



**Vaasan yliopisto**  
UNIVERSITY OF VAASA

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# **Simulation of Production Systems TUTA3250 2025**

**Final report**

School of Technology and Innovation  
Final Report  
Master in Robotics

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**ABSTRACT :**

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**KEYWORDS:** Part1- Obligatory Exercises for the final report, Part2-Selected Case study

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# Final Report for Simulation of Production Systems

In this Final report, I have done the task in 2 Sections. In the first section, I have done all 5 obligatory exercises that are listed in Moodle and second section contains the use case that I selected for part 2 from Moodle.

## 1. Part 1 - Obligatory Exercises

### 1.1 Creating a Simple Robotic Cell

## product Lathing with Robot

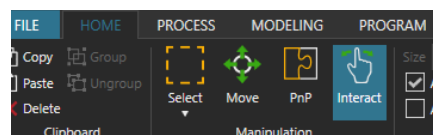
01/04/2025

#### 1. Added Product Components-

- Generic Articulated Robot
- Robot Transport Controller
- Generic 3-Jaw Gripper
- Robot Transport Controller
- Conveyor Belt (2)
- From Conveyor Process
- To Conveyor Process
- Generic Small Lathe
- Feeder
- 2 Cube
- Cylinder

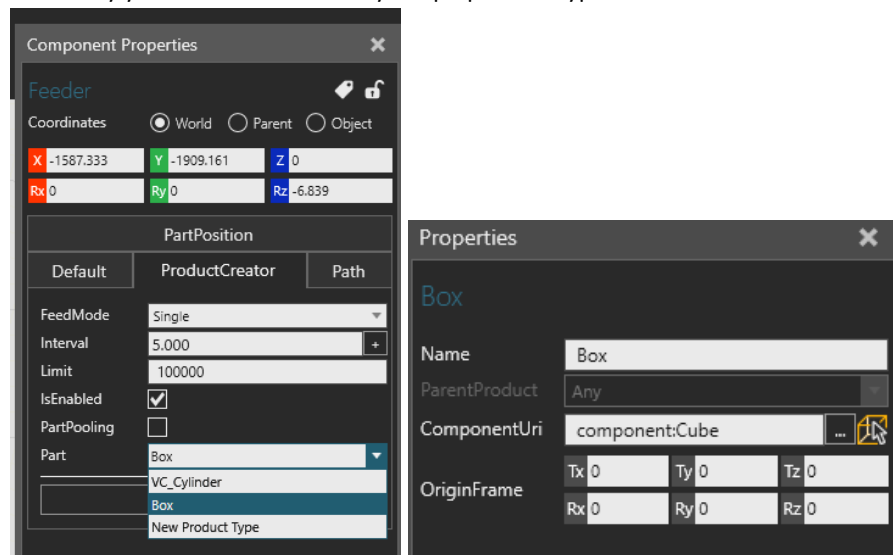
#### 2. Setup

- Robot
  1. From eCatalogue-Robots- Generic Articulated Robot is used with Robot Transport Controller. Attach both.
  2. From eCatalogue-Robot Tools- Generic 3-Jaw Gripper is attached to the Articulated Robot.
  3. Click on any part of robot- in Home – select interact- Now you can rotate the robot at any direction as well as gripper.

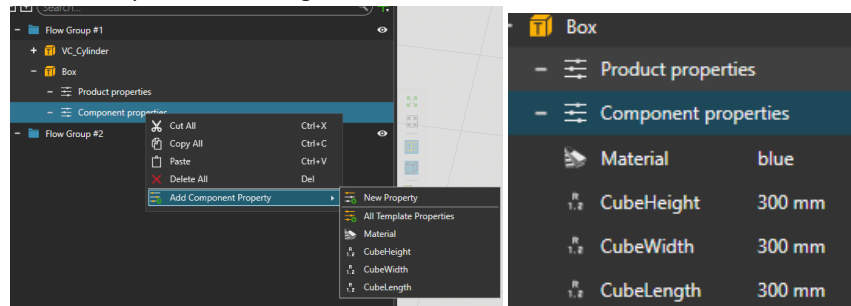


- Conveyer Belt

1. From eCatalogue-Conveyor- add conveyor to 3d world and copy and paste to make 2 conveyors. Keep both conveyors within a small distance apart.
  2. From Flow Component- add a From Conveyor Process and a To Conveyor Process and attach to the conveyors output and input side respectively.
  3. You can change the conveyors and conveyor process tools properties in property fields.
- Feeder
    1. From eCatalogue – visual component- Flow component – choose feeder. The feeder already comes with a cylinder component. Attach the feeder with conveyors.
    2. Added Box as another product – selected box from product and container in eCatalogue - in feeder property- productcreatorTAB-part- select new product type – Define Product.
    3. In Product Type editor – see the new product – rename to BOX-Click on BOX – in property – in componentURI-Pickcomponentin3d world- select the cube in layout – then you will see box name in the component uri field. Now Play – you see boxes are coming from feeder.
    4. Same way you can more differently shape product type to feeder.



5. You can manage size of box from feeder - In Product Type editor – click on box – right click on component property – add component property – all template property. Then you click on component property and in property field you can change size of box you want coming from feeder.



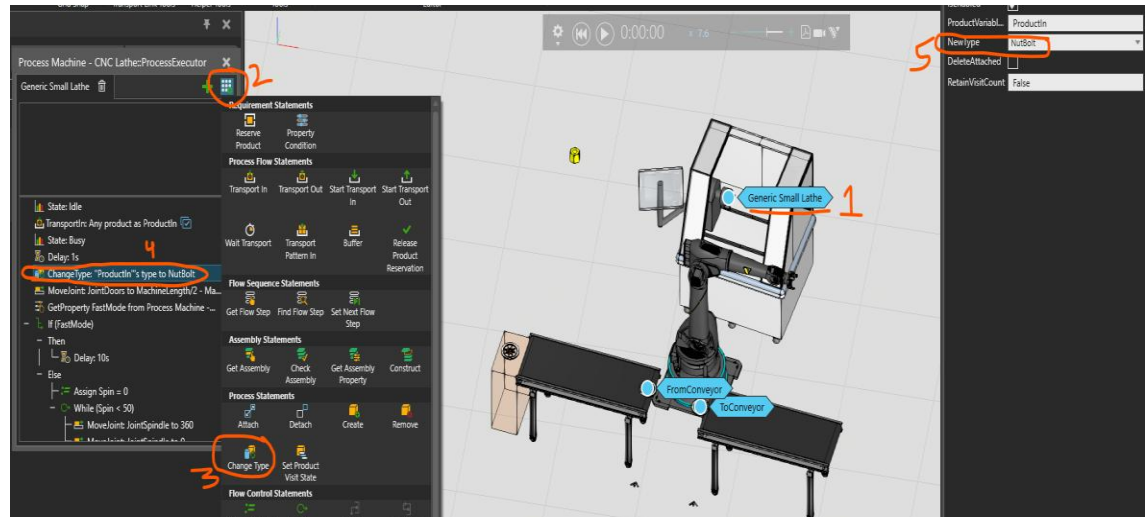
6. Feeder is defined with two product type – 2 Box and cylinder.
7. Size of the Box and cylinder. Box: 100x100x100, Cylinder: 50x50
8. To get random product from feeder, in feeder property- productcreatorTAB – Feed mode as distribution, Random stream- 1, add products into the table- then define products. Then play and see random products coming from Feeder.

The screenshot shows the 'PartPosition' window with the 'ProductCreator' tab selected. The 'FeedMode' is set to 'Distribution'. The 'Interval' is 2.000 seconds. 'RandomStream' is set to 1. The 'Limit' is 10. 'PartPooling' is unchecked. Below these settings is a table with two columns: 'Product' and 'Probability'.

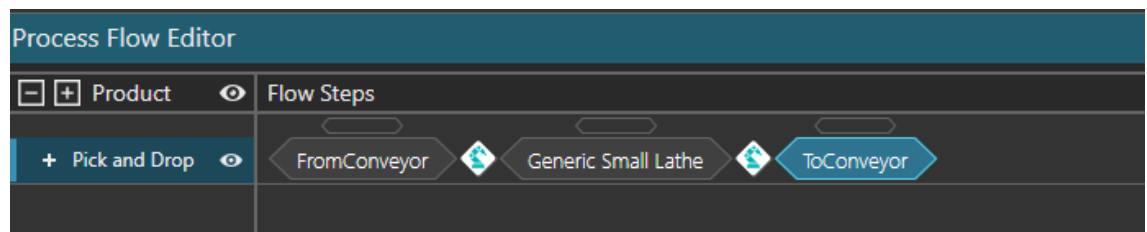
Product	Probability
Box	1
RedBox	2
VC_Cylinder	1
Select Part...	

