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BUSINESS SIMULATOR USERS MANUAL

Action Guideline 4:

Establishment/operation of a virtual lab based on the VET IT Tool - Support for the implementation of apprenticeships in enterprises

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1. Introduction

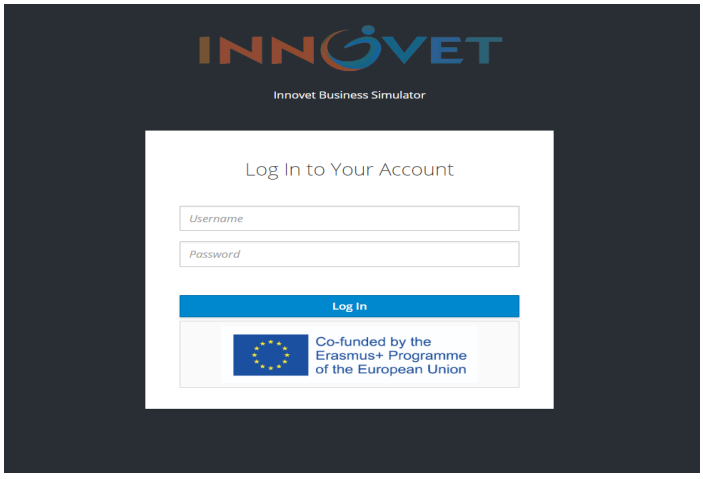
The main objective of the software tool called Business Simulator is to promote better understanding of educational theories concerning the production process incorporated in a business environment. Moreover, these objectives entail business processes optimization and redesign, minimizing the cost of production through the minimization of the cost of materials, human resources and idle time due to inappropriate schedules and restructuring of orders and inventories in accordance with business needs.

For these reasons a process model is adopted according to which each trainee is acquainted with the most significant business operations and processes of the various departments and becomes capable of identifying business weaknesses faster and more efficiently. In conclusion, trainees acquire administrative decision skills concerning business operations and processes for the future optimization of the economic organizations they are employed by.

The **Business Simulator** tool is a web-based free software tool developed under the InnoVET project funded by the Erasmus + Program. In order anyone to have access to the **Business Simulator** tool, he/she should contact the Project Coordinator via the e-mail address innovet@teiemt.gr in order to be granted access credentials (username & password). This manual first describes the functions of the **Business Simulator** tool and then provides training examples of how to use the tool in predetermined business processes.

2. Connection to the System

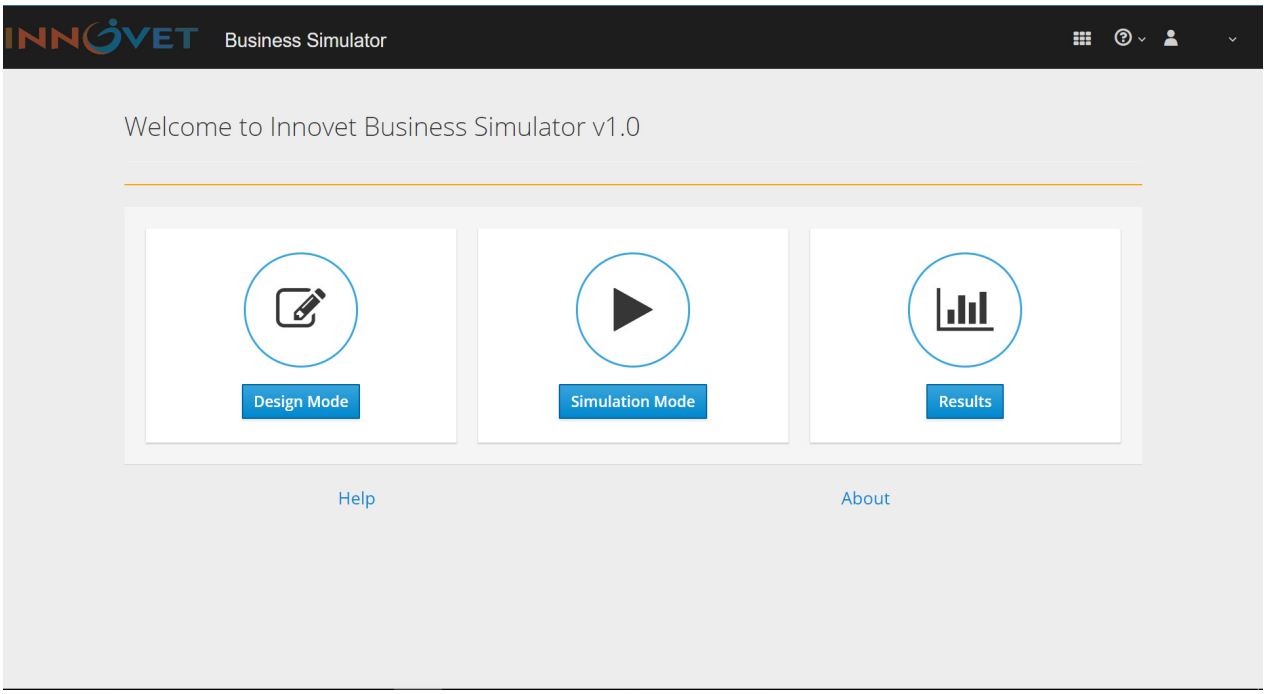
Using the address `http://innovet.teiemt.gr/bs` through a **google chrome browser** the user acquires access to the initial screen of the tool.



On this screen, the user is typing the provided credentials and clicks the *Log In* button to enter into the system.

3. Initial Screen

After the successful entry into the system, the following screen appears which displays the three main operations of the tool: **Design Mode**, **Simulation Mode** and **Results.**



- **Design Mode**

  The **Design Mode** provides the user with the ability to crate and experiment new or existing designs.

- **Simulation Mode**

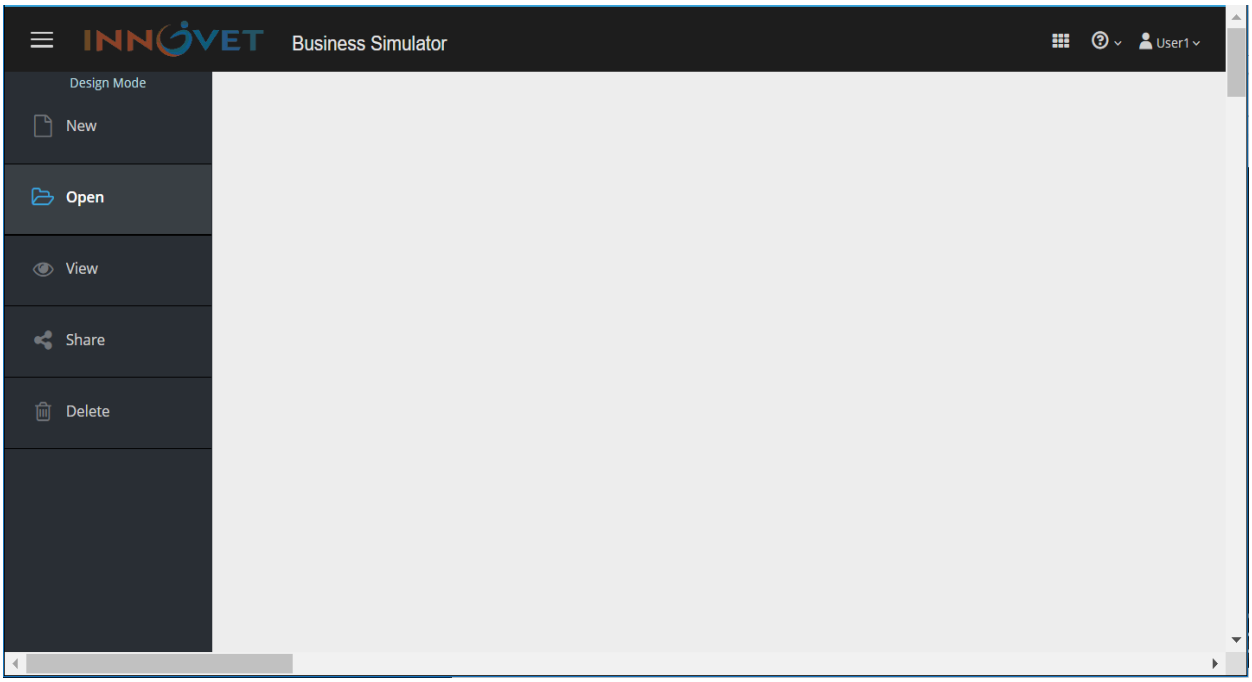
  The **Simulation Mode** button is the simulation startup tool and provides the user with options for adjusting the production schedule, workforce (people), machines, sales and orders.

- **Results**

  In the **Results** button, as the name implies, are presented the various simulation results such as machine and human idle time, material usage, production schedules, sales, etc.

4. Design Mode

The main menu of the **Design Mode** includes the following items:



- **New**

  The **New** button allows the user to start the creation of a new Design.

- **Open**

  The **Open** button allows the user to open an existing Design, either own or shared.

- **View**

  The **View** button provides the user with the ability to view and control an existing Design.

