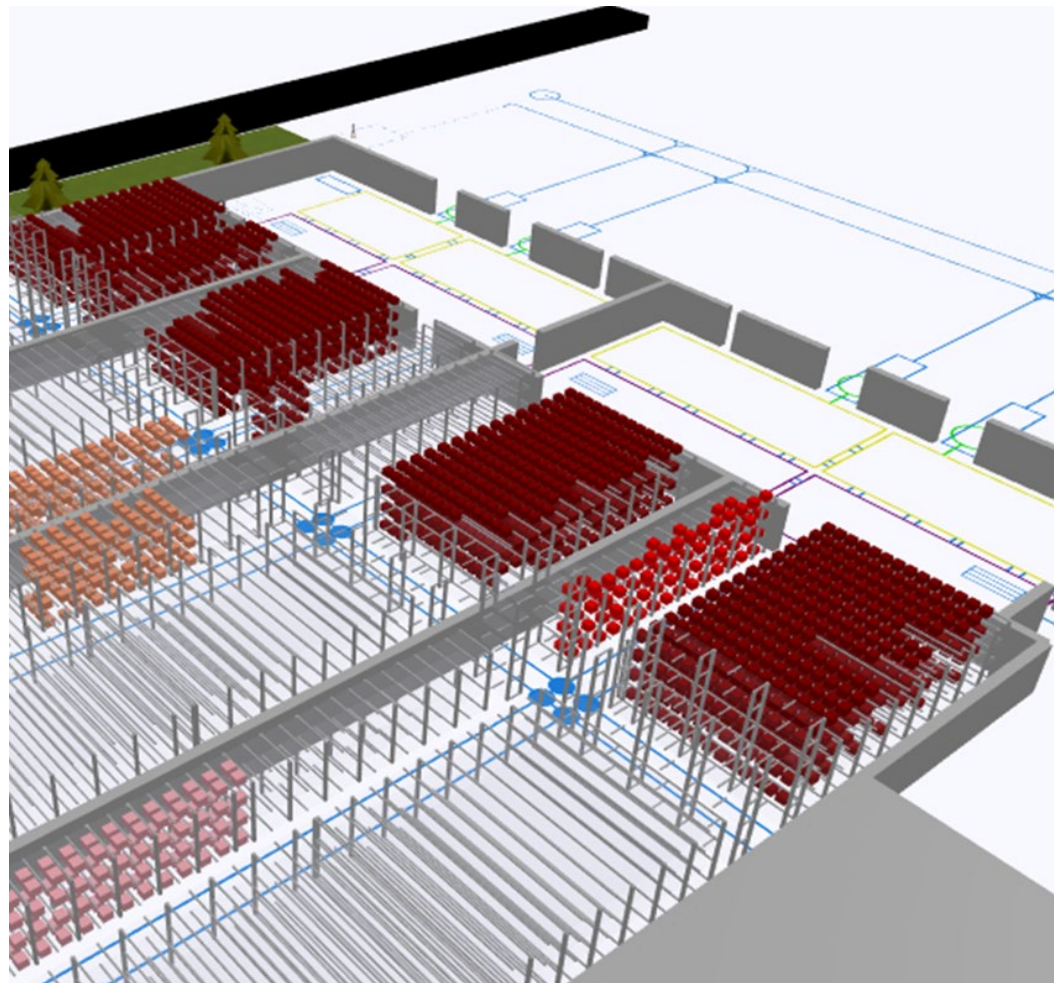


Warehouse Simulation with AnyLogic

Cold Store

23 September, 2021

Pallet Placement Rules and Constraints



Rules and Constraints:

- FIFO to ensure that fresh products are delivered.
- All depths of each rack accommodates the same product.
- Pallets can't wait at the loading area more than a specific amount of time. Loading area is not cold enough.
- Loading area can accommodate a limited number of pallets.
- Container area can accommodate a limited number of pallets.