At the bottom of the window is a button labeled 'Define Products'.

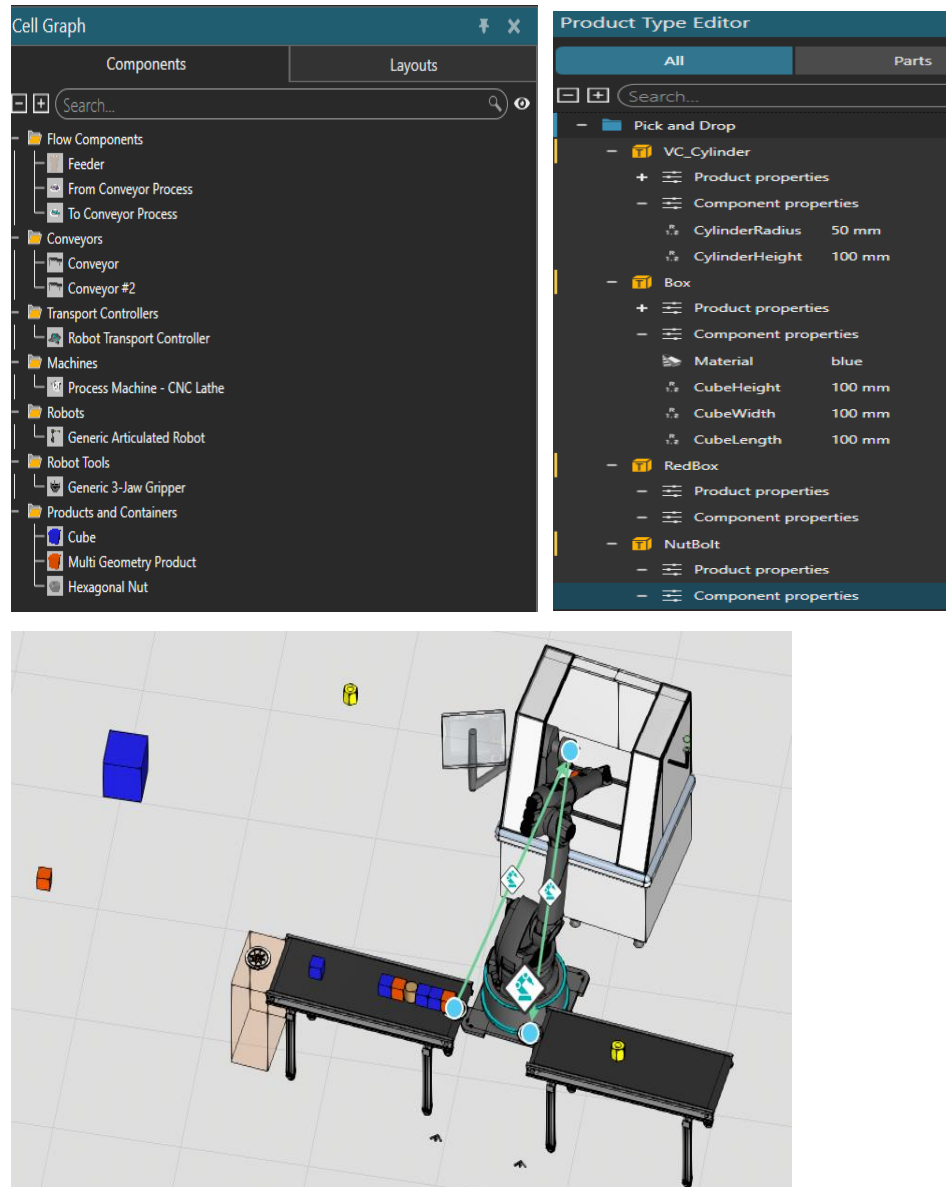
9. Feeder is configured with Distribution Feed mode with random stream 1 so that it can feed random products.
  10. The feeding interval is set to 2 seconds.
- Generic Small Lathe machine
    1. From Machines in eCatalogue – select process machine- CNC Lathe.
    2. Keep the machine near to the robot.
    3. To change the shape of the output product from Lathe, You can go to PRO-CESS TAB – select process- click on machine name in 3d world – in ProcessExecutor window – click on Delays 1s- then click on matrix icon for add new statement- select ChangeType statement in process statement section. Right side in propertytab – in new type field – change to your desire type (I chose NutBolt). After lathing all the final product would be of NutBolt shape. You can also change the process time in Machine common property.



- Process and Flow
  1. From PROCESS Tab- process-click on process and flow both.
  2. In process flow editor – Select FromConveyor – parametric Lathe – ToConveyor to form link.
  3. Flow group is created. renamed to “Pick and Drop”
  4. Select link and in property or right click , change “Interpolation Transport” to “Robot Transport controller”.



- Relevant pictures- Cell Graph, 3d platform view, Product Type Editor



## 1.2 Introduction to Layout Configuration

20/04/2025

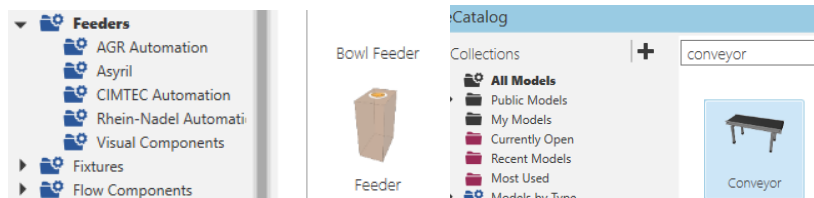
### 1. Component Used:

- Conveyor
- Feeder
- Piston head
- 2 Parametric five-axis lathe

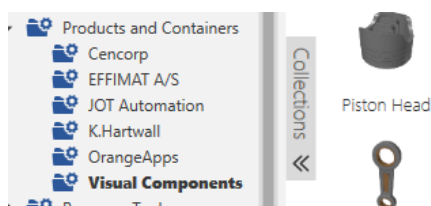
- 2 Process Machine – ProLathe
- Robot Transport Controller
- Generic Articulated Robot
- To Conveyor Process
- From Conveyor Process
- Robot Floor Track
- 2 Table A
- FenceAndWallBuilder
- Process Node
- Feeder Process
- From Conveyor Process
- Human (Anna)
- Human Transport Controller
- Warehouse Self
- Piston Rod

## 2. Setup:

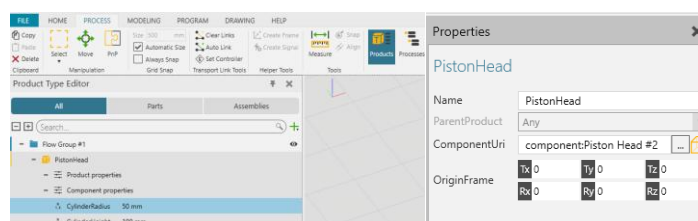
- Add conveyor and Feeder to the layout (Drag and drop) from eCatalog – model by Type



- Add piston head from eCatalog- Model By Type- Productand container



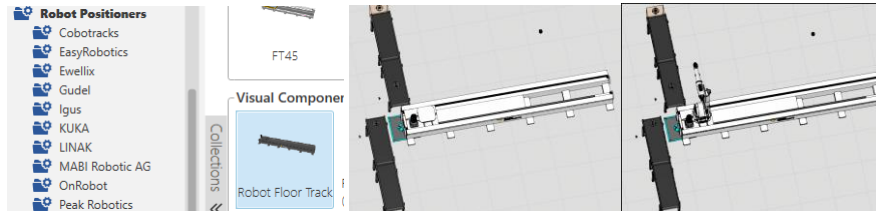
- Go to the Process tab and click on Products and Select VC\_Cylinder in the Product Type Editor and on the Properties, tab change the name to PistonHead .
- Click on the yellow cube on the right and select the Piston Head component



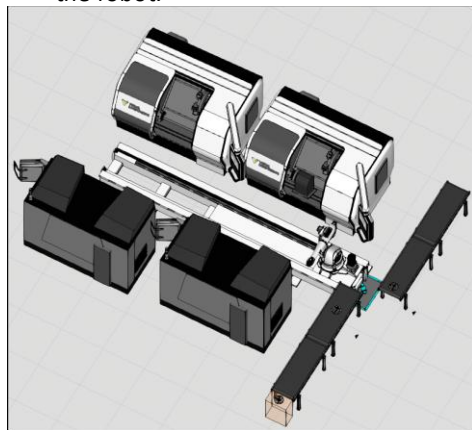
### Continue to create a Machine Tending Cell:

Robotic machine tending (CNC Machine Automation) is the process of using a robot system to automatically load and unload a production machine.

- Expand the Models by Type collection and select type Robot positioners from Visual Components and Drag and drop the Robot Floor Track and snap it to the Robot Transport Controller. Add Generic Articulated Robot to Floor Track.