- **Share**

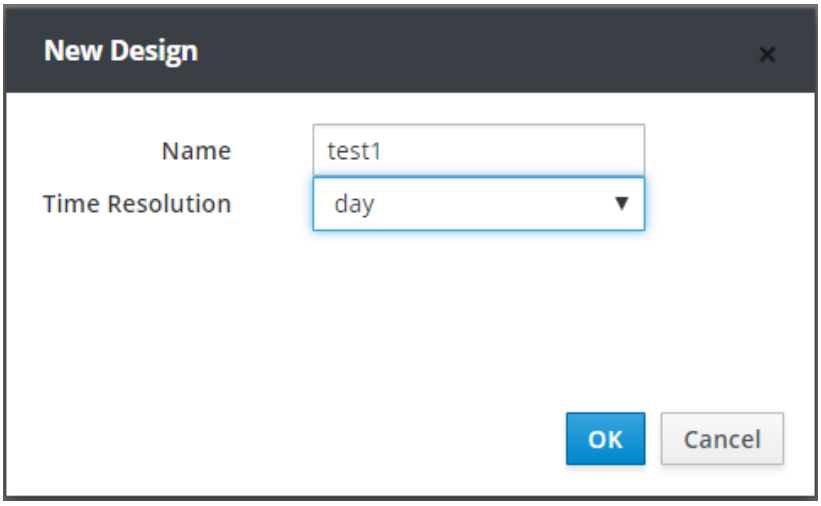
  The **Share** button allows the user to assign managements rights of the Designs to other users.

- **Delete**

  The **Delete** button allows the user to delete a saved Design that is created at earlier time. A shared Design may not be deleted by a user who has been granted access while it is created by other users.

4.1 Creation of a New Design

Click the **New** button in the **Design Mode** and a window named **New Design** appears.



In the field **Name**, the user defines the name of the new Design.

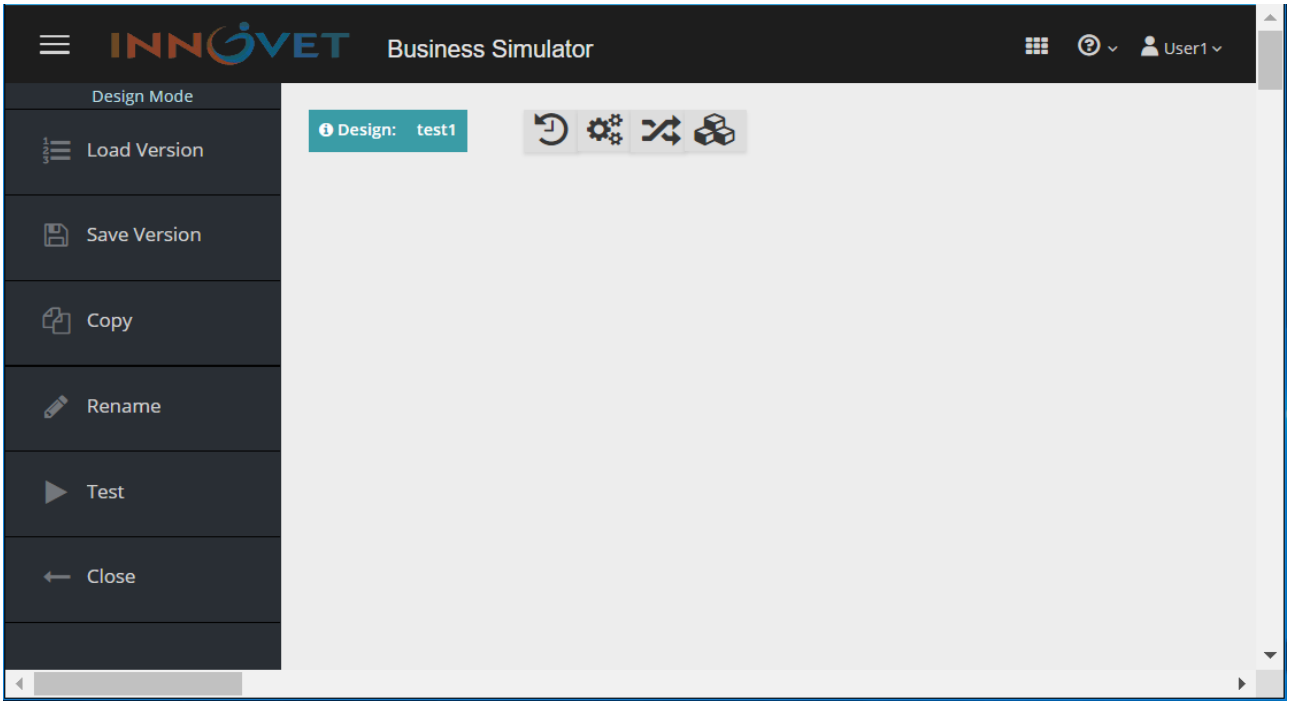
In the field **Time Resolution**, the user can adjust the discrete interval between 2 consecutive process steps of the Design. The field values are set in seconds, minutes, hours, days or weeks.

The creator of a Design is the only person who has rights to this particular Design and these rights can be assigned or shared with other users via the **Share** button in the menu of the **Design Mode**.

⊙ In the field **Name** set *test1* and in the field **Time Resolution** set *day* and click **OK**.

Upon completion of this action, the user enters the **Main Design Screen** of the Design **test1**.

4.2 Main Design Screen



The **Main Design Screen** is divided in three areas. On the left side of the screen is the **Main Menu** of the **Design test1**, in the center there is a tool bar and underneath, there is a design surface.

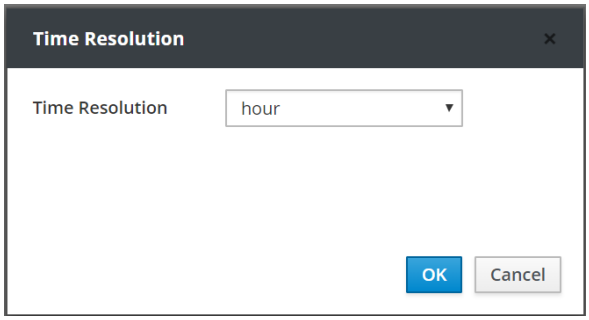
Moreover, the name of the Design appears in a blue frame.

4.3 Tool Bar

Time Resolution

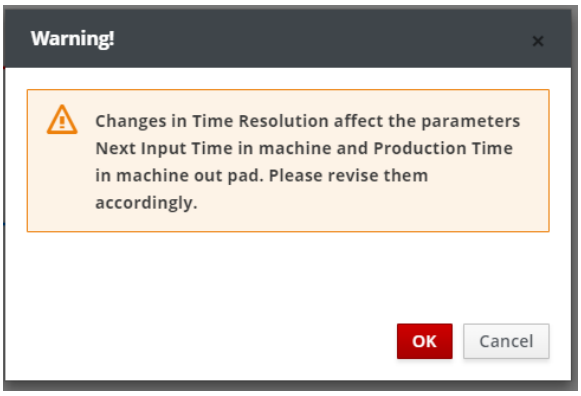
The first button in the tool bar is **Time Resolution**. Here, the user has the ability to modify the **Time Resolution** defined during the creation of the **Design**.

⓪ Set as **Time Resolution** *hour* and press **OK**.



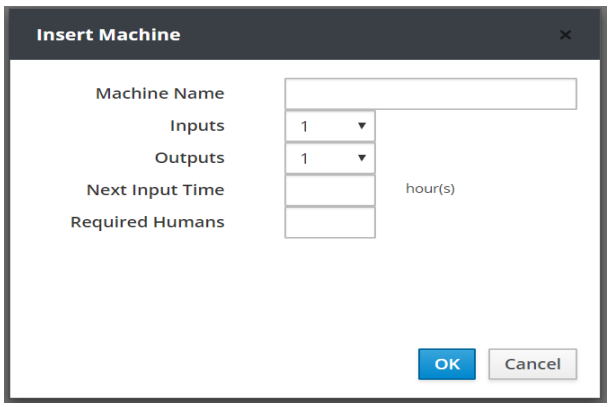
A message appears that informs the user in case of existing **Machines** in the **Design**, these **Machines** should be adjusted in terms of the new **Time Resolution.**

⓪ Press **OK.**

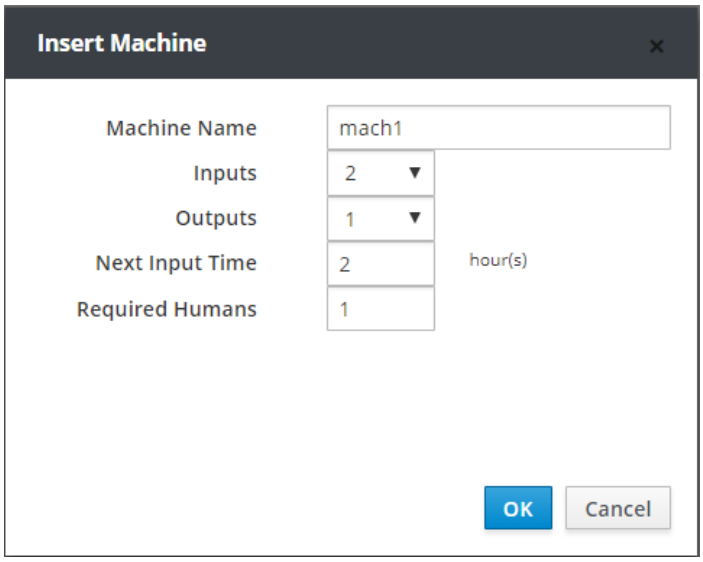


Machines

The second button in the tool bar is **Machine**. Press the **Machine** button. A window appears in which the user can set the name of the machine, the number of inputs-outputs, the minimum time between two consecutive inputs, and the number of humans required for the operation of the machine (in case of no human requirements, set zero value).

