UNIVERSITÀ DEGLI STUDI DI MILANO

DEPARTMENT OF COMPUTER SCIENCE

SIMULATION

Milk Processing Plant Project

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ACADEMIC YEAR 2021-22

INTRODUCTION

This Simulation is developed to demonstration model of an integral knowledge-based system to be used by Processing/packaging line for milk farm. We are currently simulating the Milk Factory Model where we have 4 services units.

We have classified as Milk Storage unit, Milk processing unit, Packaging unit and loading unit.

The issue am representing in the model is the status of the Assemble or Worker to change depending on the current utilization. We have predicted the unit is idle and utilized in effective and productive way. Amount of resource unit are utilized are in 24 hours. Number of worker work in packaging probability for gender, age and salary they received

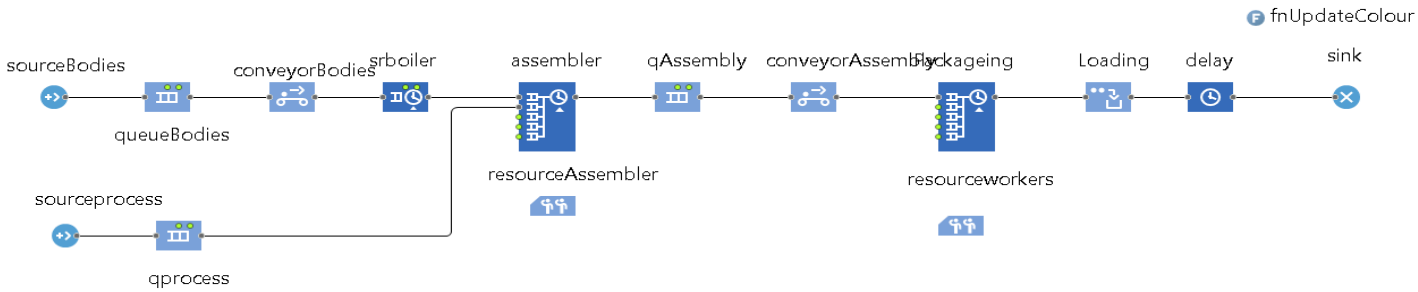
Milk Storage Unit : In this unit the milk are collected from different farms and stored in vertical cooling tanks and pumps further once the required. It is primary unit the more important is the keep the milk fresh and healthy.

Milk processing unit: It's an automatic processing unit where depending on the amount and type of microorganism that need to be killed and the shelf life of the product we want to achieve different processes are used: pasteurization, UHT, HTST or filtration. Even we store the package containers. Milk can be packed into different types of packages: carton, glass, pouches, PET bottles, etc.

Packaging unit: Once the product pasteurization and bottled process is finished, the milk passes to the packaging process. Milk is a valuable time- sensitive product, we need to package that will keep our dairy product safe and fresh. This action is performed by worker.

Loading unit: In loading unit function is keep the product clean, labeled, keep the product cold condition and delivers the product in timely manner**.** The final goal in **transport dairy** to local or regional locations to consumes.

MODEL



An Agent-based model (ABM) is a class of computational models for simulating the actions and interactions of autonomous agents (both individual and collective entities such as organizations or groups) with a view to assessing their effects on the system as a whole.

Here we introduce 5 Agents in this model

Body (Milk store in storage unit)

Door (Bottled processing unit)

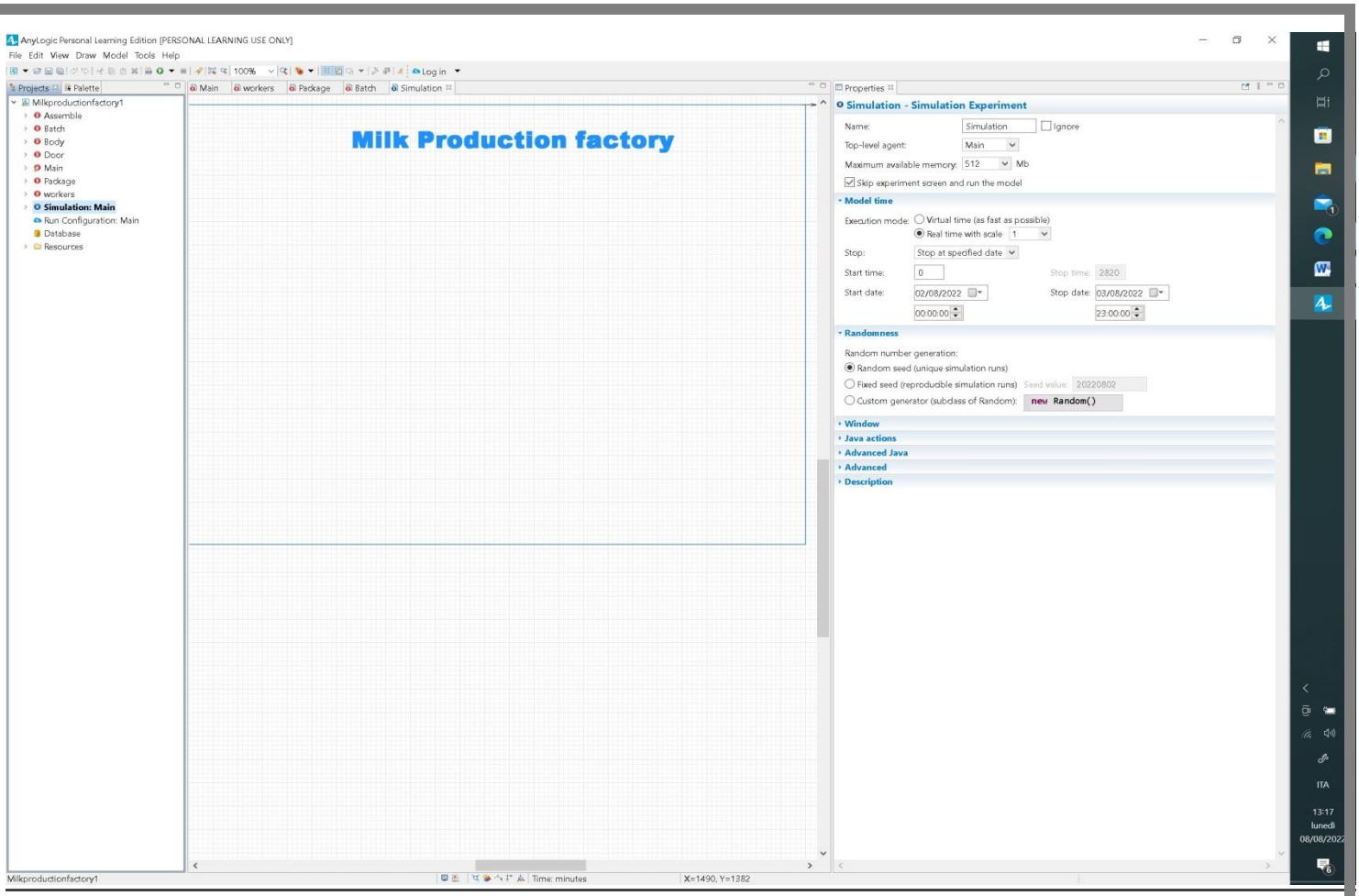
Assemble (final product after processing)