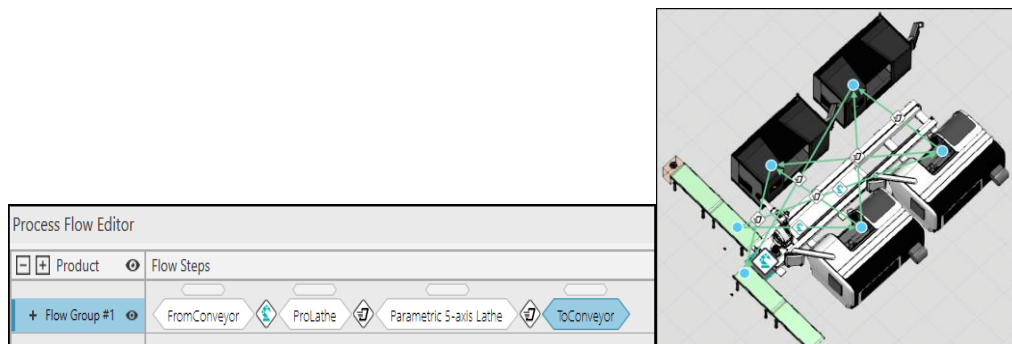


- Go to eCatalog-Machines-Visual Component- drag and drop two Parametric five-axis lathe and two Process Machine-ProLathe and place them like the doors must be located facing the robot.



### 3. Flow Component

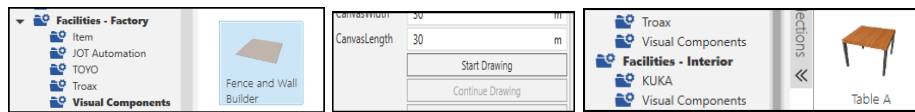
To create a flow, Select the label of FromConveyor component - Select the Robot Controller - select the ProLathe label. Automatically, the flow from both machines would be created. Then select Robot Controller- select Parametric 5-axis Lathe machine label and finally select ToConveyor label. Then complete flow is created now.



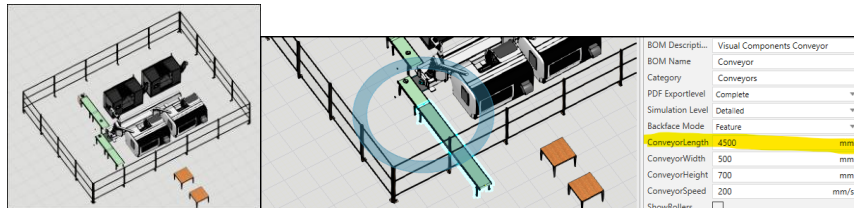
### 4. Interior Facilities:

- These components are static components used for enriching the simulation environment with tables, fences, walls.

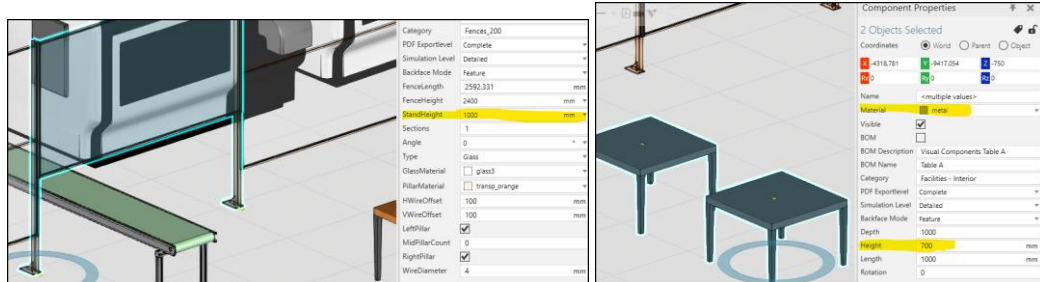
- Add FenceAndWallBuilder from Facilities Factory and Table A from Facilities Interior
- Start drawing and make fence and end drawing and delete the FenceAndWallBuilder once done.



- Now extend the last conveyor length so that it reaches through the fence.



- Select the panel that the Conveyor crosses and change its StandHeight to 1000 and change the wooden tables material to Metal for industrial use and their height of the tables to 700 mm.

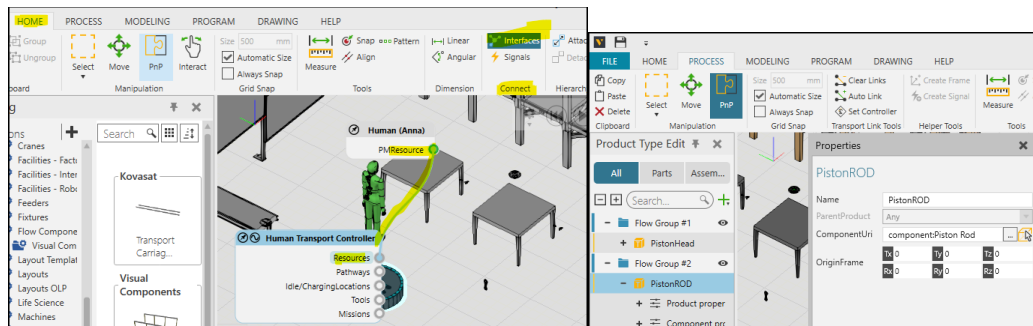


## 5. Create Statements:

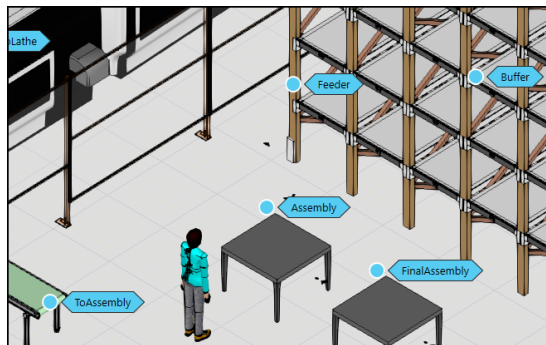
- A Process Modeling statement is used for creating and executing specific tasks.
- Drag Process Node, Feeder Process, From Conveyor Process, Human (Anna), Human Transport Controller, Warehouse Self, Piston Rod and drop in 3D world and arrange.
- Place them like below



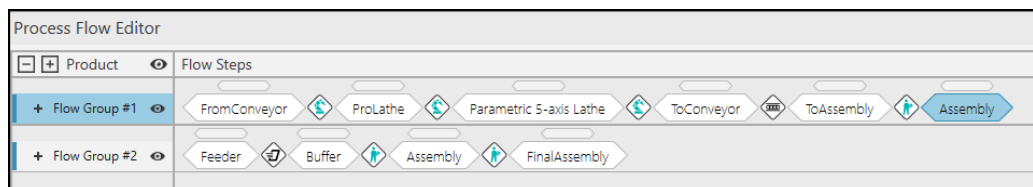
- select Home tab- select the Human Transport Controller and click on Interfaces from the Connect Tab. This displays an action pane along with connection editors in the 3D world for wiring connections. Then connect the Human Transport Controller with the Human
- Go to the Process tab click on Products -> Flow group #2 -> VC\_Can, now change the name from VC\_Can to PistonRod, and select it following the steps from before.
- Click on Processes select FromConveyor and change the name to ToAssembly.
- Select the Process Nodes and change the names from Process #1 to Assembly and FinalAssembly



- In process-select processes tab, Change label of “FromConveyor” to “ToAssembly” .
- Select the Process Nodes and change the names from Process #1 to Assembly and FinalAssembly.

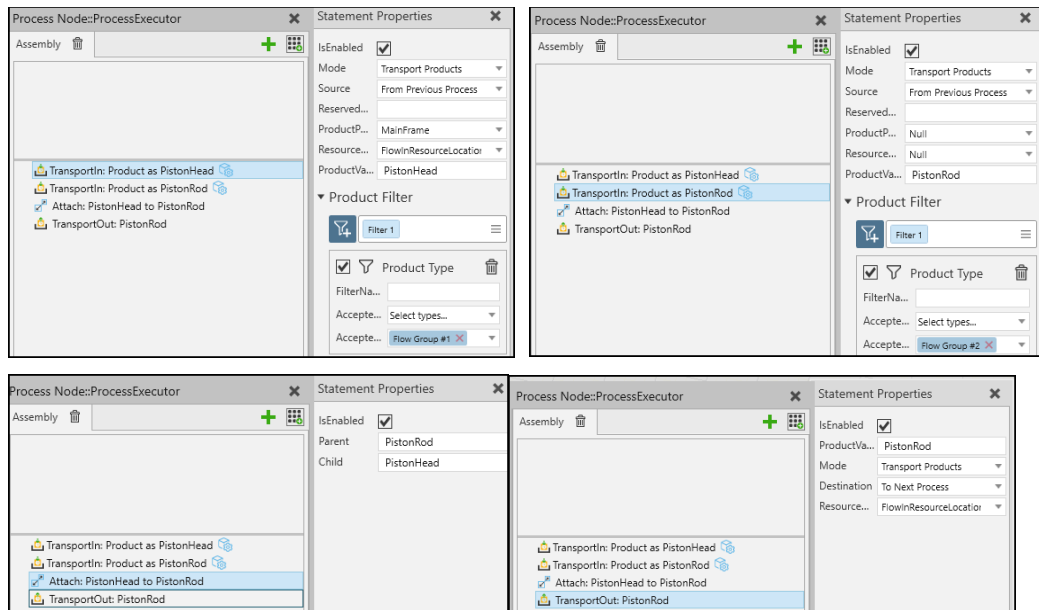


- Now we need to create a flow which describes as Anna (human) is supposed to pick the part from the conveyor, place it in the Process Node (ToAssembly), assemble it with the piece from the buffer and place it to the other Process Node (FinalAssembly).