Objective:

- Efficient use of resources
 - Forklifts
 - Collectors
 - Runners

Active Docks	Inbound Priority	Outbound Priority	Export Priority
<input checked="" type="checkbox"/> Dock 1	<input type="text" value="1"/>	<input type="text" value="1"/>	<input type="text" value="1"/>
<input checked="" type="checkbox"/> Dock 2	<input type="text" value="2"/>	<input type="text" value="2"/>	<input type="text" value="2"/>
<input checked="" type="checkbox"/> Dock 3	<input type="text" value="3"/>	<input type="text" value="3"/>	<input type="text" value="3"/>
<input checked="" type="checkbox"/> Dock 4	<input type="text" value="4"/>	<input type="text" value="4"/>	<input type="text" value="4"/>

1: high priority 7: low priority 0: not used

Assign Docks By: Predefined priority Distance to load / unload racks

Active Racks	Rack Type	SKU Type
<input checked="" type="checkbox"/> A	<input type="text" value="runner"/>	<input type="text" value="all"/>
<input checked="" type="checkbox"/> B	<input type="text" value="runner"/>	<input type="text" value="all"/>
<input checked="" type="checkbox"/> C	<input type="text" value="runner"/>	<input type="text" value="all"/>
<input checked="" type="checkbox"/> D	<input type="text" value="runner"/>	<input type="text" value="all"/>
<input checked="" type="checkbox"/> E	<input type="text" value="runner"/>	<input type="text" value="all"/>
<input checked="" type="checkbox"/> G	<input type="text" value="runner"/>	<input type="text" value="all"/>
<input checked="" type="checkbox"/> H	<input type="text" value="runner"/>	<input type="text" value="all"/>
<input checked="" type="checkbox"/> J	<input type="text" value="runner"/>	<input type="text" value="all"/>

Initial Stock pallets

Use SKU segments for slotting

Resources	Morning Shift	Night Shift
Forklifts Inbound	<input type="text" value="2"/>	<input type="text" value="2"/>
Forklifts Outbound	<input type="text" value="4"/>	<input type="text" value="4"/>
Forklifts Çatal	<input type="text" value="0"/>	<input type="text" value="0"/>
Transpalets	<input type="text" value="5"/>	<input type="text" value="5"/>
Assemblers	<input type="text" value="8"/>	<input type="text" value="8"/>
Trafficers	<input type="text" value="1"/>	<input type="text" value="1"/>