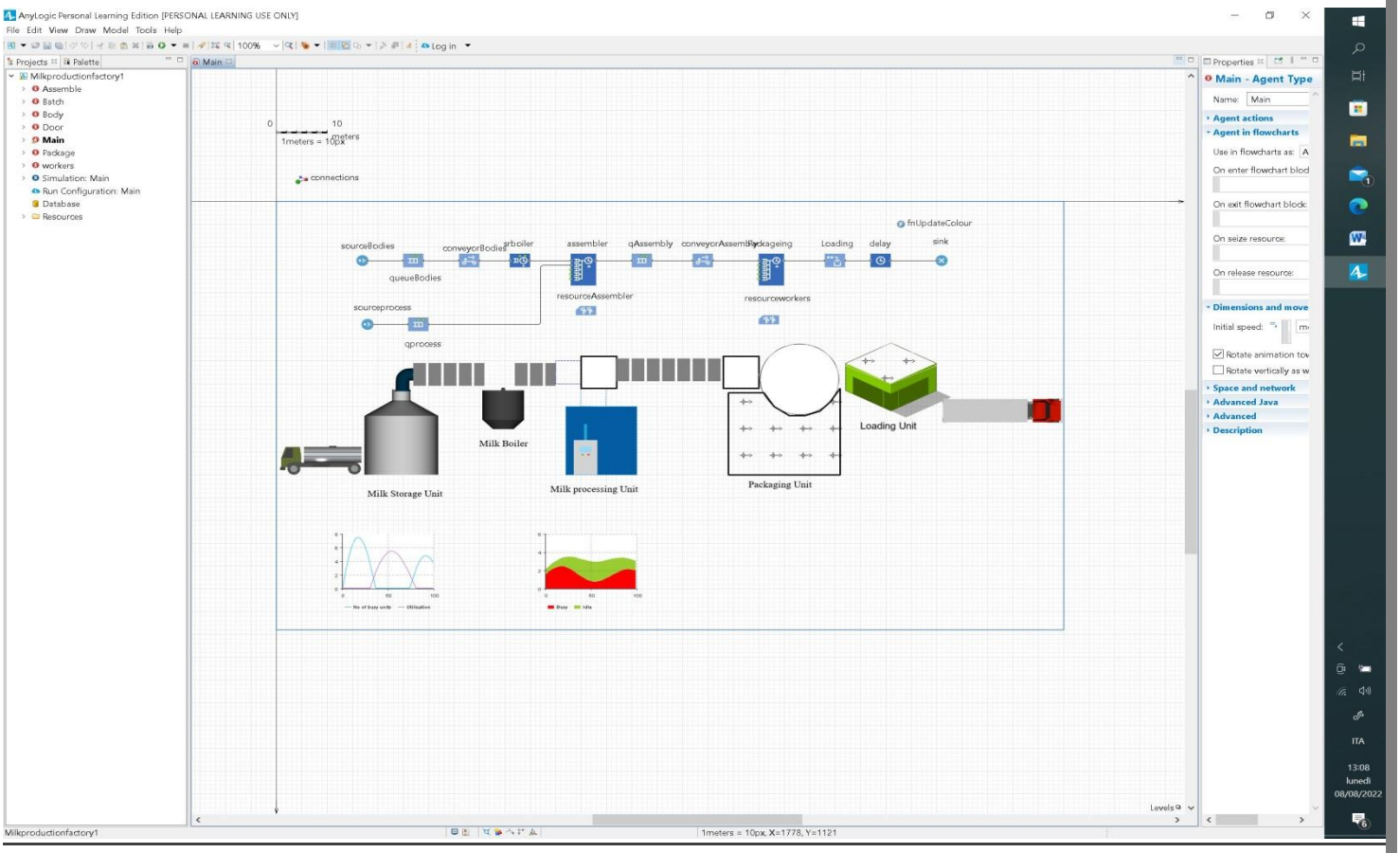
Package (Packaging unit)

Batch (loading unit)

Build Model time unit is in Minutes, Milk we received form the farm and then store in Storage tanks. Simulation model time will stop at specific date here it is demonstrated only for 24 hours.

IMPLEMENTATION


AnyLogic Personal Learning Edition [PERSONAL LEARNING USE ONLY]
File Edit View Draw Model Tools Help
Milk Production factory
Simulation - Simulation Experiment
Name: Simulation
Top-level agent: Main
Maximum available memory: 512 Mb
Skip experiment screen and run the model
Model time
Execution mode: Virtual time (as fast as possible)
Real time with scale
Stop: Stop at specified date
Start time: 0
Start date: 02/08/2022
Stop time: 2820
Stop date: 03/08/2022
Randomness
Random number generation:
Random seed (unique simulation runs)
Fixed seed (reproducible simulation runs)
Custom generator (subclass of Random):
new Random()
Window
Java actions
Advanced Java
Advanced
Description
Milkproductionfactory1
Time: minutes
X=1490, Y=1382


AnyLogic Personal Learning Edition [PERSONAL LEARNING USE ONLY]
File Edit View Draw Model Tools Help
connections
sourceBodies
queueBodies
conveyorBodies
qrboiler
assembler
resourceAssembler
qAssembly
conveyorAssembly
Packageing
resourceworkers
Loading
delay
sink
fnUpdateColour
scurceproicess
qprocess
Milk Boiler
Milk Storage Unit
Milk processing Unit
Packaging Unit
Loading Unit
Main - Agent Type
Name: Main
Agent actions
Agent in flowcharts
Dimensions and move
Space and network
Advanced Java
Advanced
Description
Milkproductionfactory1
1meters = 10px, X=1778, Y=1121