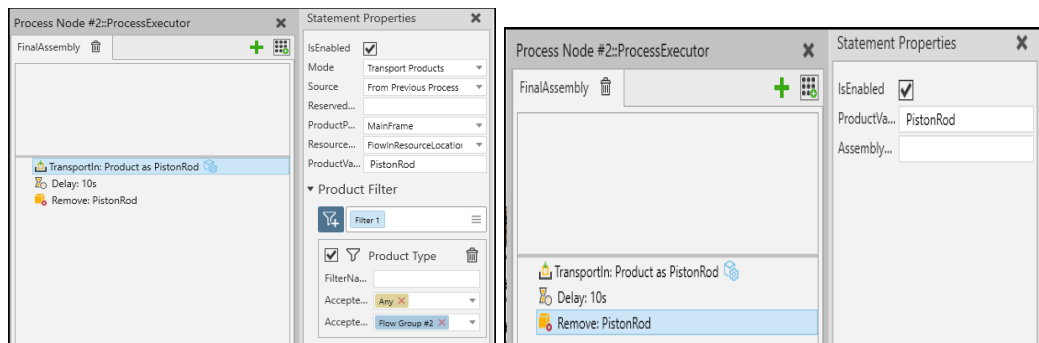


- Modify the process statement of the processnodes so that human can pick piston head from conveyor and bring piston rod from self and merge them in processnode1(Assembly) and them transfer them to Processnode2(Final Assembly). Below are the statement changes in process nodes.

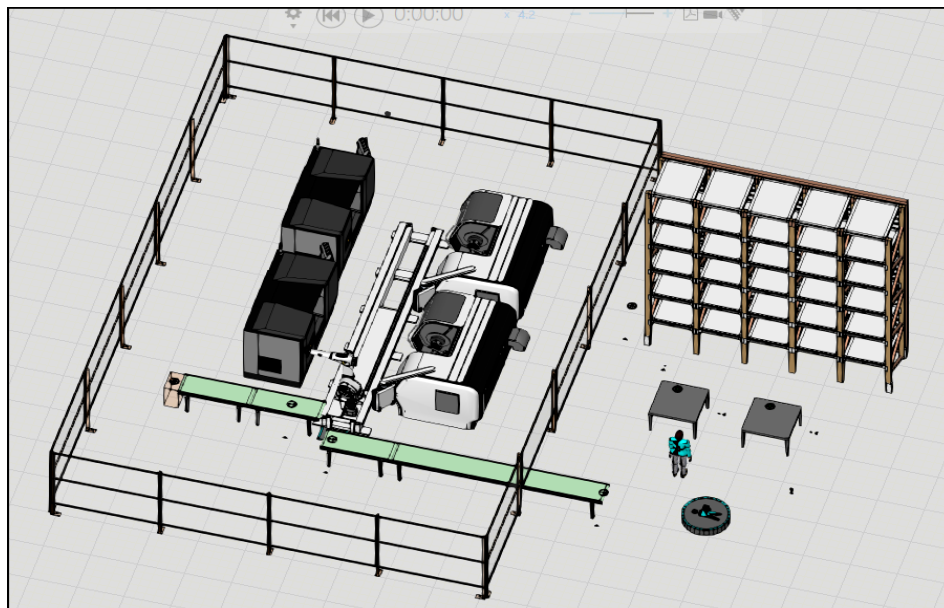
- Assembly Process node statement modifies:



- FinalAssembly Process node statement modifies



- Now everything is completed, and final layout look like below:



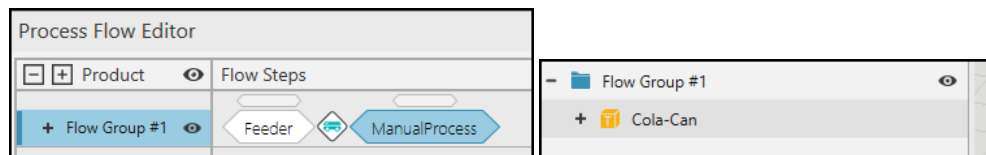
## Sample Video Shorts: Layout Configuration

### 1.3 Transport and Work Priority (double case)

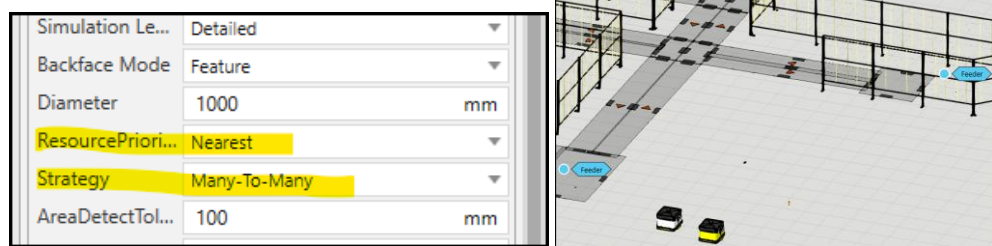
#### A. Part 1: Resource Priority and Multi-transporting

Aim: Pick up the parts from the feeder and take it to manual process.

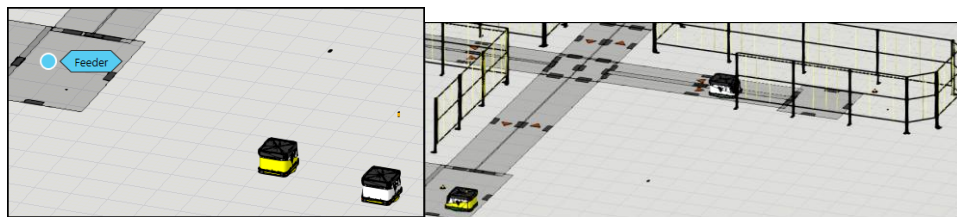
1. Create a flow from feeder to manual process by mobile robot and I change the product type from chocolate to Cola Can.



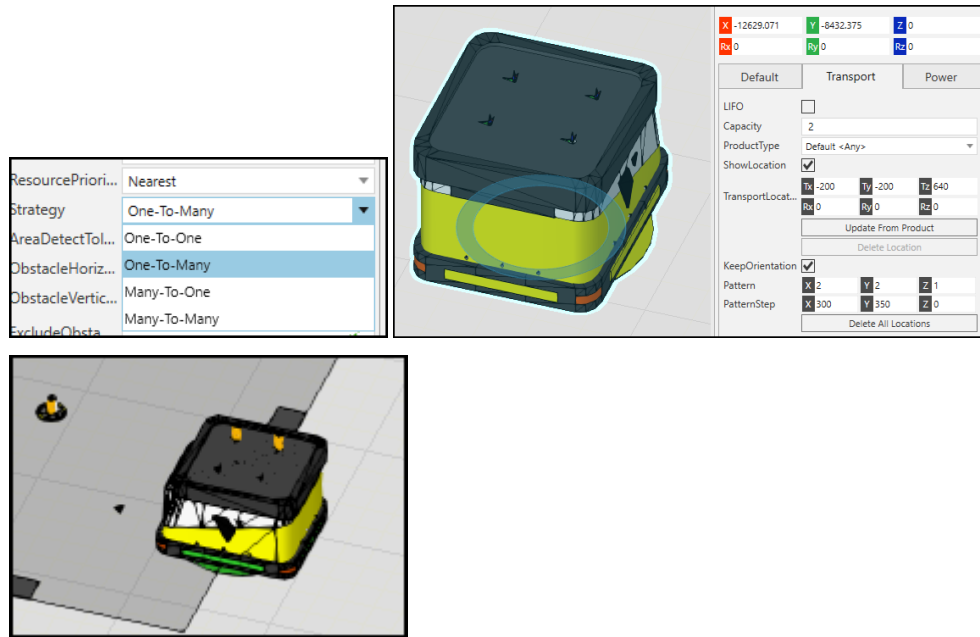
2. Now change the resource priority and strategy by clicking on mobile robot transport controller. Right now, below is the current value set for respective properties



3. I have 2 robots, white robots are near to feeder 1 left to the robot, Now I will change the position of the white robot little far from feeder so yellow will be the nearest from feeder 1 and yellow robot will pick from feeder 1.