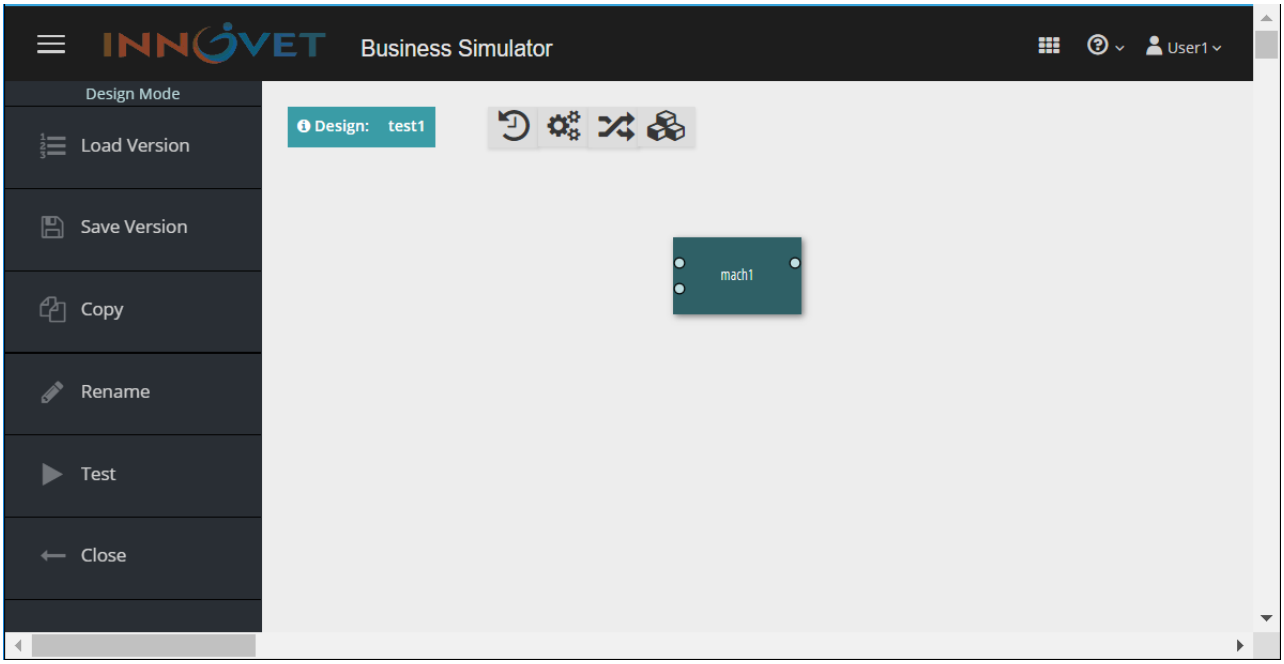


⓪ Create one Machine named *mach1*, with *2* inputs, *1* output, Next Input Time *2* hours and required personnel *1* human.



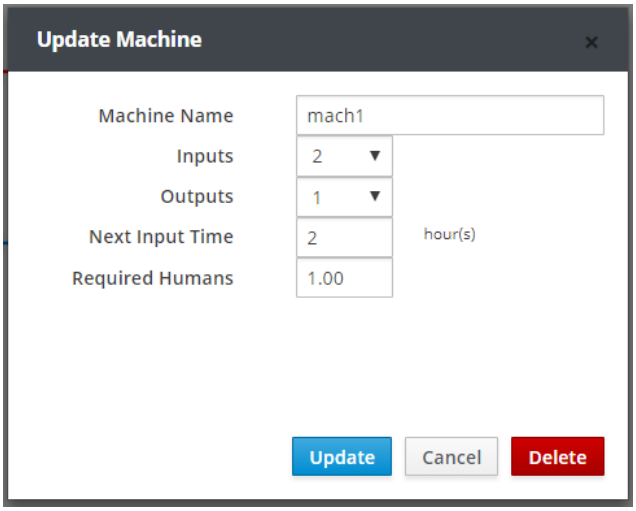
⓪ Press **OK**.

A Machine named *Mach1* is created on the design surface. The user is capable, with the Drag & Drop function, to transfer the Machine anywhere on the design surface.



With right click on the Machine *Mach1* a window named **Update Machine** appears which allows the user to **Update** the features of the Machine or even to **Delete** the Machine.

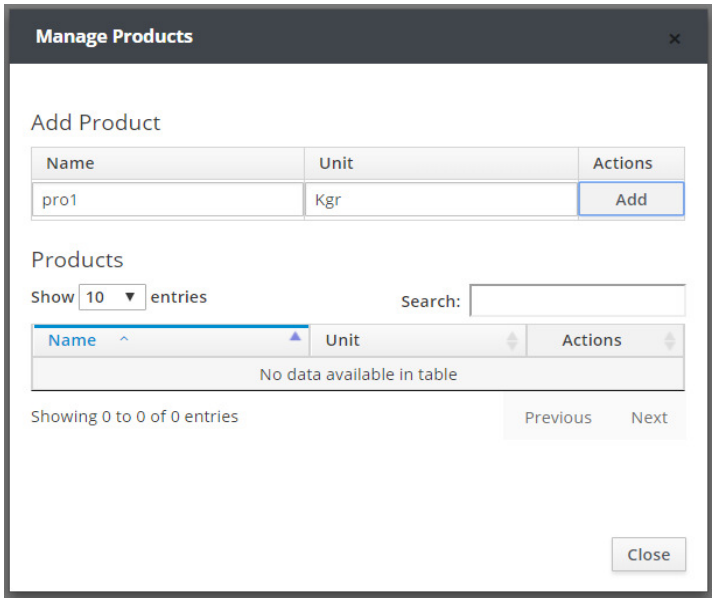
⓪ Click the right button of the mouse on the Machine *Mach1*.



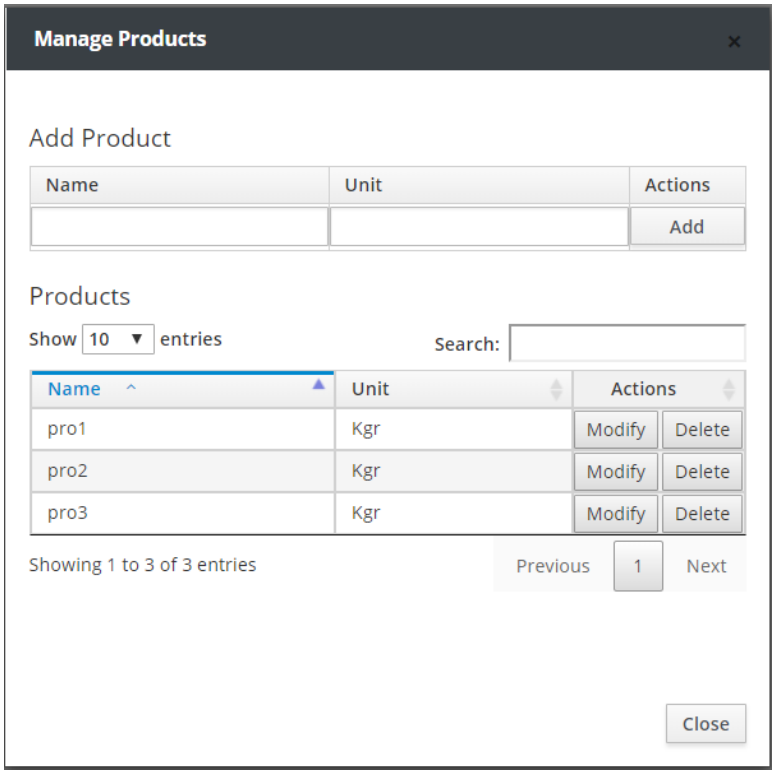
⓪ Press **Cancel**.

Product

All the relevant raw materials and finished and semi-finished products have to be created in each Design. The fourth button in the tool bar is **Product.** Press the **Product** button. A window named **Manage Products** appears which allows the user to define the name of each product/raw material, unit values (i.e. kgr, minutes, meters, data etc). A product is introduced in a **Design** by pressing the **Add** button.



⓪ Create three **Products** named pro1,pro2 & pro3, with unit values Kgr for all.



Moreover, the user can delete/modify a product with the use of the corresponding **Delete/Modify** buttons.

⓪ Press **Close**.