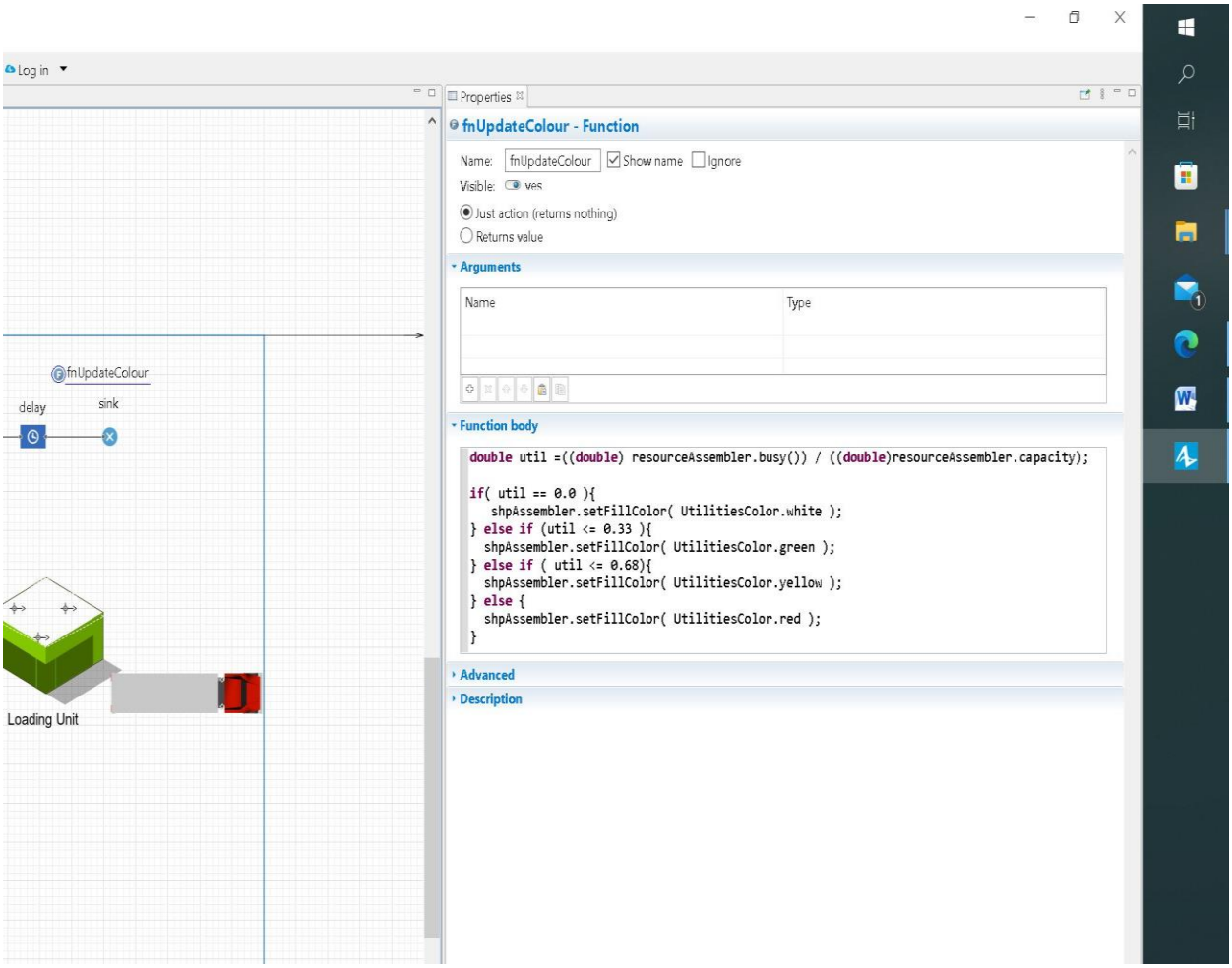
STEP IN IMPLEMENTATION

1. Arrival time is defined by inter-arrival time which will be an average 10 minutes but it will be exponentially distributed the time between arrivals. We create multiple agents per arrival for the bodies and it arrive 4 units at a time. Then Body will be in queue (Bit for buffer) before they move somewhere into the model. Queue capacity is set the storage capacity of body storage unit.
2. Sourcedoor Is where the milk bottle is stocked, the time between arrivals we have taken an exponential distribution with mean time between arrivals of 2.5 minutes which implies as 1/2.5 =0.4.
3. Then the bodies will associate with door in Assembler.
4. Delay Time is generate in a triangular distribution, the **triangular distribution** is continuous distribution bounded on both sides, is it basically time take to join one body to one door.
   (Triangular distribution is often used when number of or little data is available, it is rarely an accurate representation of data set. However, it is employed as the functional form of regions for fuzzy logic due to its ease of use)
5. Then Resources pool is introduced now. Define a set of resources units, resources are objects required by the agent to perform some task. Resources are sized and released by the agents on entities using seize, Release, Assembler and Service flowchart blocks. We have three type of resources; static, moving and portable. So, we are using static type and **8 units** to function for the Assembler. Then we will associate Assembler with resources sets.
6. We will build the agents now bodies and Door and associate them with sourcebodies and sourceprocess respectively.
7. Once the entities enter the assembler the new entity is form or agent which we name as Assembly.
8. Next we will add the Time plot chart to our model, our purpose of this is to look while model is running at the utilization of our resources pool which associates the assembler.
   Frist elements to the plot is no of busy units
   Second element to the plot is utilization, so we convert the average utilization to the average actual working 8 unit's. Return value will be 0 & 1 which we multiply by the total capacity (8 units).
   This will be over the entire model runtime period. By this we will get the running tally of average no. of units that are busy.
9. We also implement the Fupdate to have clear picture of the idle and utilized state of the assembler.so we have update color every time when new assembly is started it means that our resources pool has actually been updated because an assembly will only starts if there

are resources available and then when the assembly is done it should release them. Last it will resume back the idle state and it respective color.