4. Similarly, Changing the robot strategy, if I want robot to take product from feeder to one process or many process. I need to change the capacity of the feeder to 2 and keep strategy one to many.



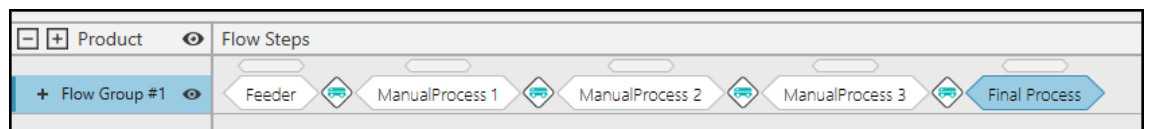
- Finally, I change transport controller property like below, and robot is taking product from randomly from either of the feeder and taking to multiple processors.

Diameter	1000	mm
ResourcePrior...	None	
Strategy	Many-To-Many	
AreaDetectTol...	100	mm
ObstacleHoriz...	300	mm

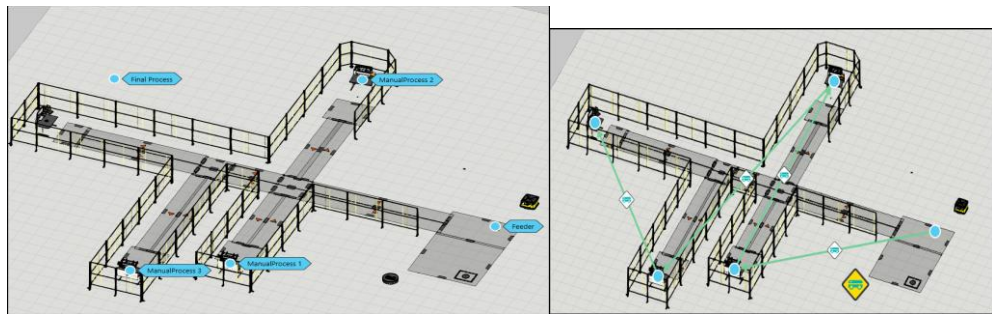
**Sample Video Shorts:** <https://youtu.be/Yj26aDZ0Dko>

## B. Part 2: Transport and Work Priority

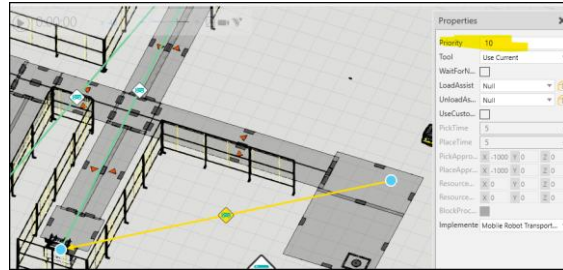
- Added a process flow.



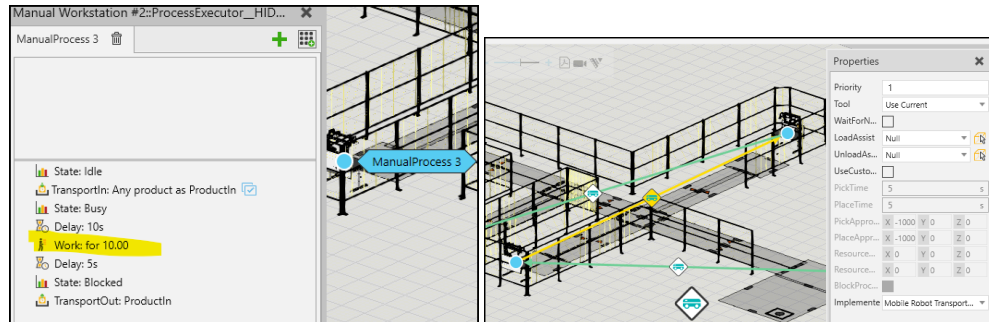
- 



- 
- 
- 
- Set priority of process flow(1 -Highest and 100-lowest).



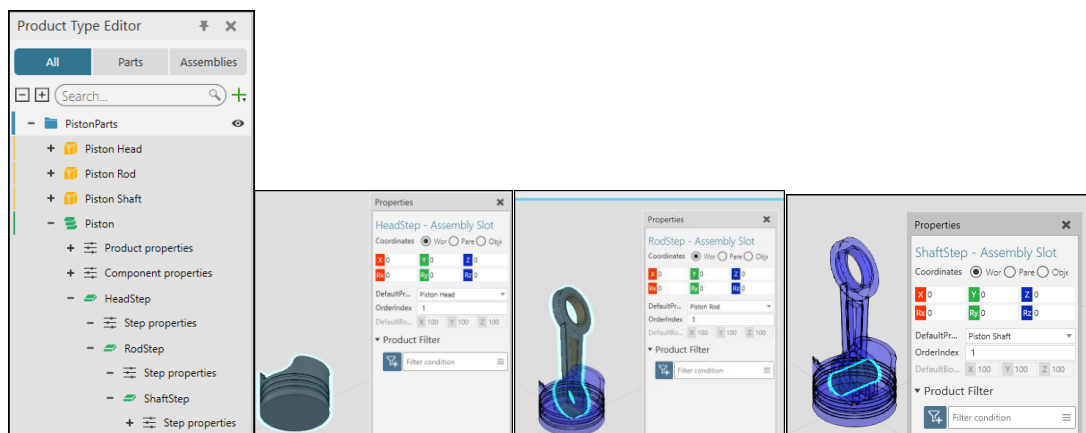
- 5.
6. added priority of manual process1-2 as 1, manual process2-3 as 2, manual process3-Final-Process as 3 and added work process in manual process 3.



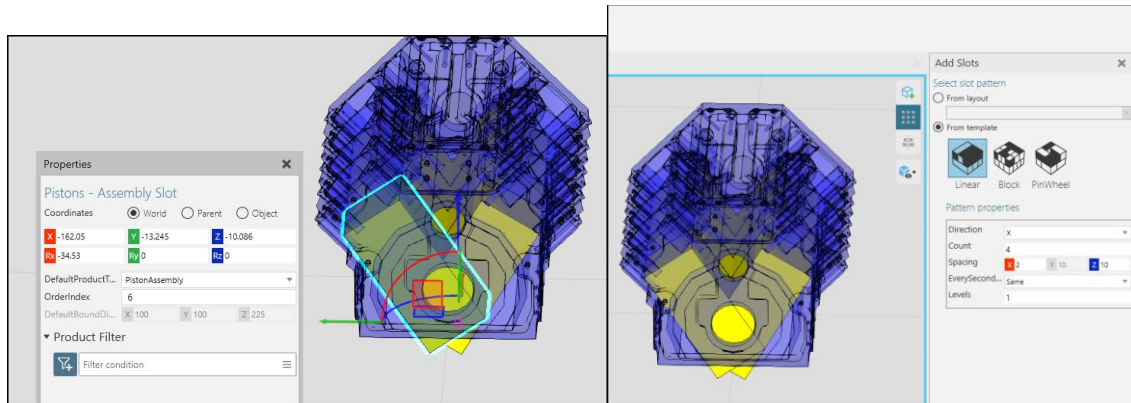
7. Now, whenever there is a request for part to take from process 1-2 or work process in manual process 3, Robot will take priority in FIFO manner. First request with highest priority 1 will be served first.

## 1.4 Assembly in Processes

Assemble a piston with piston head, piston rod and piston shaft. Add three components and add the product in product type sections. Then add assembly and create three steps assembly for assemble piston. In assembly editor space, add the assembly slot for each component.