Number of AGV

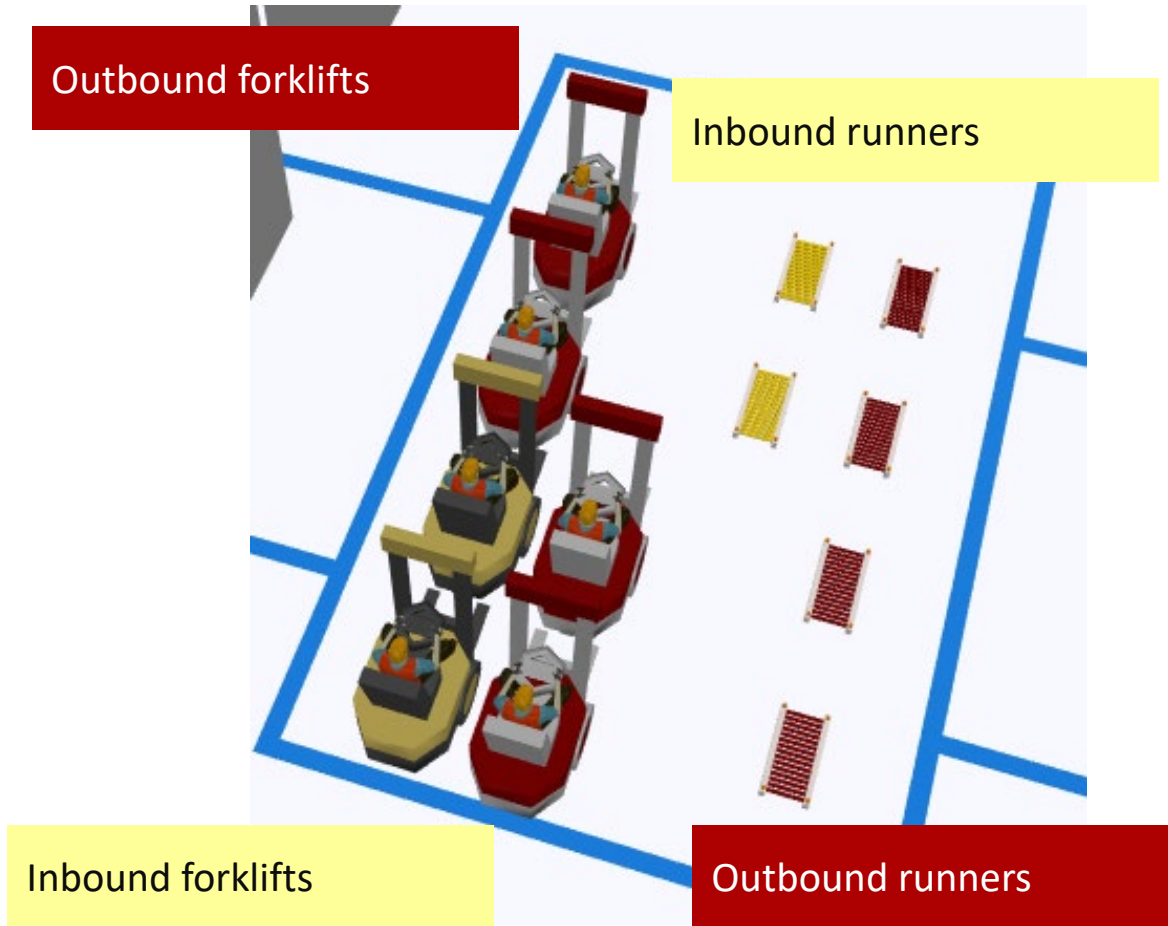
Number of Shuttles

Pallet Colors By

Report Transactions

Simulation Data	
<input checked="" type="radio"/> Use real data	
<input type="radio"/> Generate random data	
Inbound trucks per day	<input type="text" value="21"/>
Outbound trucks per day	<input type="text" value="28"/>
Pallets from factory per day	<input type="text" value="100"/>

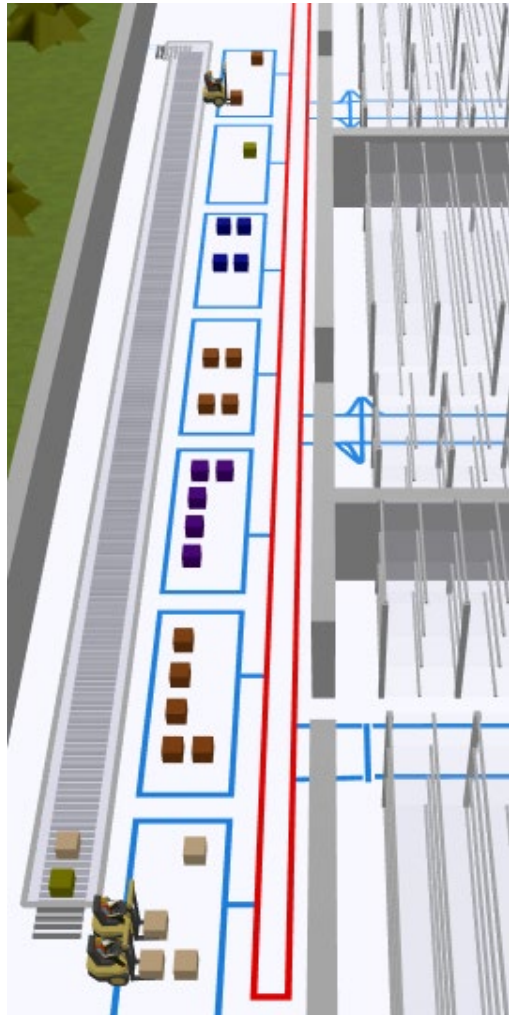
Forklifts and runners are classified as inbound and outbound resources



	Inbound	Outbound	Total
Forklifts	2	4	6
Collectors			8
Runners	2	4	6
Transpalets	1	4	5