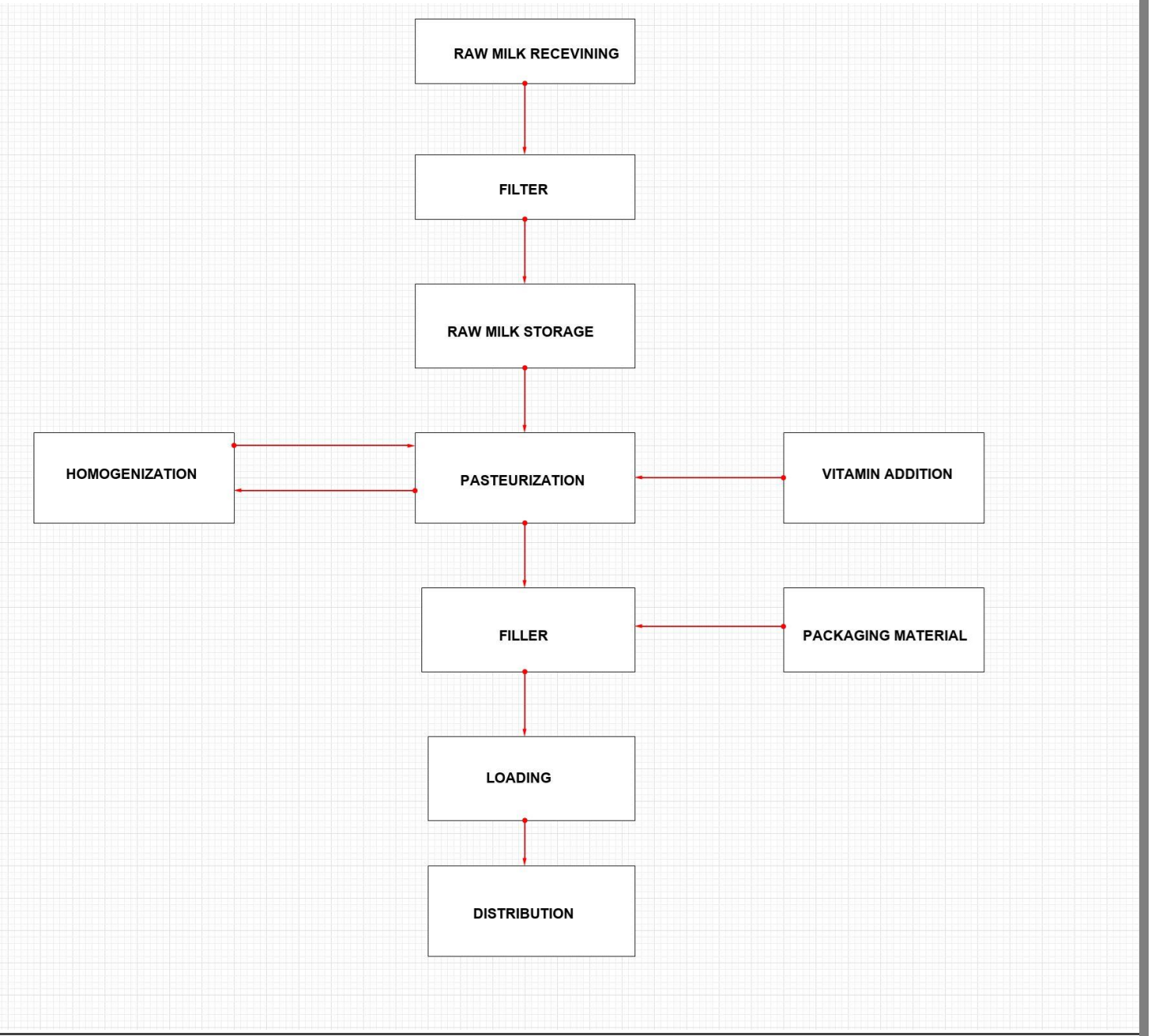
So we will change the color of the assemble block depending on what the utilization state let say;

- White color – if it completely idle
- Green if it less than a 30 %utilized.
- Yellow if it less than a 60% utilized.
- Red – if it is less than a 100% utilized

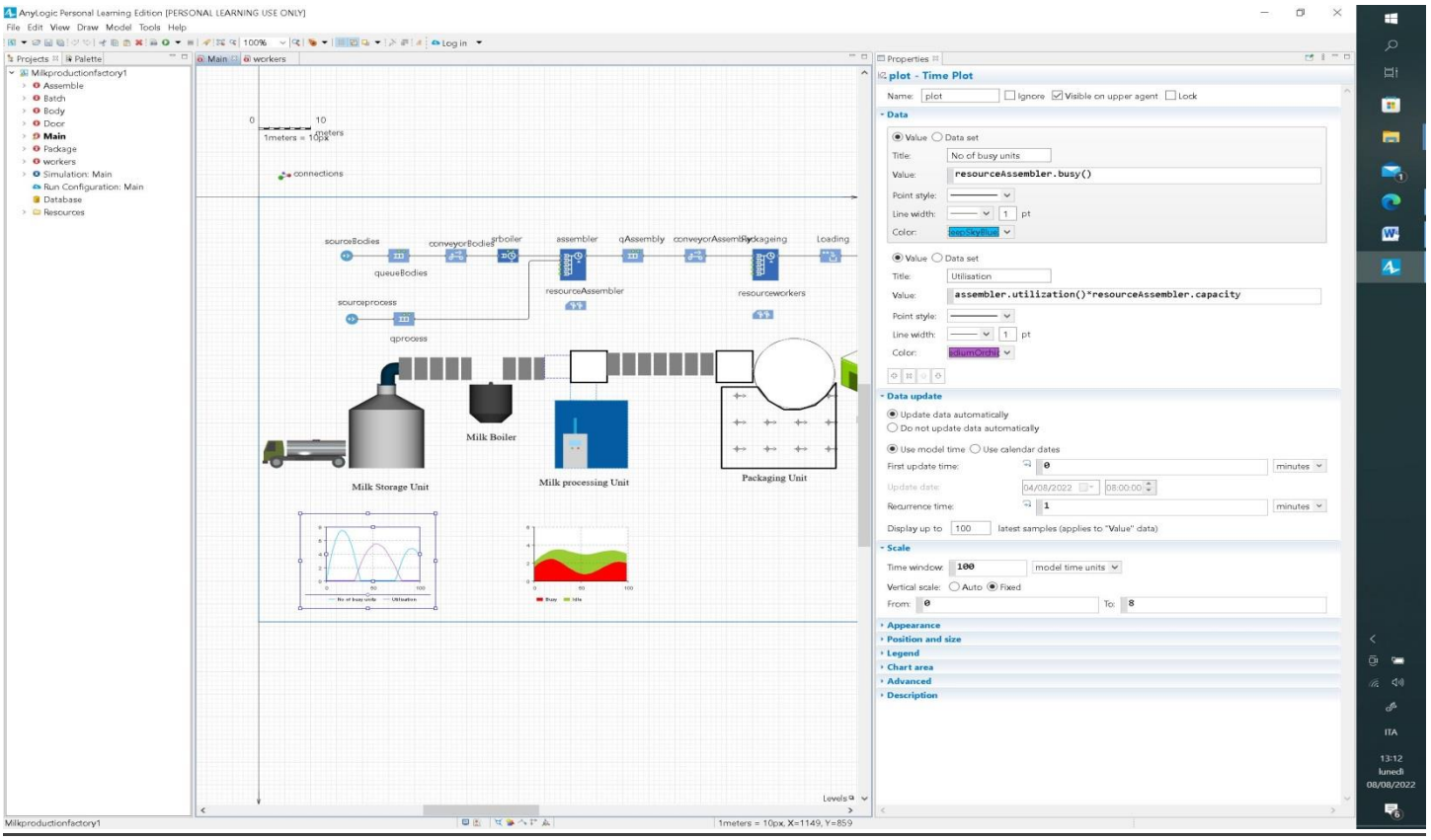


10. We have added batch block agent with size of 10 units per batch. Its take the unit form package from loading area and then batch them. Batch block converts a number of agents into one agent(batch) by either discarding the original agent and creating a new one this is called permanent batch or adding the original agents to the contents of the new agent.