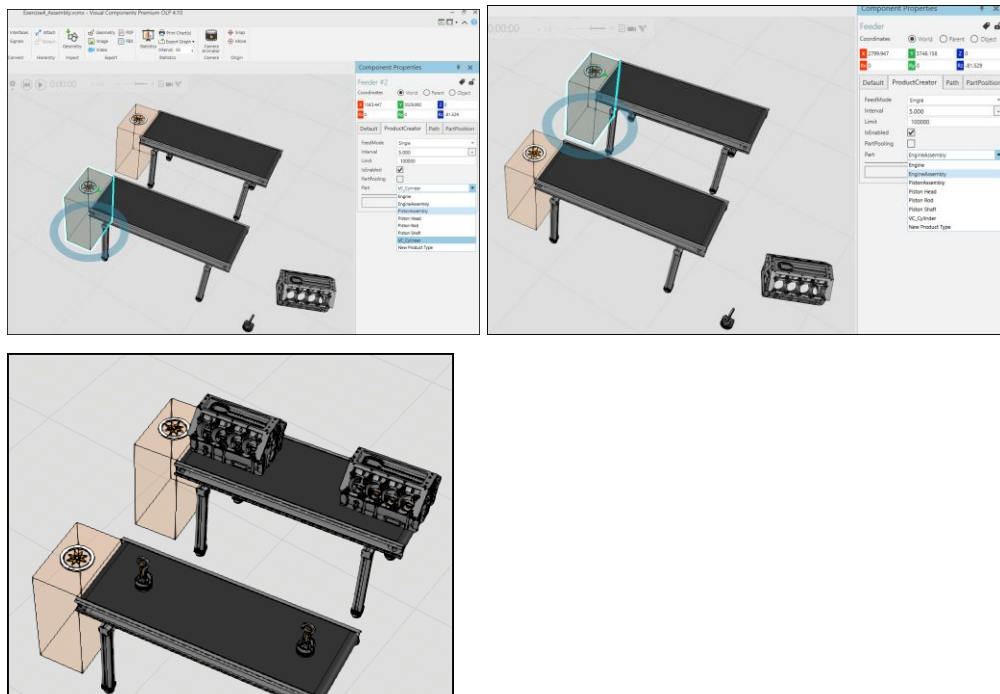


Pistons Default Bounds Dimensions is set to match PistonAssembly's dimensions (~100x100x225) and Piston Assembly is defined into AcceptedProductTypes .Step is rotated and moved to match the EngineBlock and more slots are added with AddSlots - tool.



#### 1.4.1 Creating assembly Vs Product Type

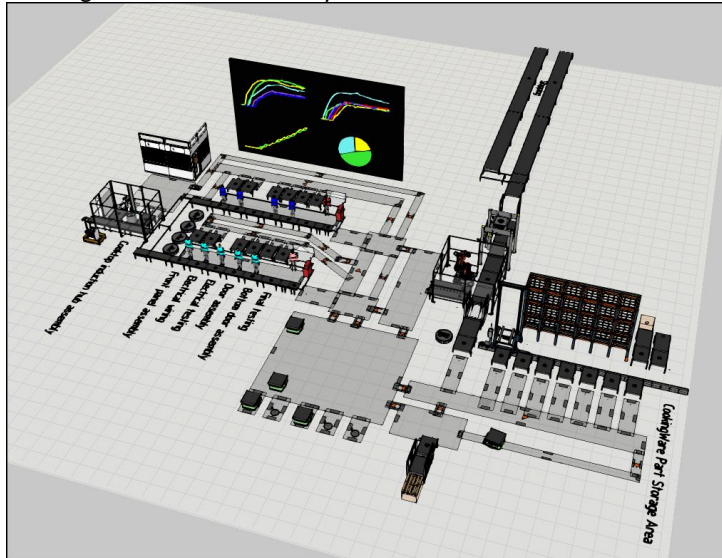
1. Add conveyors and feeders to 3d world and add piston assembly and engine assembly to each of the feeder.



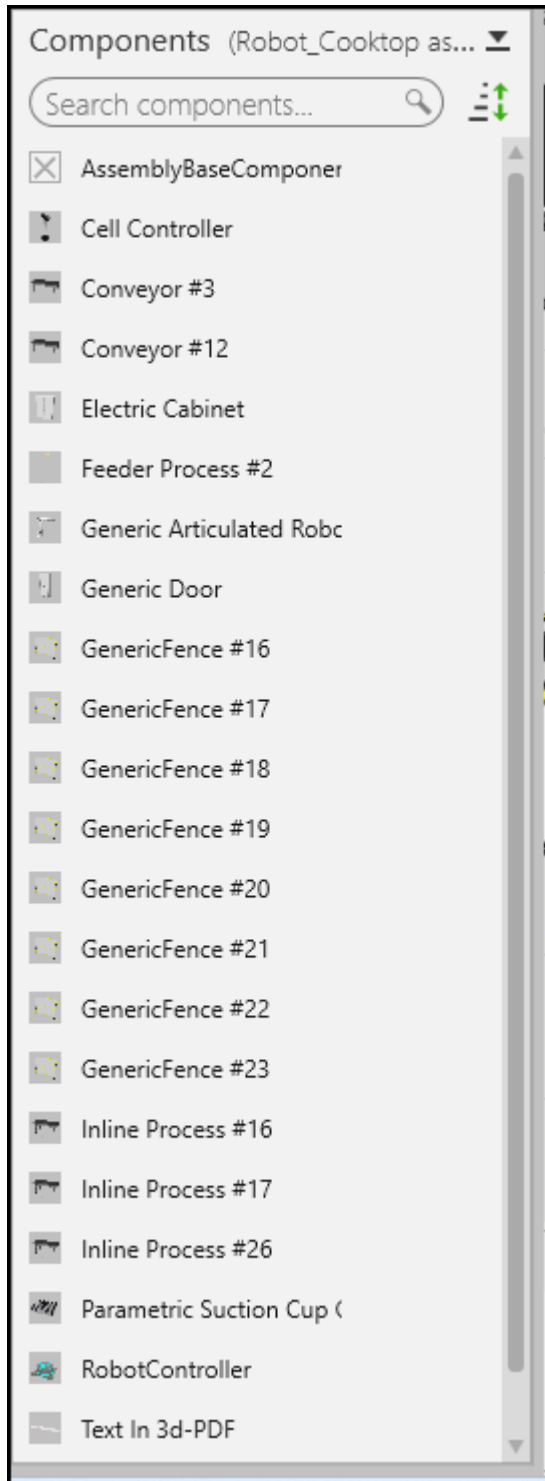
## 2. Part 2- Use Case - Cooking Hub Manual assembly

**Sample video:** [https://youtu.be/dkq-eCrSd\\_c](https://youtu.be/dkq-eCrSd_c)

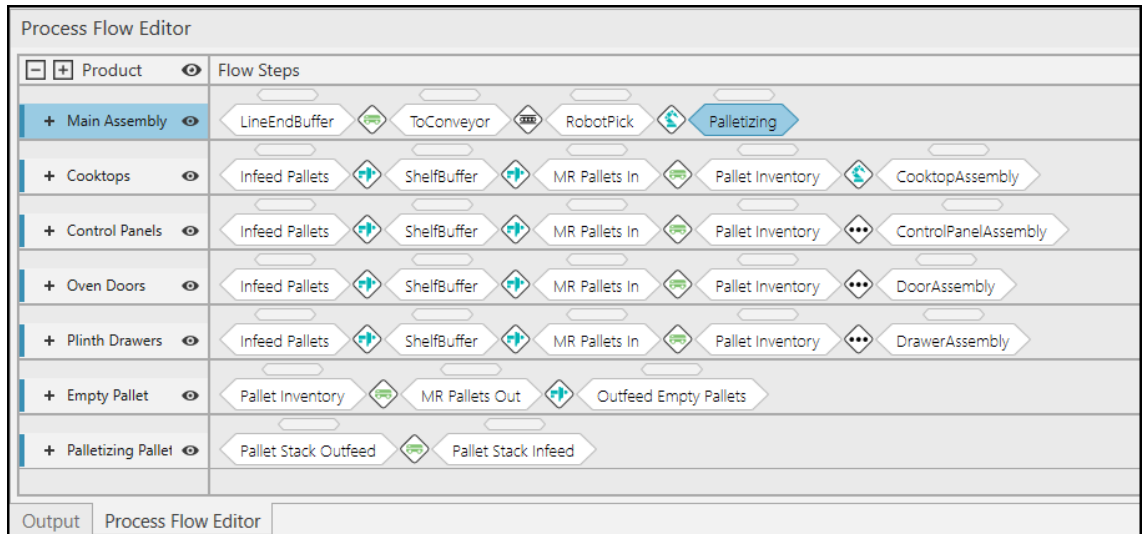
1. Cooking Hub Manual assembly



- 2.
3. Components used in project part 2.