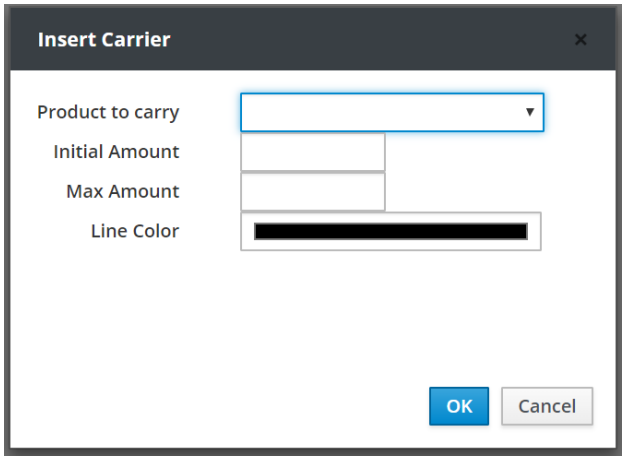
Carrier

In order to store, to transfer, to input/output products from one machine to another, the **Carriers** are employed. The third button in the tool bar is **Carrier.**

⓪ Press the **Carrier** button.

A window appears in which the user must define the name of the product, the **Carrier** transfers and set the **Initial Amount** of the product in the **Carrier**, the **Maximum (Max) Amount** of the product in the **Carrier** and the **Line Color** that identifies the particular **Carrier.**

⓪ Press **OK** to create the **Carrier**.

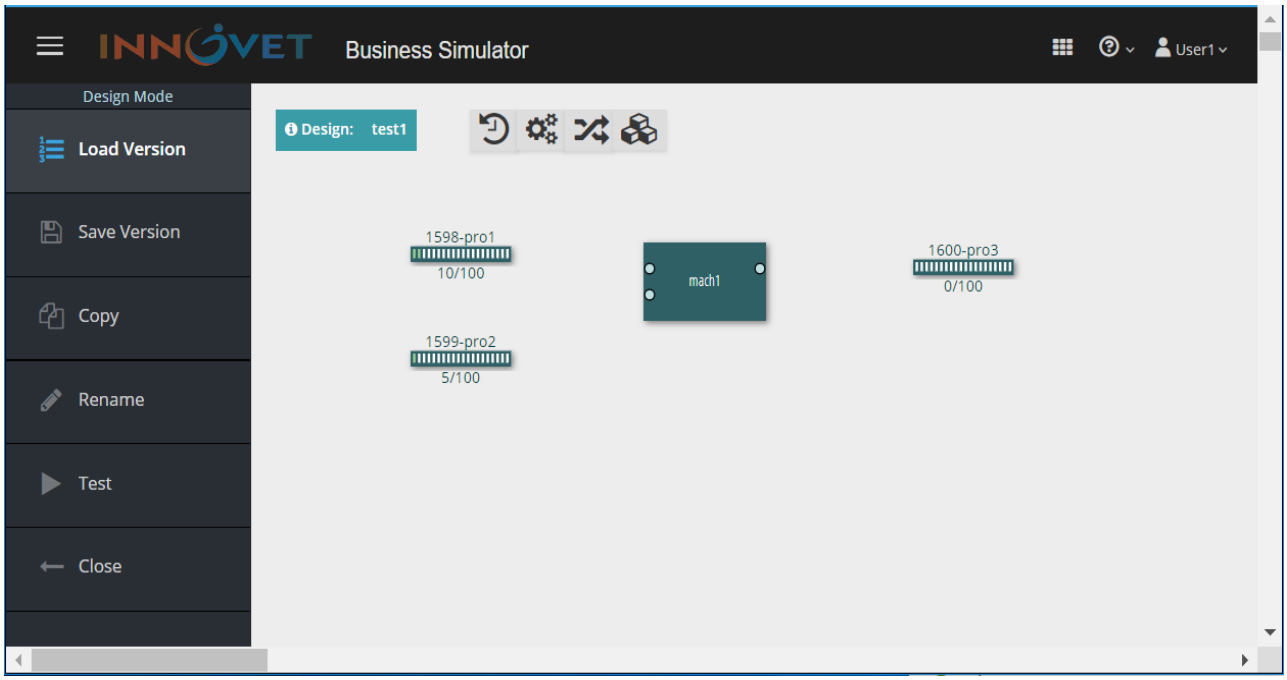


⓪ Create three **Carriers** with the following features:

Product to Carry pro1, Initial Amount 10, Max Amount 100 and Line Color red,

Product to Carry pro2, Initial Amount 5, Max Amount 100 and Line Color blue,

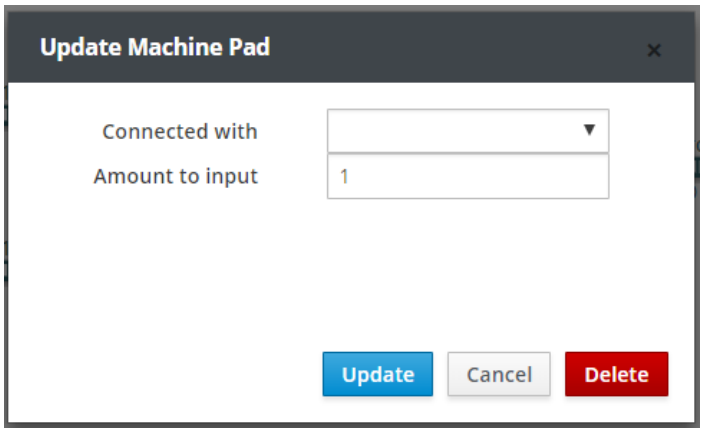
Product to Carry pro3, Initial Amount 0, Max Amount 100 and Line Color green.



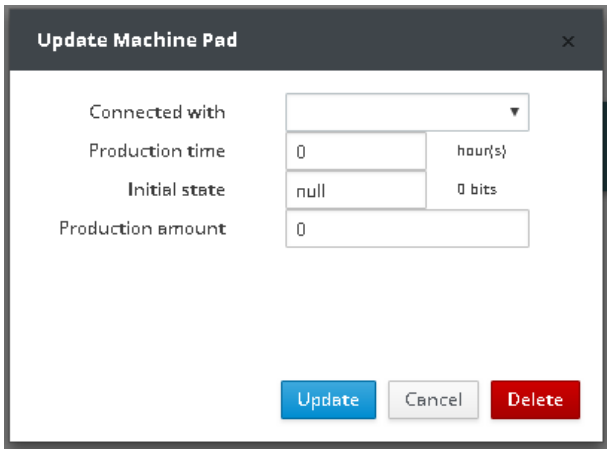
Creation of Connections

Connection is the matching of one input/output of a **Machine** with a **Carrier** and it is created through the round pads of input/output of the **Machine.**

With a click on the right button of the mouse on an input pad, a window named **Update Machine Pad** appears. In the field *Connected With* the user can define the *Carrier* with which the machine will be connected and in the field *Amount to input* the user defines the quantity of the product that is imported to the machine, each time the machine imports products.



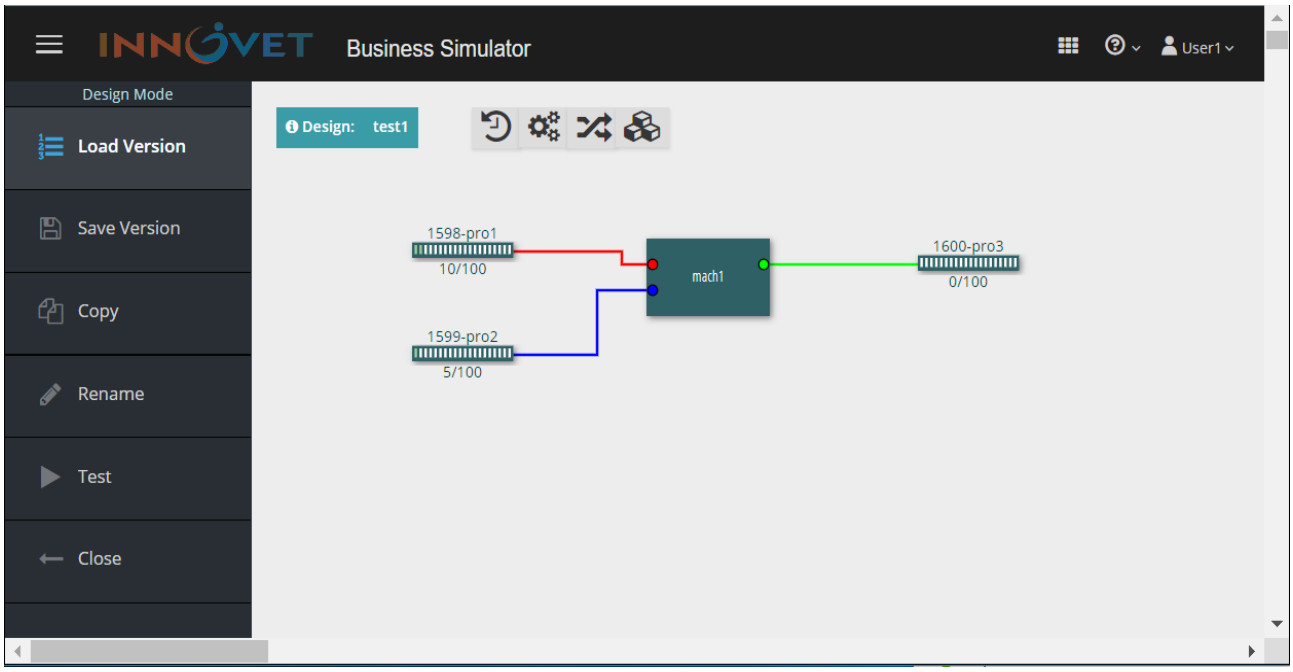
With a click on the right button of the mouse on an output pad, a window named **Update Machine Pad** appears. In the field *Connected With* the user can define the *Carrier* with which the machine will be connected, in the field *Production time* the user defines the required time for the production of a product, in the field *Initial state* the initial state of the machine is set (the stage of product development at the beginning of the simulation – zeros in case of non-existent work in progress) and in the field *Production amount* the quantity of the product produced is defined.