Flow Chart



11. Next will add timepolt chart to our model. So as to look while model is running at the utilization of the resources pool which is called by resource assembler. First bit will be no of busy unit. Second data element is the utilization. This will give utilization value 0 & 1 multiply total capacity (8 assembler).
12. This will be over the entire model runtime period that is 24 hours. We will get running tally of average no units that are busy.


AnyLogic Personal Learning Edition (PERSONAL LEARNING USE ONLY)
File Edit View Draw Model Tools Help
Projects Palette
Milkproductionfactory1
Assemble
Batch
Body
Door
Main
Package
workers
Simulation: Main
Run Configuration: Main
Database
Resources
Main workers
connections
sourceBodies
queueBodies
conveyorBodies
qrboiler
assembler
qAssembly
conveyorAssembly
Packageing
Loading
resourceAssembler
resourceworkers
sourceprocess
qprocess
Milk Boiler
Milk Storage Unit
Milk processing Unit
Packaging Unit
Properties
plot - Time Plot
Name: plot
Ignore
Visible on upper agent
Lock
Data
Value
Data set
Title: No of busy units
Value: resourceAssembler.busy()
Point style:
Line width: 1 pt
Color: deepSkyBlue
Title: Utilisation
Value: assembler.utilization()*resourceAssembler.capacity
Color: aquamarine
Data update
Update data automatically
Do not update data automatically
Use model time
Use calendar dates
First update time: 0 minutes
Update date: 04/08/2022 08:00:00
Recurrence time: 1 minutes
Display up to 100 latest samples (applies to "Value" data)
Scale
Time window: 100 model time units
Vertical scale: Auto Fixed
From: 0 To: 8
Appearance
Position and size
Legend
Chart area
Advanced
Description
Levels
Milkproductionfactory1
1meters = 10px, X=1149, Y=859
ITA
13:12
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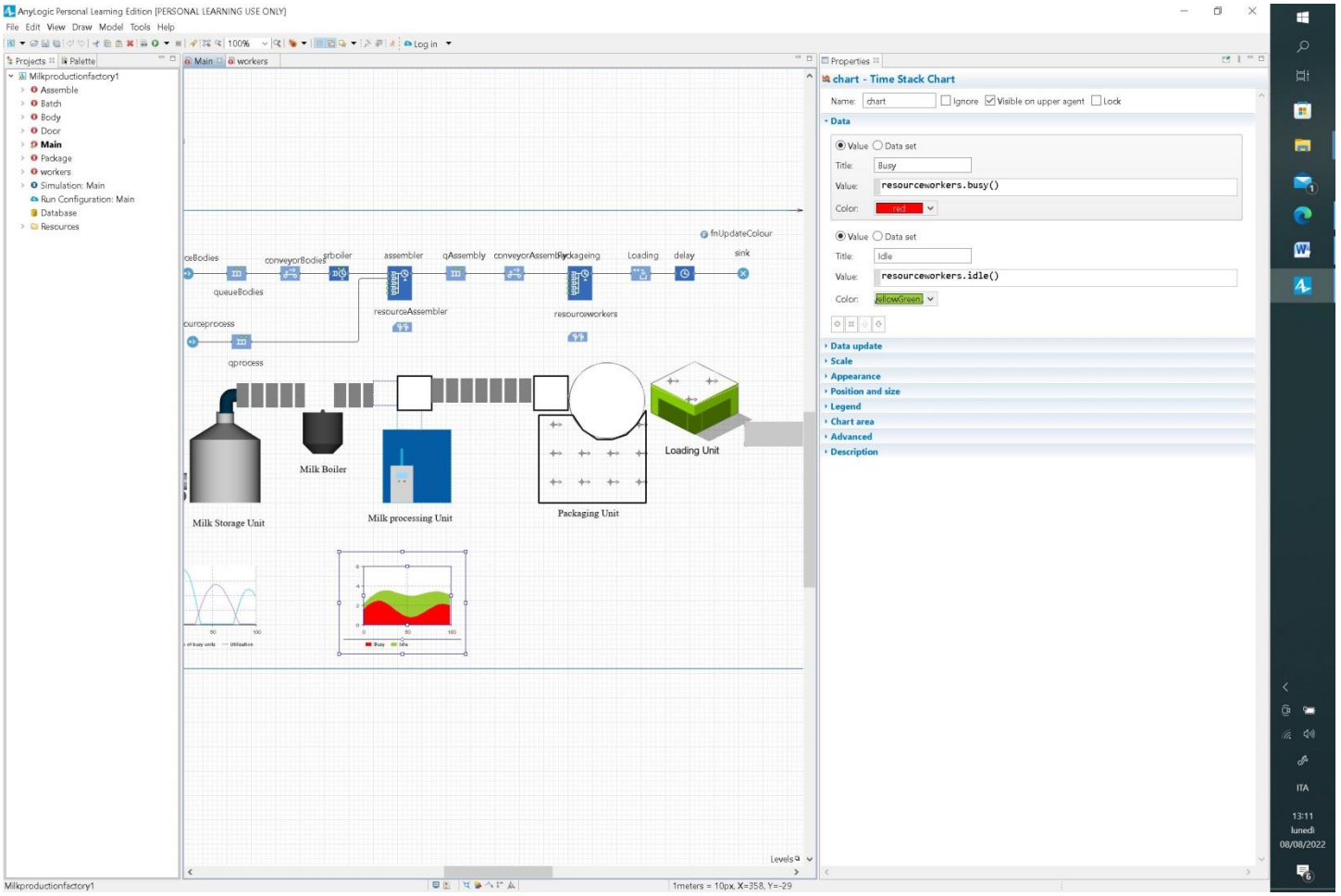
AnyLogic Personal Learning Edition (PERSONAL LEARNING USE ONLY)
File Edit View Draw Model Tools Help
Projects Palette
Milkproductionfactory1
Assemble
Batch
Body
Door
Main
Package
workers
Simulation: Main
Run Configuration: Main
Database
Resources
Main workers
fnUpdateColour
queueBodies
conveyorBodies
qrboiler
assembler
qAssembly
conveyorAssembly
Packageing
Loading
delay
sink
resourceAssembler
resourceworkers
qprocess
Milk Boiler
Milk Storage Unit
Milk processing Unit
Packaging Unit
Loading Unit
Properties
chart - Time Stack Chart
Name: chart
Ignore
Visible on upper agent
Lock
Data
Value
Data set
Title: Busy
Value: resourceworkers.busy()
Color: red
Title: Idle
Value: resourceworkers.idle()
Color: YellowGreen
Data update
Scale
Appearance
Position and size
Legend
Chart area
Advanced
Description
Levels
Milkproductionfactory1
1meters = 10px, X=358, Y=-29
ITA
13:11
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13. At last we have introduced the custom probability for the selection for the worker in packaging unit.