Storing and picking pallets using runners

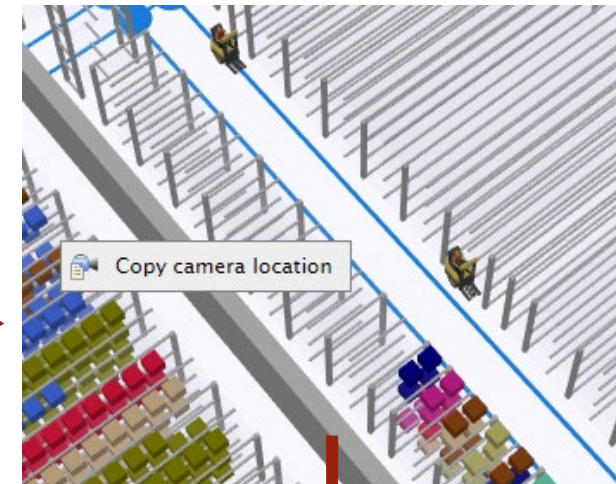
Pallets are batched by SKU



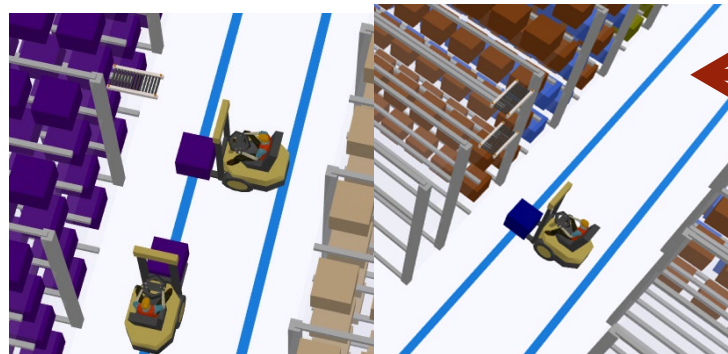
1) Forklift picks available runner



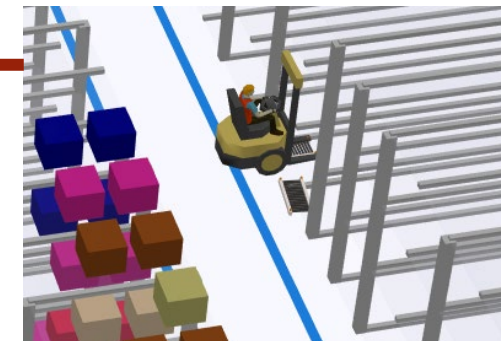
2) Runner carried to racks



4) Pallet stored in rack using runner



3) Runner placed on rack



Current State Fullfillment

Order Fullfilment (Pallets)

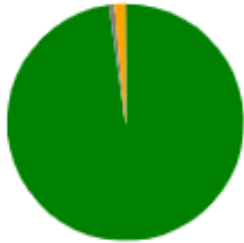
Pallet Placement: Slotting by Transaction Volume
 FL: 6, Coll: 8, Runner: 6

Inbound Truck



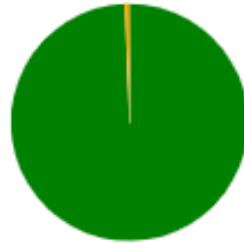
Completed 494 (100%)
 Not Started 0 (0%)
 In Process 0 (0%)

Inbound Conveyor



Completed 2,440 (98%)
 Not Started 18 (1%)
 In process 38 (2%)

Outbound Truck

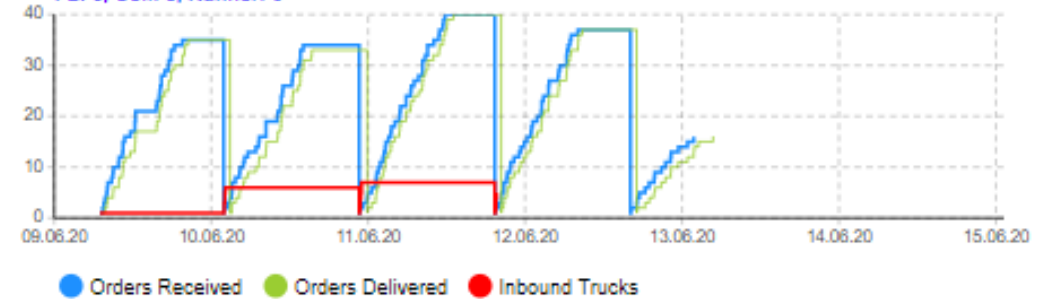


Completed 4,172 (99%)
 Not Started 0 (0%)
 In Process 26 (1%)