In order to match the **Carriers** with the **Machine** click on the right button of the mouse on the input/output pads of the **Machine** and adjust the following parameters:

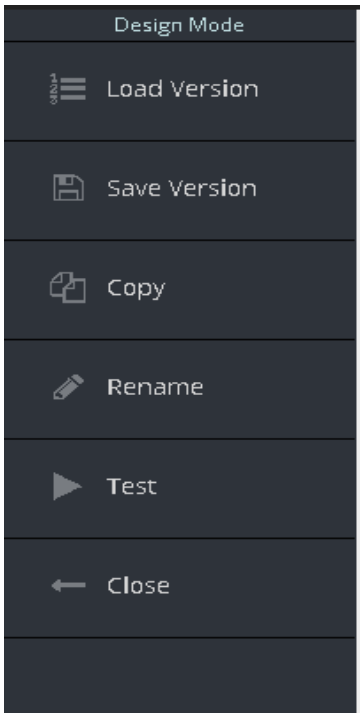
- In the first input of the **Machine**, in the field *Connected With* the *Carrier* of pro1 and in the field *Amount to input* set value 1 and then press the *Update* button.
- In the second input of the **Machine**, in the field *Connected With* the *Carrier* of pro2 and in the field *Amount to input* set value 1 and then press the *Update* button.

- In the output of the **Machine**, in the field *Connected With* the *Carrier* of pro3, in the field *Production time* set value 1, in the field *Initial state* set value 0 and in the field *Production amount* set value 1 and then press the *Update* button.



4.4 Main Menu of the Design

The main **Menu** of the environment of the **Design**, is presented in the following section:



Load Version: Load of a saved version of the Design.

Save Version: Save the current version of the Design.

Copy: Copy the current Design with another name.

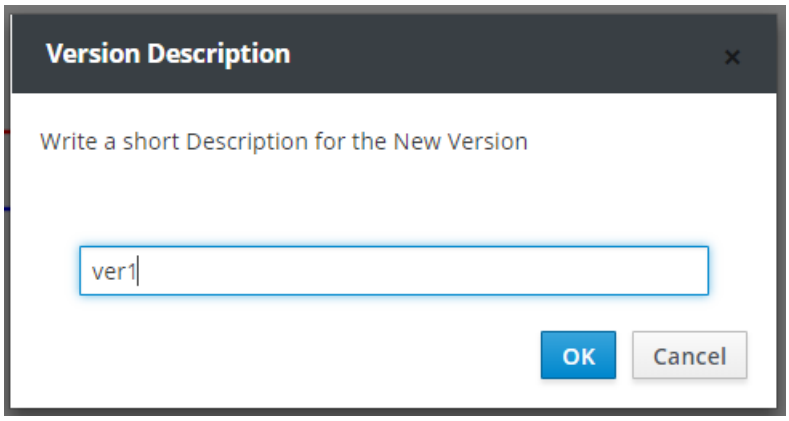
Rename: Rename the current Design.

Test: Start the test state of the current Design.

Close: Exit from the Design.

Create A Version

⓪ Click on the **Save Version** button, type *ver1* and press **OK**.

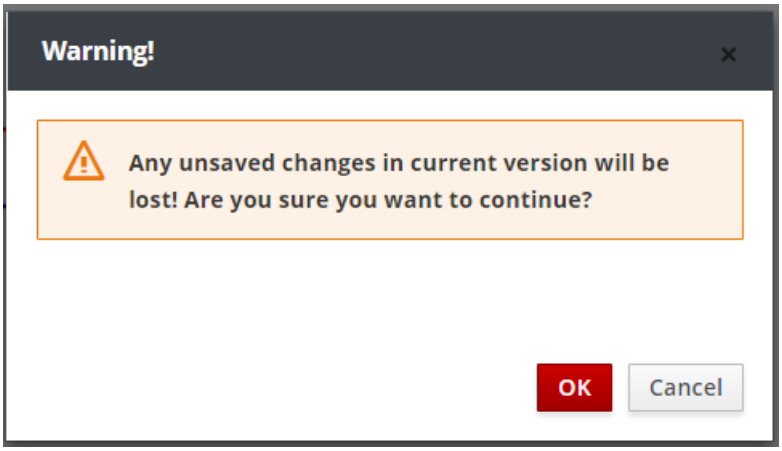


With the preceding action, the user creates a copy of the current state of the Design test1 named ver1. That copy belongs to the Design test1 and it is referred as a version of that particular Design. The user is able to continue working in the environment of the Design while the state of the saved version remains unaffected.

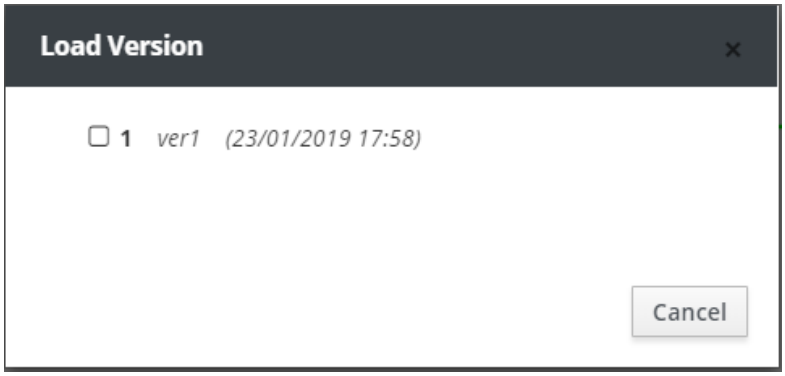
The user can upload in the environment of the Design, at any time, any version of the Design that has been saved at an earlier time.

Load Version

⓪ Click on the **Load Version** button. The following warning window appears which informs the user that in case of loading a version, all the objects of the current Design will be lost.



⓪ Press **OK**.



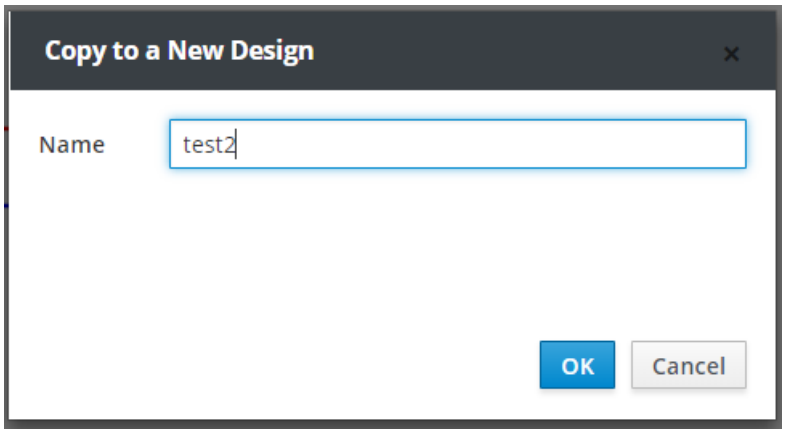
⓪ Select *ver1*.

With the preceding action, the user loads the saved version *ver1* of the Design test1 in the work environment.

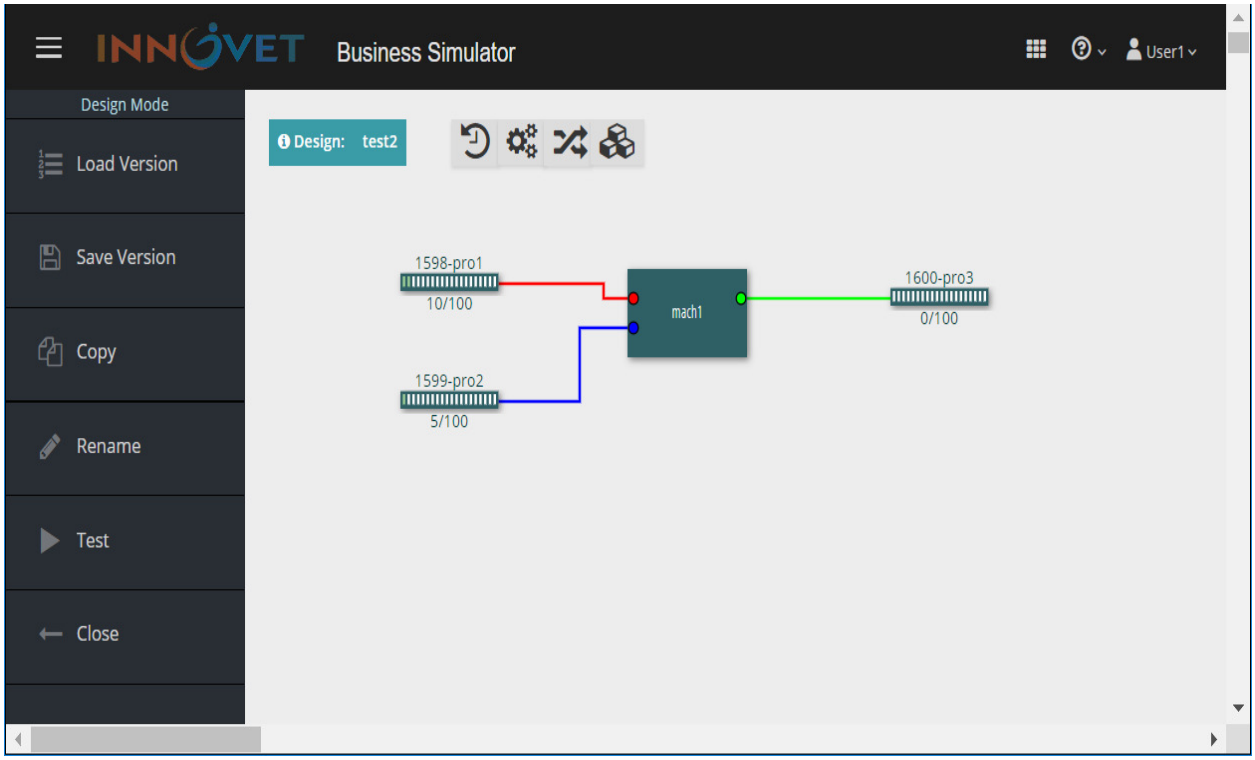
Create a Copy of a Design

⓪ Click on the **Copy** button. Type test2.