KEY SYSTEM PARAMETER (KSP) & KEY PERFORMANCE INDICATIORS

The key Performance Indicators (KPI) is a type of performance measurement that helps you understand how your organization or department is performing. KPIs are used to help you measure your progress toward achieving your strategic goals

Labor effectiveness is probably the most under-utilized manufacturing metric. Where Overall equipment effectiveness (OEE) quantifies how your machine assets are performing, OLE does the same for your most important assets: Worker

On time' means meeting whatever commitment you made to your customer.

Tracking On-Time-In-Full will highlight deficiencies in your full order process, from order creation right through to delivery. Monitor the Resource utilization in our model for which we use resources pools and associate them either with assemblers.

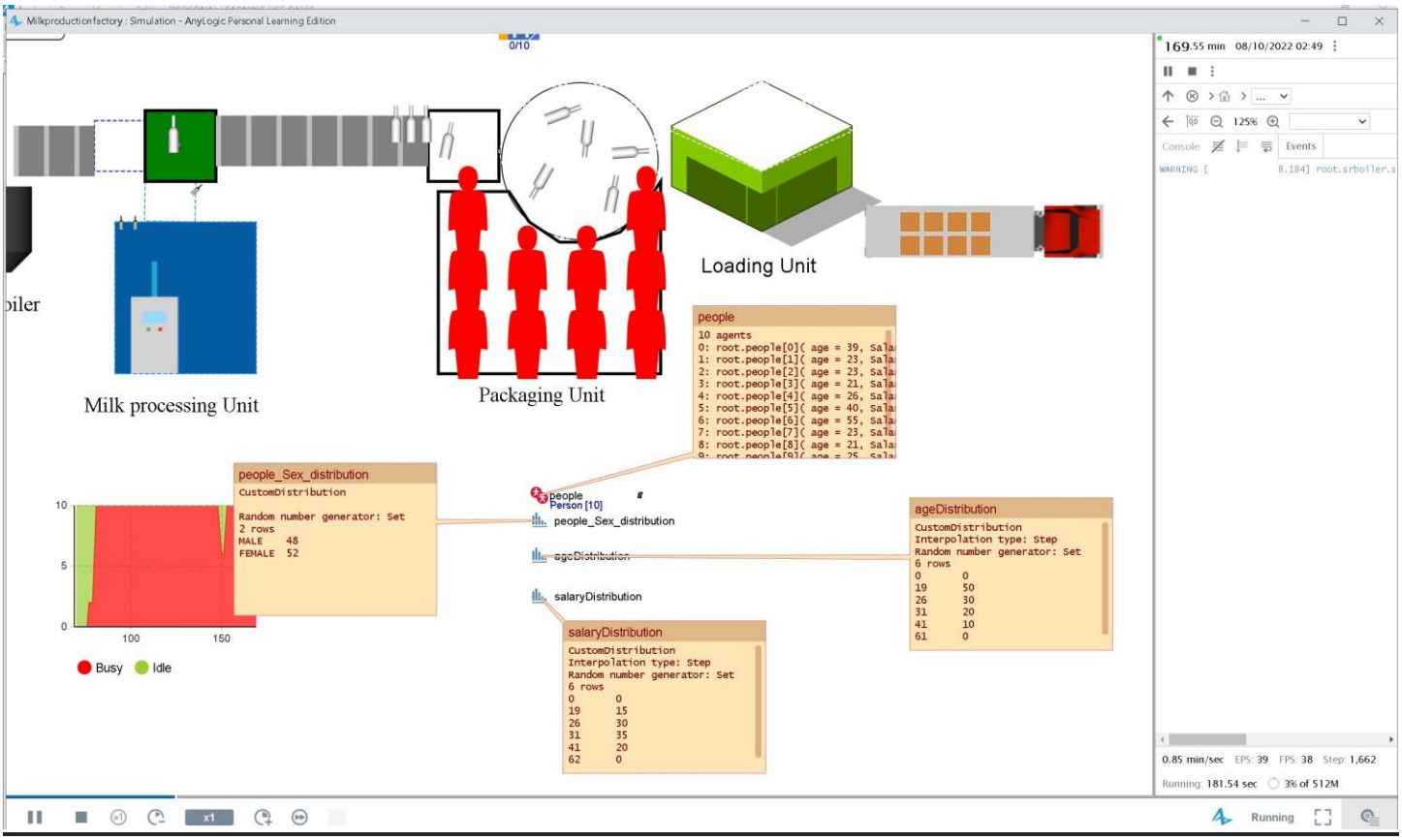
PARAMETERS	VALUE
inter-arrival time milk storage	1/10 minutes =0.1 minutes
Inter- arrival time processing unit	1/2.5minutes =0.4 minutes
arrival for the bodies	4 units
Resources units in assembler	8 resource unit
Resources units in packaging	10 resource unit

Assembler: The efficient of the assembler is when the 8 units perform the task in 24 hours.

Worker: The efficient of the assembler is when the 10 units perform the task in 24 hours.

We introduce the customs probability for the 10 resources for classified their gender, the age range and salary there will received.

Gender	Male (48%) or Female (52%)
Age group	18 to 65
Salary group	15,30,35,20 depending on the age.