Konya Data	Number of Pallets
Inbound by Truck	494
Inbound Conveyor	2,478
Outbound	4,200

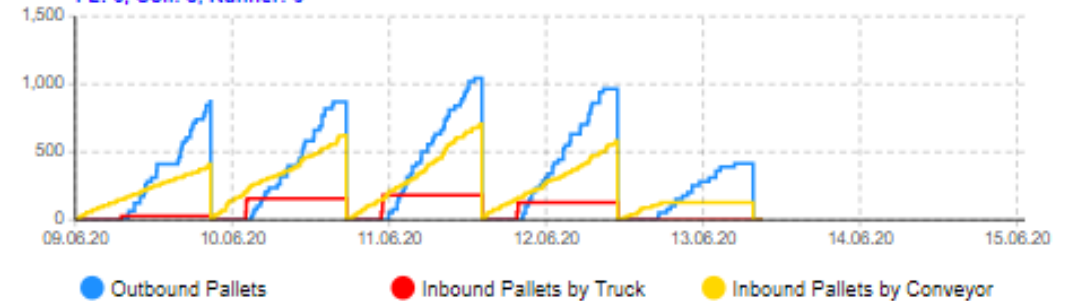
Truck Arrival and Departure

Pallet Placement: Slotting by Transaction Volume
 FL: 6, Coll: 8, Runner: 6



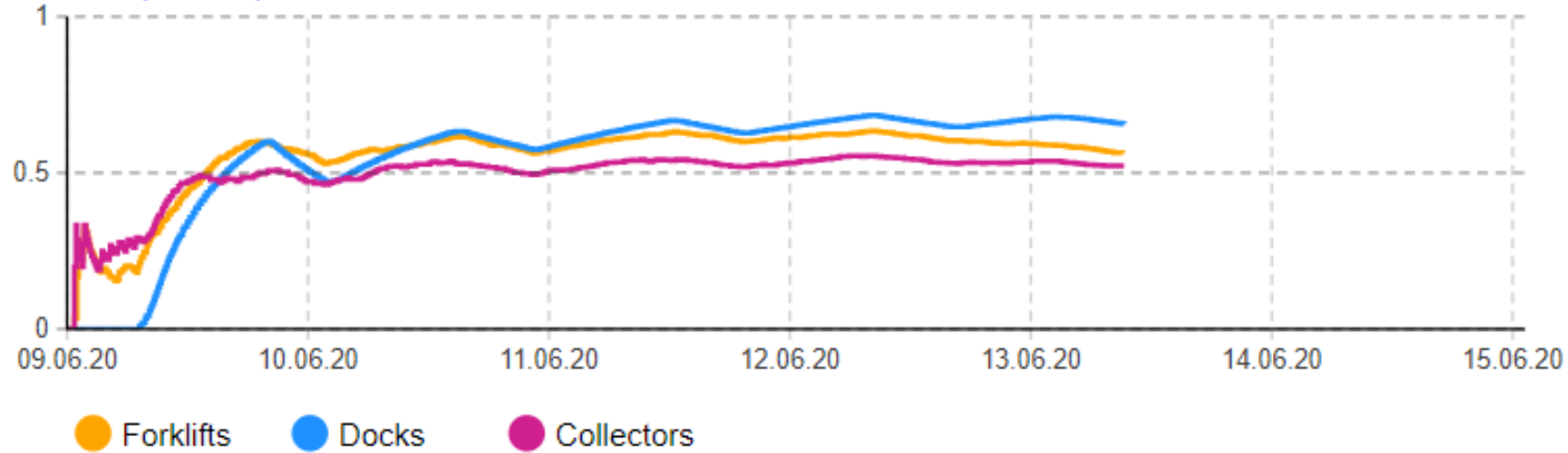
Pallets Moved

Pallet Placement: Slotting by Transaction Volume
 FL: 6, Coll: 8, Runner: 6

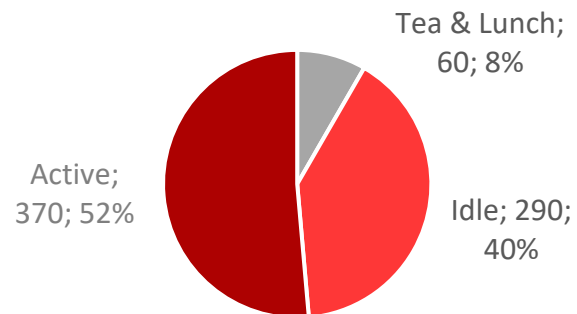


Current State Utilization

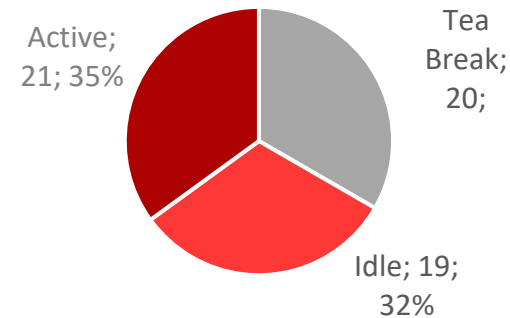
Resource Utilization
 Pallet Placement: Slotting by Transaction Volume
 FL: 6, Coll: 8, Runner: 6



Forklifts One Shift (minutes)



Collectors One Hour (minutes)



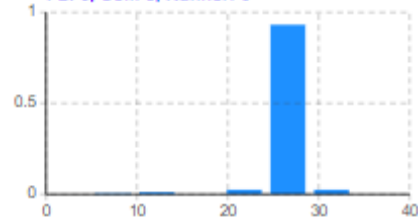
Current State Other Statistics

Pallets in Inbound Truck