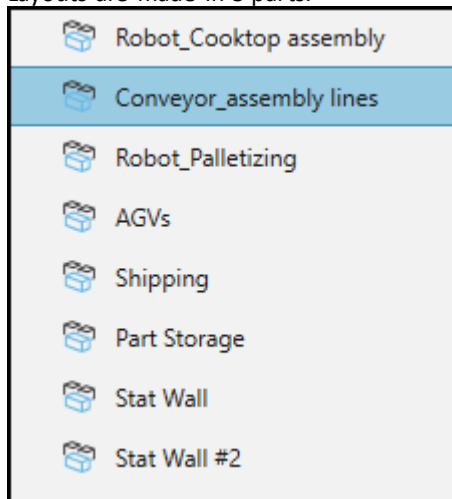


- 4.
5. The Process flows used in this project are listed below



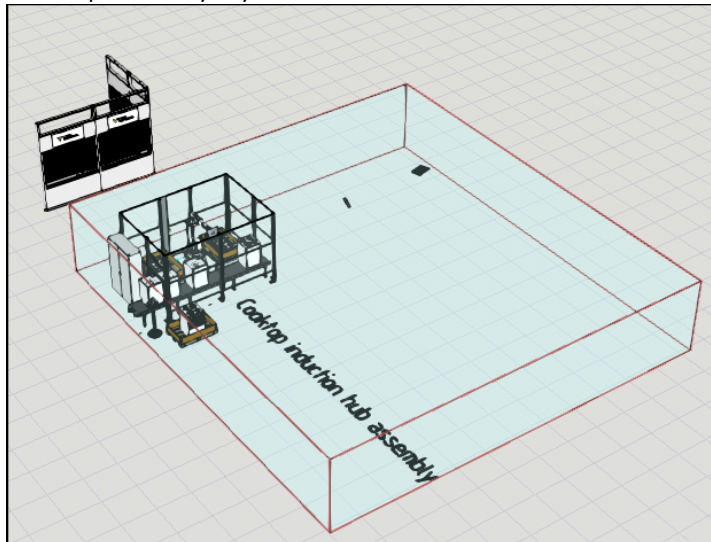
6.

7. Layouts are made in 8 parts.



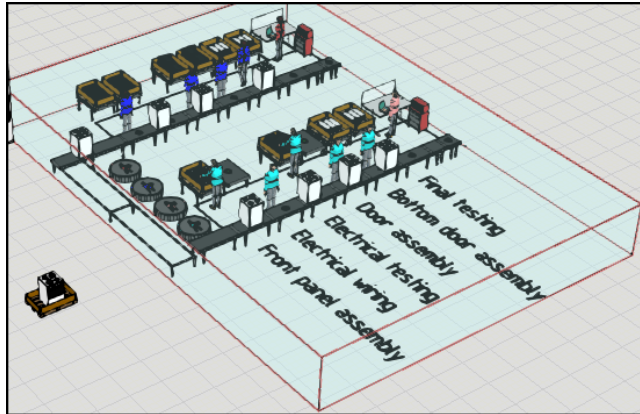
8.

9. Cook top Assembly Layout:



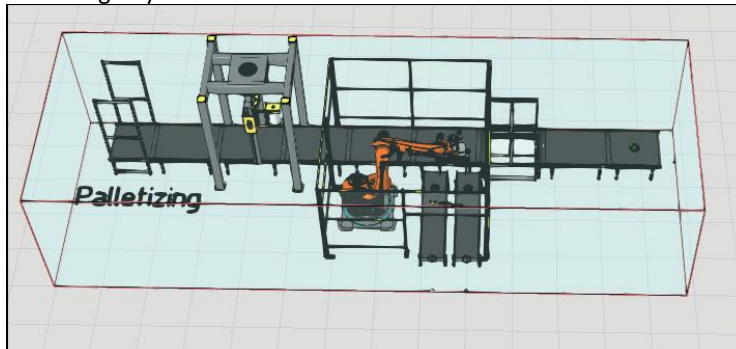
10.

11. Conveyor Assembly Layout:



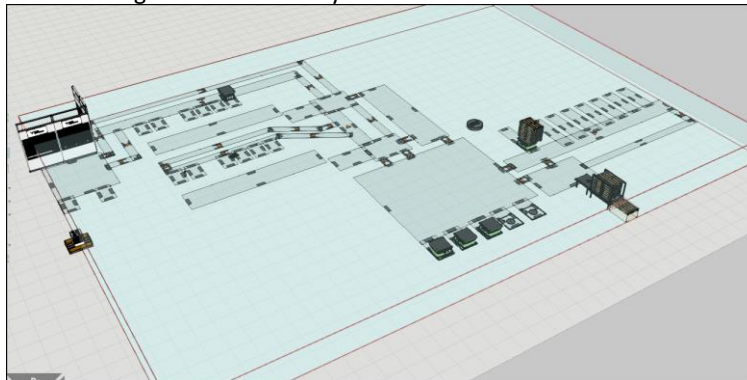
12.

13. Palletizing Layout:



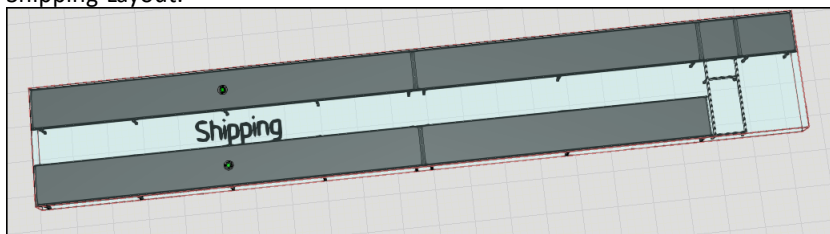
14.

15. Automated guided Vehicles Layout:



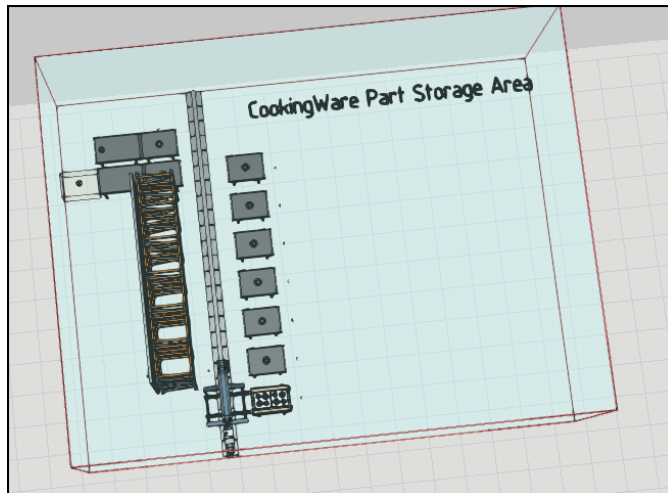
16.

17. Shipping Layout:



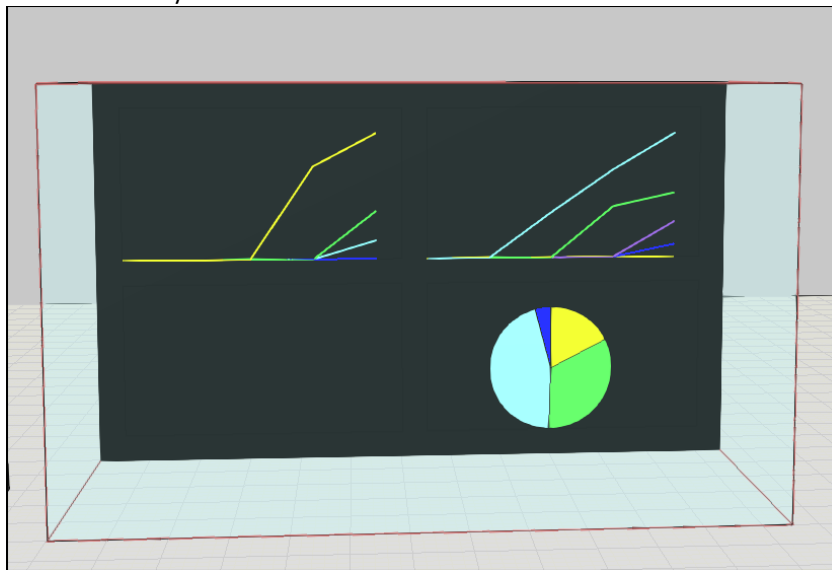
18.

19. Cooking ware part storage Layout:



20.

21. Statistic Wall Layout:



22.

23. Human transport control setup

**Component Properties**

Human Transport Controller #2

Coordinates ☒ World ☐ Parent ☐ Object

X -6423.728 Y -7000 Z 0

Rx 0 Ry 0 Rz 0

Default LinkDefaults Work Avoidance

Name Human Transport Controller #2

Material light\_cyan

Visible ☒

BOM ☐

BOM Descript... Human Transport Controller

BOM Name Human Transport Controller

Category Process Transport Controllers

PDF Exportlevel Complete

Simulation Le... Detailed

Backface Mode Feature

Diameter 1000 mm

ResourcePrior... Nearest

Strategy Many-To-Many

AreaDetectTol... 100 mm

ObstacleHoriz... 300 mm

ObstacleVerti... 300 mm

ExcludeObsta...