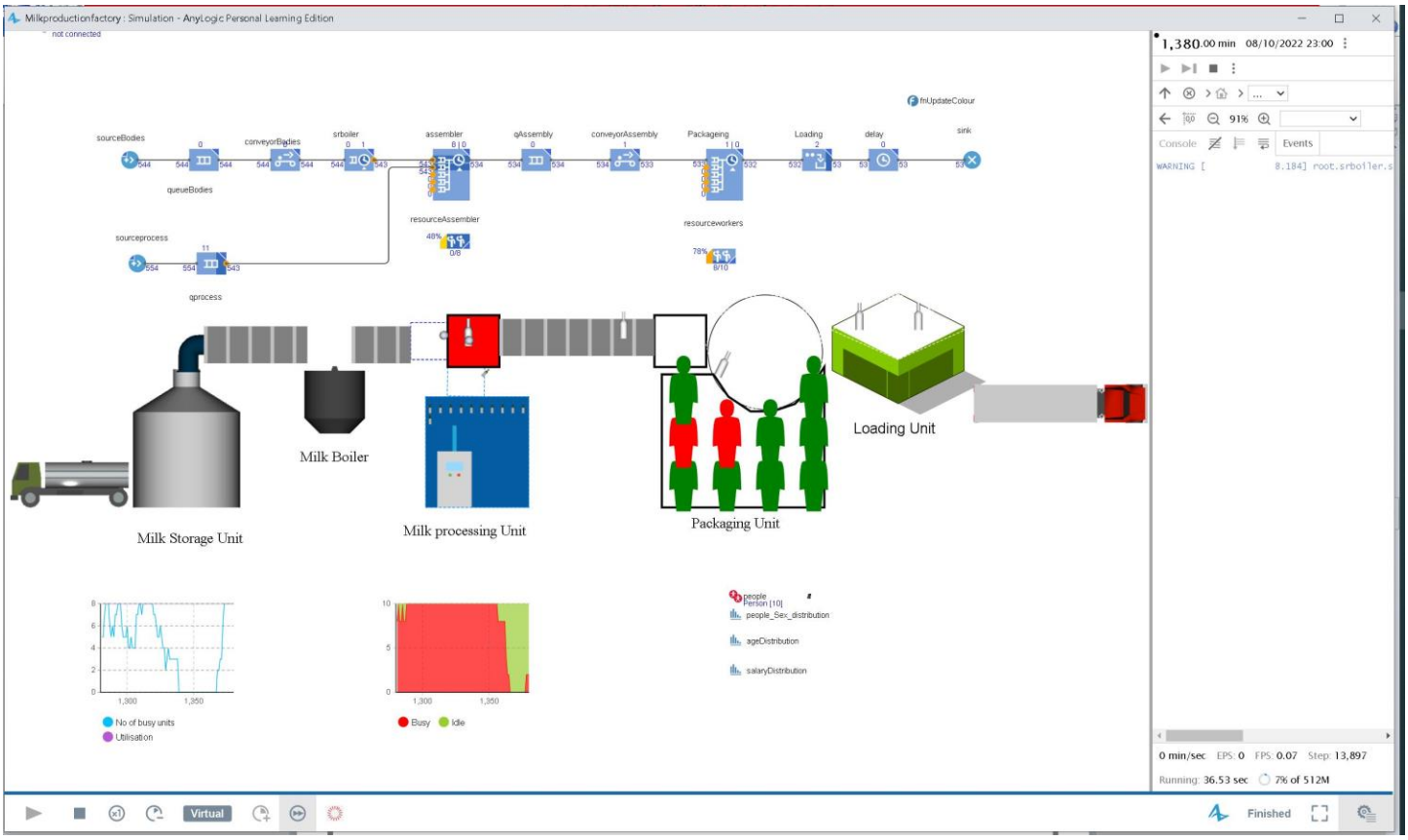
CONCLUSION

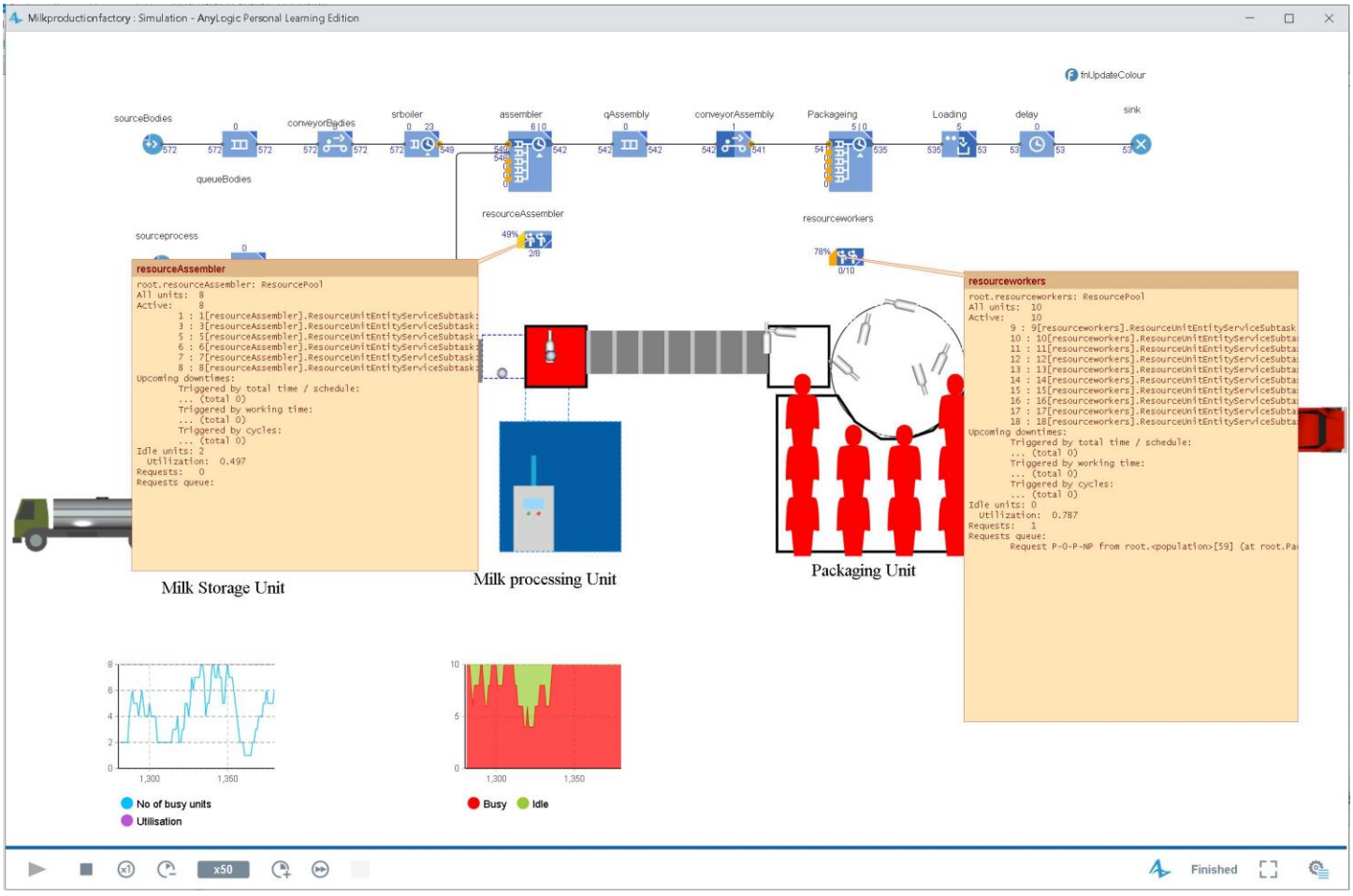
As we can see the total MILK in storage is 572 unit/liters in 24 hours.