Pallet Placement: Slotting by Transaction Volume
FL: 6, Coll: 8, Runner: 6



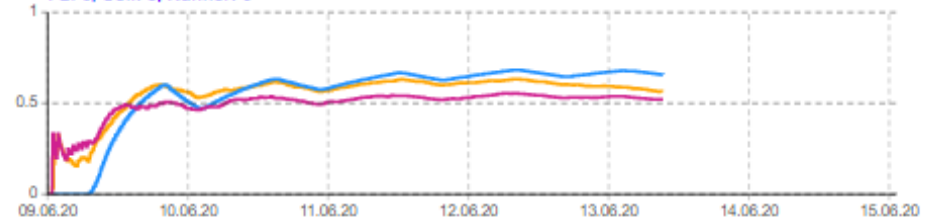
● Pallets / Inbound Truck 26

Pallets in Outbound Truck
Pallet Placement: Slotting by Transaction Volume
FL: 6, Coll: 8, Runner: 6



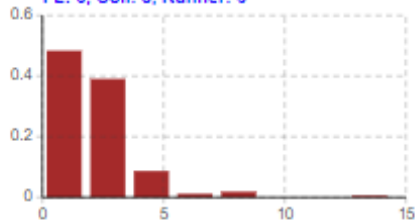
● Pallets / Outbound Truck 25.91

Resource Utilization
Pallet Placement: Slotting by Transaction Volume
FL: 6, Coll: 8, Runner: 6



● Forklifts ● Docks ● Collectors

Mixed Pallets / Order
Pallet Placement: Slotting by Transaction Volume
FL: 6, Coll: 8, Runner: 6



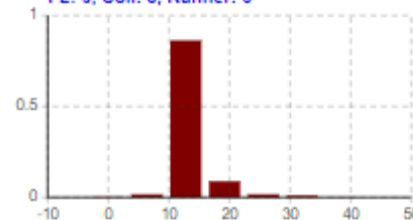
● Number of Mixed Pallets 1.89

SKUs / Mixed Pallet
Pallet Placement: Slotting by Transaction Volume
FL: 6, Coll: 8, Runner: 6