With the preceding action, the user creates a copy of the current Design named test2.



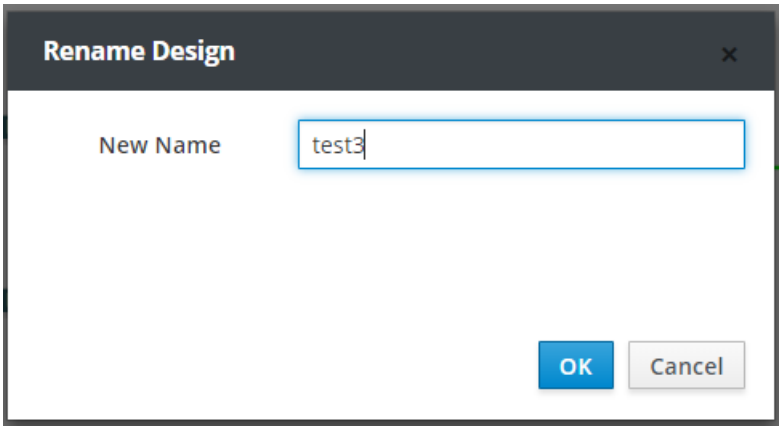
⓪ Press **OK**.



Rename a Design

◎ Click on the **Rename** button. Type test3.

With the preceding action, the user renames the current Design named test2 to test3.



◎ Press **OK** and then press **Close.**

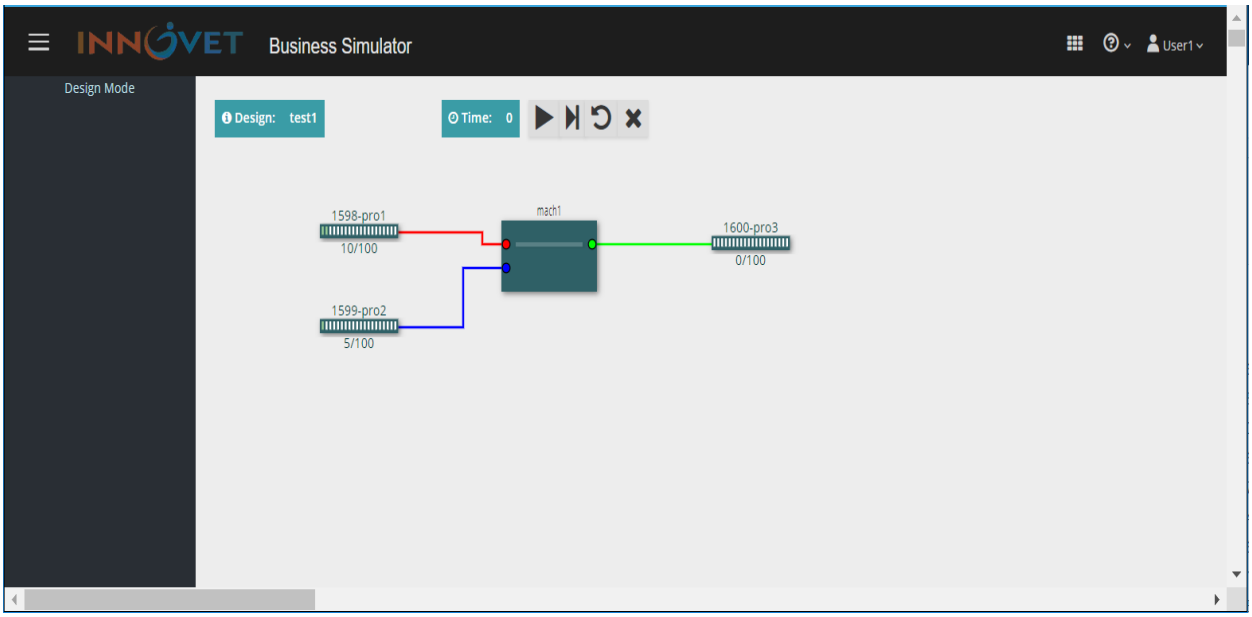
4.5 Test Mode

The **Business Simulator** allows, with the **Test** function, the user to perform a quick check of the Design for design inefficiencies.

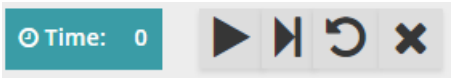
⓪ Press **Open** and select *test1***.**

⓪ Press **Test.**

The user is transferred in a new Test Mode environment.



In this environment, a test tool bar and the blue frame Time appear.



In the initial state of the Test, time is zero and the **Carriers** exhibit the values defined during the designing process of the Design. The **Step Forward** button launches the simulation and the Design is transferred in time 1 (as it is defined previously in the field **Time Resolution**) while a second press of the button transfers the Design in time 2 etc. Simultaneously, the new values of the objects appear in the Design. Particularly for the **Machines**, the stage of product development appears thoroughly in each output of the **Machines**.

The **Step Backwards** button allows the user to transfer the Design in a preceding time of the simulation.

The **Play** button allows the user to launch the simulation process while the **Pause** button that appears allows the user to pause this process.

The **Reset** button allows the user to reset the Design to its initial state of the Test.

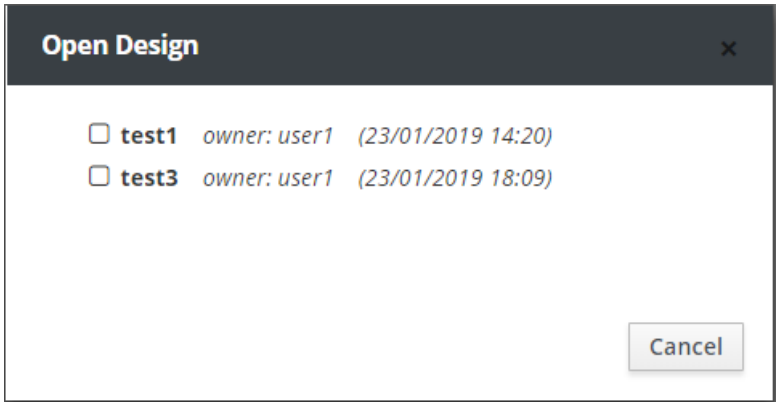
The **Close** button allows the user to exit from the Test Mode environment.

⓪ Press ✖ to exit from the Test Mode environment.

⓪ Press **Close** to exit from the environment of the Design.

4.6 Open a Saved Design

Click on the *Open* button in the menu of the **Design Mode** and a window named **Open Design** appears.

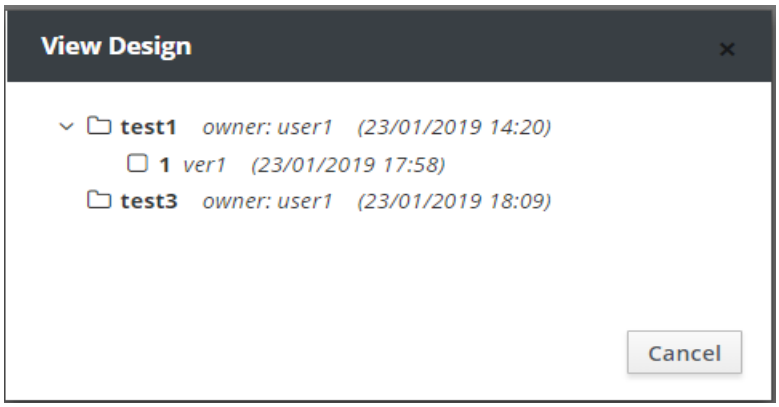


⓪ Select the Design *test3*.

⓪ Press **Close** to return to the main menu of the **Design Mode**.

4.7 View a Saved Design

The **View** button allows the user to view an existing Design. Click on the **View** button and a window named **View Design** appears.



⓪ Select the Version *ver1* of the Design *test1*.