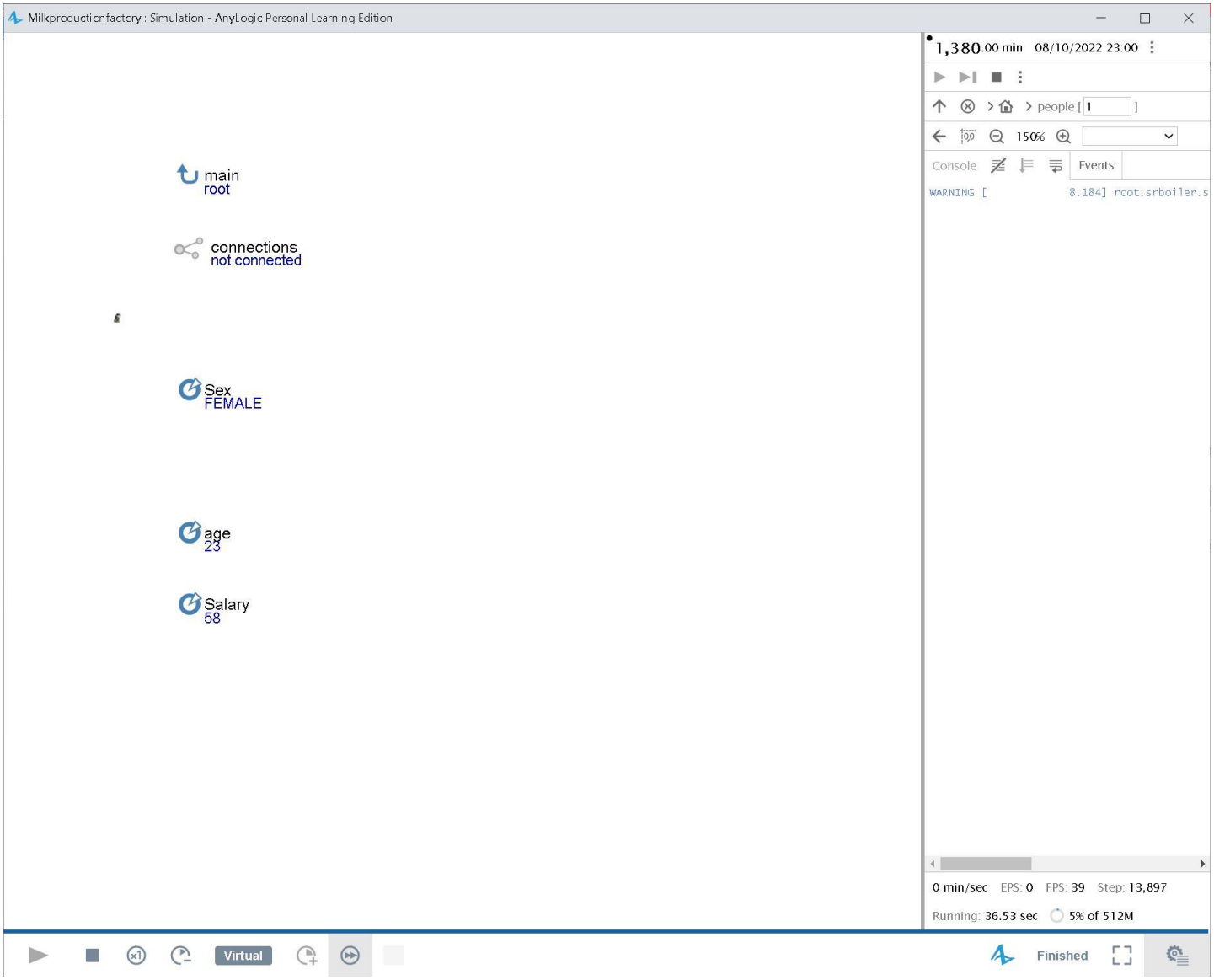
Milk container produce / store in processing unit are 548 units for 24 hours.

Once assemble its count is 542 units,

In the loading area total stack made are 53 packages with 535 units.


Milkproductionfactory : Simulation - AnyLogic Personal Learning Edition
not connected
1,380.00 min 08/10/2022 23:00
fnUpdateColour
sourceBodies
conveyorBodies
srboiler
assembler
qAssembly
conveyorAssembly
Packageing
Loading
delay
sink
queueBodies
sourceprocess
resourceAssembler
resourceworkers
qprocess
Milk Boiler
Loading Unit
Milk Storage Unit
Milk processing Unit
Packaging Unit
people
people_Sex_distribution
ageDistribution
salaryDistribution
No of busy units
Utilisation
Busy
Idle
Console
Events
WARNING [8.184] root.srboiler.s
0 min/sec EPS: 0 FPS: 0.07 Step: 13,897
Running: 36.53 sec 7% of 512M
Virtual
Finished


Milkproductionfactory : Simulation - AnyLogic Personal Learning Edition
fnUpdateColour
sourceBodies
conveyorBodies
srboiler
assembler
qAssembly
conveyorAssembly
Packageing
Loading
delay
sink
queueBodies
sourceprocess
resourceAssembler
resourceworkers
resourceAssembler
root.resourceAssembler: ResourcePool
All units: 8
Active: 8
1 : 1[resourceAssembler].ResourceUnitEntityServiceSubtask
3 : 3[resourceAssembler].ResourceUnitEntityServiceSubtask
5 : 5[resourceAssembler].ResourceUnitEntityServiceSubtask
6 : 6[resourceAssembler].ResourceUnitEntityServiceSubtask
7 : 7[resourceAssembler].ResourceUnitEntityServiceSubtask
8 : 8[resourceAssembler].ResourceUnitEntityServiceSubtask
Upcoming downtimes:
Triggered by total time / schedule:
... (total 0)
Triggered by working time:
... (total 0)
Triggered by cycles:
... (total 0)
Idle units: 2
Utilization: 0.497
Requests: 0
Requests queue:
resourceworkers
root.resourceworkers: ResourcePool
All units: 10
Active: 10
9 : 9[resourceworkers].ResourceUnitEntityServiceSubtask
10 : 10[resourceworkers].ResourceUnitEntityServiceSubta
11 : 11[resourceworkers].ResourceUnitEntityServiceSubta
12 : 12[resourceworkers].ResourceUnitEntityServiceSubta
13 : 13[resourceworkers].ResourceUnitEntityServiceSubta
14 : 14[resourceworkers].ResourceUnitEntityServiceSubta
15 : 15[resourceworkers].ResourceUnitEntityServiceSubta
16 : 16[resourceworkers].ResourceUnitEntityServiceSubta
17 : 17[resourceworkers].ResourceUnitEntityServiceSubta
18 : 18[resourceworkers].ResourceUnitEntityServiceSubta
Upcoming downtimes:
Triggered by total time / schedule:
... (total 0)
Triggered by working time:
... (total 0)
Triggered by cycles:
... (total 0)
Idle units: 0
Utilization: 0.787
Requests: 1
Requests queue:
Request P-O-P-NP from root.<population>[59] (at root.Pa
Milk Storage Unit
Milk processing Unit
Packaging Unit
No of busy units
Utilisation
Busy
Idle
x50
Finished


Milkproductionfactory : Simulation - AnyLogic Personal Learning Edition
1,380.00 min 08/10/2022 23:00
people [1]
150%
Console
Events
WARNING [8.184] root.srboiler.s
main
root
connections
not connected
Sex
FEMALE
age
23
Salary
58
0 min/sec EPS: 0 FPS: 39 Step: 13,897
Running: 36.53 sec 5% of 512M
Virtual
Finished