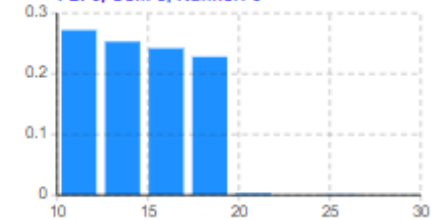
● Number of SKUs / Mixed Pallet 1.85

Number of Layers / Pallet
Pallet Placement: Slotting by Transaction Volume
FL: 6, Coll: 8, Runner: 6



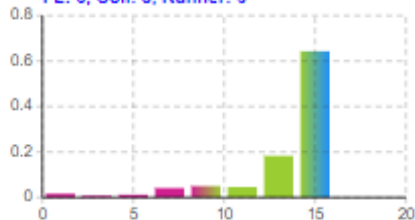
● Layers / Pallet 13.29

Racks Put/Pick Time
Pallet Placement: Slotting by Transaction Volume
FL: 6, Coll: 8, Runner: 6



● Storage Delay Time 14.32

Number of Pallets Stored / Runner
Pallet Placement: Slotting by Transaction Volume
FL: 6, Coll: 8, Runner: 6



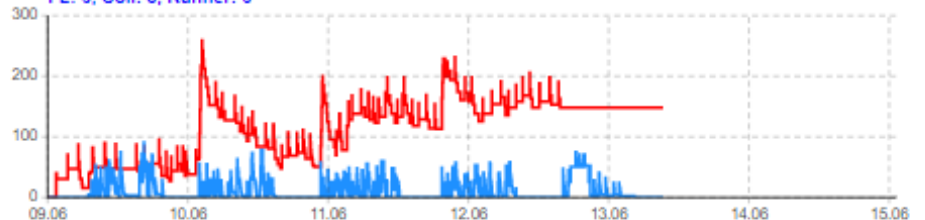
● Number of Stored Pallets / Runner 12.71

Number of Pallets Picked / Runner
Pallet Placement: Slotting by Transaction Volume
FL: 6, Coll: 8, Runner: 6



● Number of Picked Pallets / Runner 1.96

Waiting Pallets
Pallet Placement: Slotting by Transaction Volume
FL: 6, Coll: 8, Runner: 6



● Inbound ● Outbound

Summary of Simulation Scenario Results

Scenario	Day Shift and Night Shift			Utilization (*)		Fullfilment Inbound /Outbound/Conv
	Forklift	Collector	Runner	Forklift	Collector	
Current State	6 (2 IB+ 4 OB)	8	6	0.56	0.52	OK
1	5 (2 IB + 3 OB)	7	6	0.62	0.55	OK
2	4 (2 IB + 2 OB)	6	6	0.73	0.59	OK
3	4 (2 IB + 2 OB)	5	6	0.75	0.64	OK
4	3 (1 IB + 2 OB)	5	6	0.83	0.64	Can not deliver
5	3 (1 IB + 2 OB)	6	6	0.83	0.59	Can not deliver

IB: Inbound
OB: Outbound

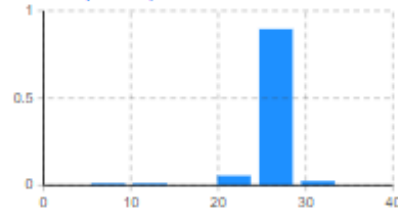
Scenario	Day Shift and Night Shift			Utilization (*)		Fullfilment Inbound /Outbound/Conv
	Forklift	Collector	Runner	Forklift	Collector	
3	4 (2 IB + 2 OB)	5	6	0.75	0.64	OK

Pallets in Inbound Truck
Pallet Placement: Slotting by Transaction Volume
FL: 4, Coll: 5, Runner: 6