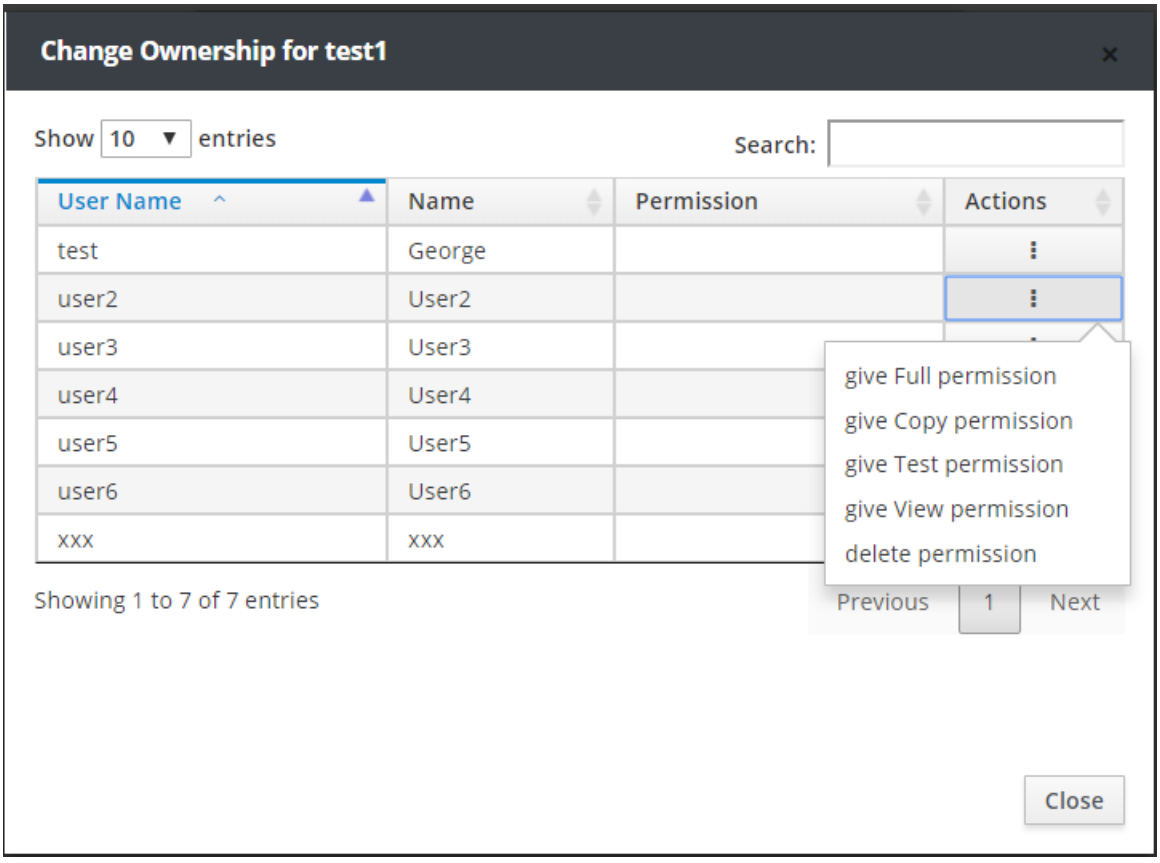
⓪ Press **Close** to return to the main menu of the **Design Mode**.

4.8 Share Management Rights of a Saved Design

The **Share** button allows the user to share management rights to the Designs, with other users. Click on the **Share** button and a window named **Share Design** appears.

◎ Select the Design *test1*.

A window named **Change Ownership for test1** appears. Each user can be assigned, by employing a corresponding option from the Actions list, one of the Full, Copy, Test, View και Delete permissions. Moreover, the window exhibits all the users of the system.



⓪ Press **Close** to close the window named **Change Ownership for test1** and press **Cancel** in the window named **Share Design** to return to the main menu of the **Design Mode**.

4.9 Delete a Saved Design or Version

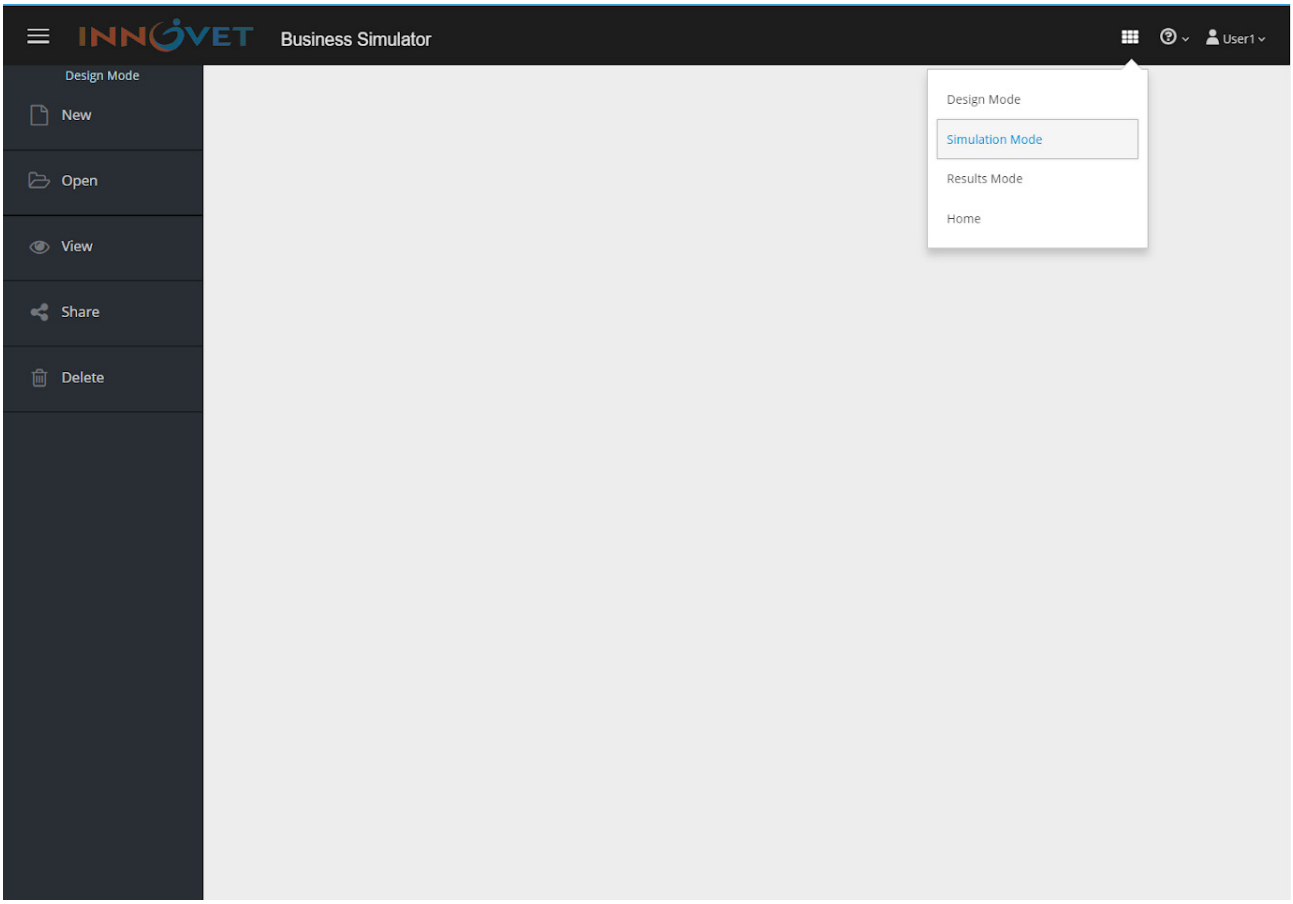
The **Delete** button allows the user to delete a Version of a Design or even the whole Design itself. Click on the **Delete** button and a window named **Delete Design or Version** appears.

In cases where certain Designs are connected with existing simulations, these particular Designs or Versions appear in the window in red letters and the system do not allow the user to delete them.

⓪ Press **Cancel** to return to the main menu of the **Design Mode**.