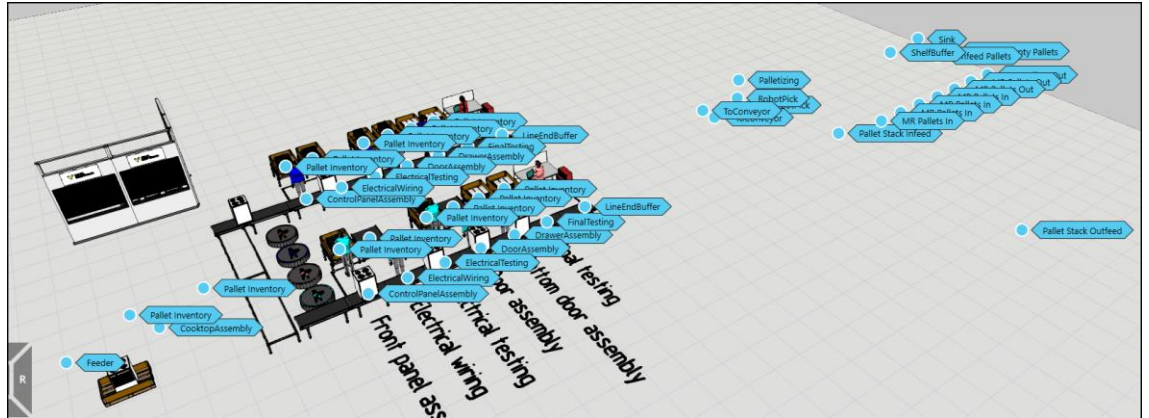
PrecisionObst...

ApplyColorTo... ☒

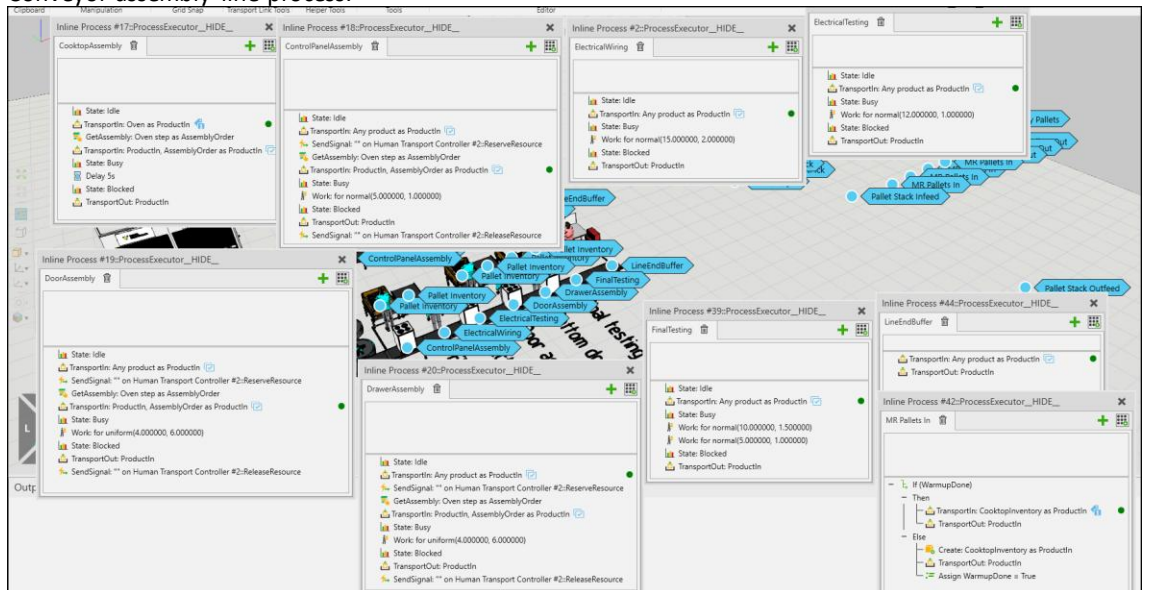
UseGlobalArea ☐

Connect All Pathways

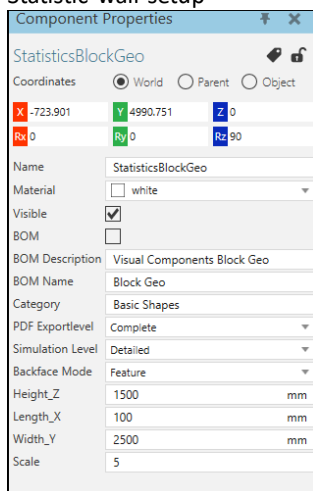
- 24.
25. All process views:



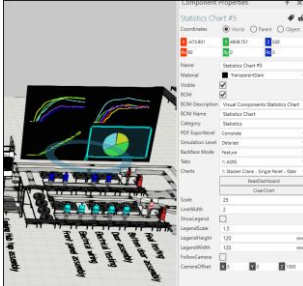
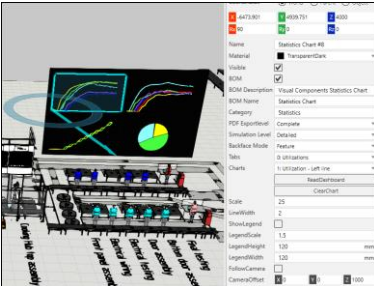
26.  
27. Conveyor assembly line process:

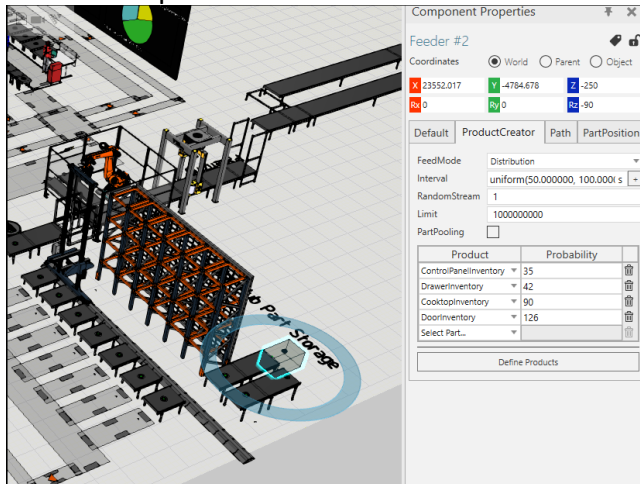


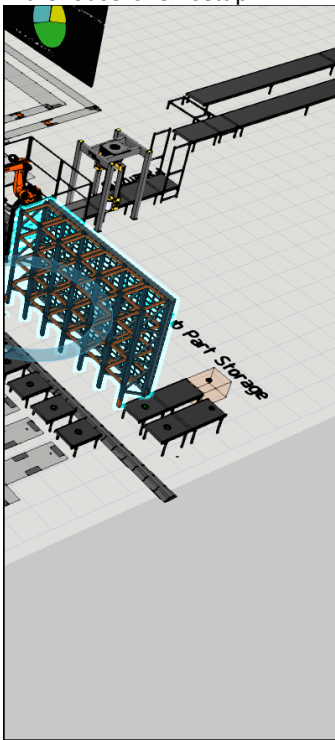
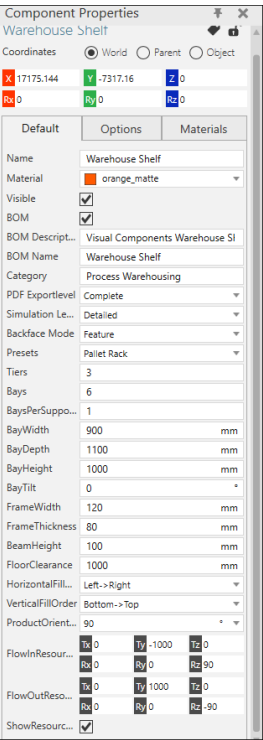
28.  
29. Statistic wall setup



30.  
31. Statistic chat setup

32. 
33. 



34. 
35. 

36.

### 3. Analysis and conclusions

**A. List of possible pitfalls you might have come up with.**

I have difficulties understanding statement creation and process modeling.

**B. How did you overcome these, or did you not?**

With help of Visual component academy , I learnt how to set up the process modeling and statement creation and how to automate the process with step by step manner from the videos and guides.

**C. Key learning points.**

General production simulation creation, assembly line creation, transport and work priority setup, various layout configuration, Human and mobile robot setup and build up process and flow and different component creation and custom component creation.

**D. what did you learn and what you didn't learn.**

Any specific manufacture component used and heavy layout for big production system.

**E. How did the course meet your expectations**

The course is interesting it needs more practice and understanding of the layout on how things be done prior to building your own simulation. Because of the real-life example and simulation, it feels like game and design and that's what makes this course the most interesting among others.

===== END =====