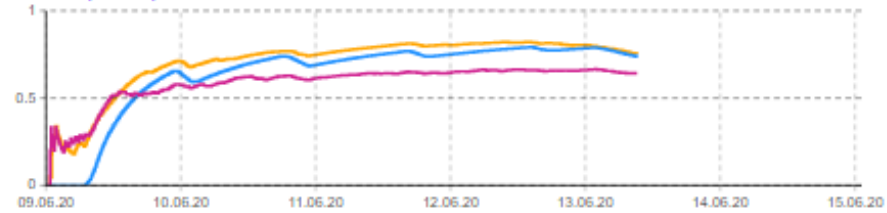
● Pallets / Inbound Truck 26

Pallets in Outbound Truck
Pallet Placement: Slotting by Transaction Volume
FL: 4, Coll: 5, Runner: 6



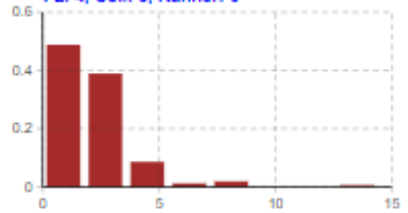
● Pallets / Outbound Truck 25.81

Resource Utilization
Pallet Placement: Slotting by Transaction Volume
FL: 4, Coll: 5, Runner: 6



● Forklifts ● Docks ● Collectors

Mixed Pallets / Order
Pallet Placement: Slotting by Transaction Volume
FL: 4, Coll: 5, Runner: 6



● Number of Mixed Pallets 1.88

SKUs / Mixed Pallet
Pallet Placement: Slotting by Transaction Volume
FL: 4, Coll: 5, Runner: 6



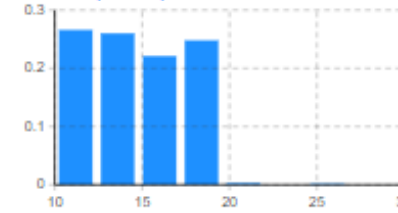
● Number of SKUs / Mixed Pallet 1.85

Number of Layers / Pallet
Pallet Placement: Slotting by Transaction Volume
FL: 4, Coll: 5, Runner: 6



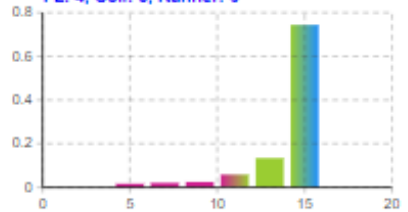
● Layers / Pallet 13.28

Racks Put/Pick Time
Pallet Placement: Slotting by Transaction Volume
FL: 4, Coll: 5, Runner: 6



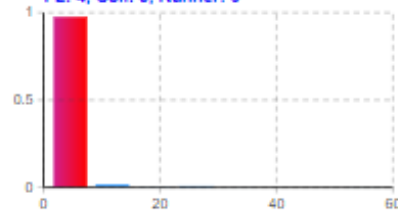
● Storage Delay Time 14.4

Number of Pallets Stored / Runner
Pallet Placement: Slotting by Transaction Volume
FL: 4, Coll: 5, Runner: 6



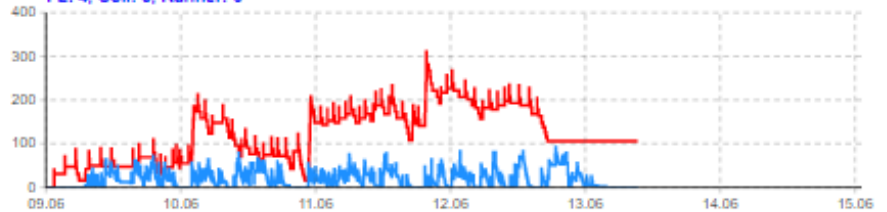
● Number of Stored Pallets / Runner 13.32

Number of Pallets Picked / Runner
Pallet Placement: Slotting by Transaction Volume
FL: 4, Coll: 5, Runner: 6



● Number of Picked Pallets / Runner 2.05

Waiting Pallets
Pallet Placement: Slotting by Transaction Volume
FL: 4, Coll: 5, Runner: 6



● Inbound ● Outbound