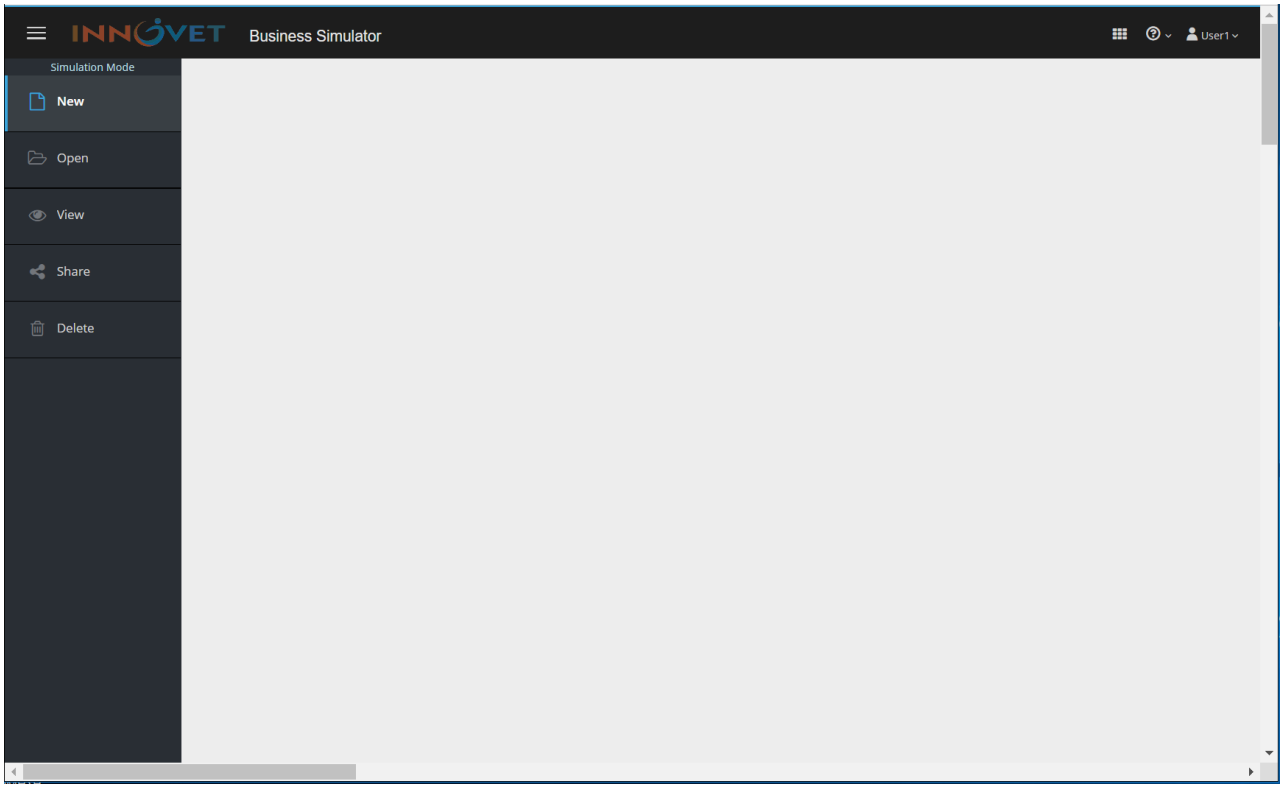
5. Simulation Mode

The **Simulation Mode** is a subsystem of the **Business Simulator** which allows the user to simulate the Designs. To enter the subsystem, click on the button situated in the horizontal tool bar of the system and select the field **Simulation Mode** from the pop-up list.



To perform a simulation is necessary to create a **Simulator** first. The **Simulator** is a simulation environment where the user can perform a simulation, save it, perform other simulations with different parameters and recall previously saved simulations. Each **Simulator** refers to a saved **version** of a **Design**.

The main menu of the **Simulation Mode** includes the following items:



- **New**

  The **New** button allows the user to start the creation of a new **Simulator**.

- **Open**

  The **Open** button allows the user to open a saved **Simulator**.

- **View**

  The **View** button allows the user to view the **version** of the **Design** that a saved **Simulator** refers to.

- **Share**

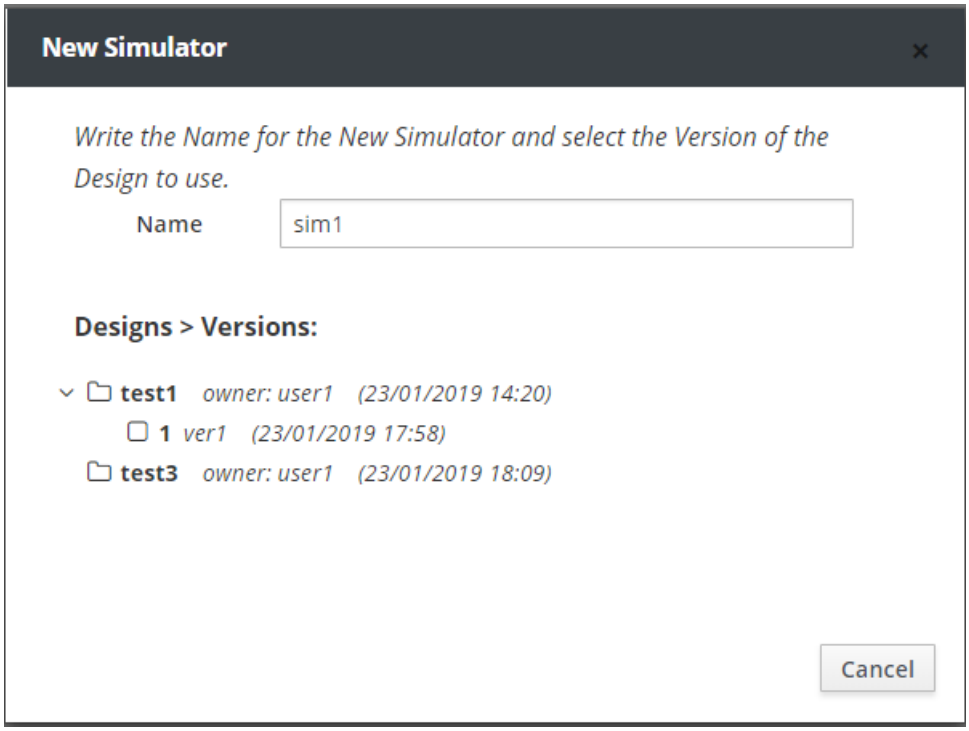
  The **Share** button allows the user to assign certain management rights of the **Simulator** to other users.

- **Delete**

  The **Delete** button allows the user to delete a saved **Simulator**.

5.1 Creation of a Simulator

Click on the *New* button in the **Simulation Mode** and a window named **New Simulator** appears.



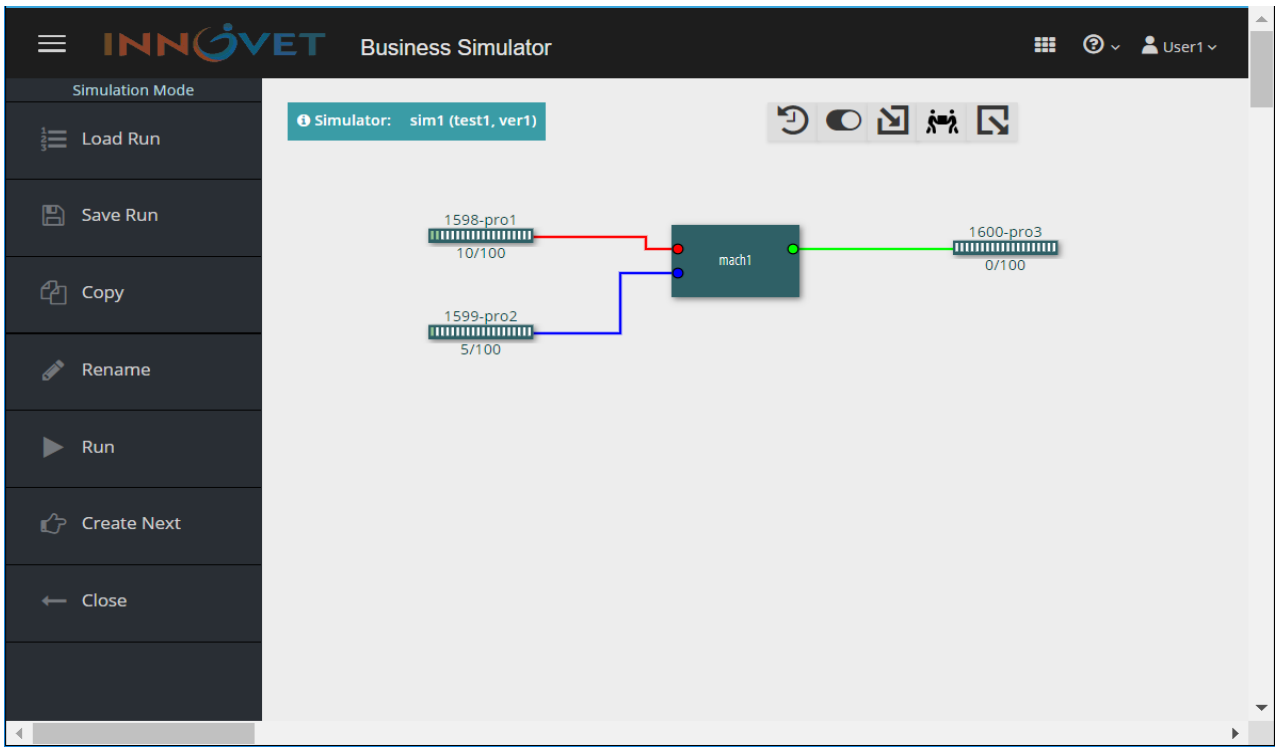
In the field **Name**, the user defines the name of the new Simulator.

The window exhibits a list of the available versions of the Designs in which the user can perform simulations.

◎ In the field **Name** set *sim1* and select the **Version** *ver1* of the **Design** *test1*.

Upon completion of this action, the user enters the **Main Screen** of the **Simulator** *sim1***.**

5.2 Main Screen of the Simulator



The **Main Screen** of the **Simulator** is divided in three areas. On the left side of the screen is the **Main Menu** of the **Simulator** *sim1*, in the center there is a tool bar and underneath is the version of the Design to which the **Simulator** refers.

Moreover, the name of the Simulator and the corresponding Version of the Design appear in a blue frame.

5.3 Tool Bar

Simulation Time

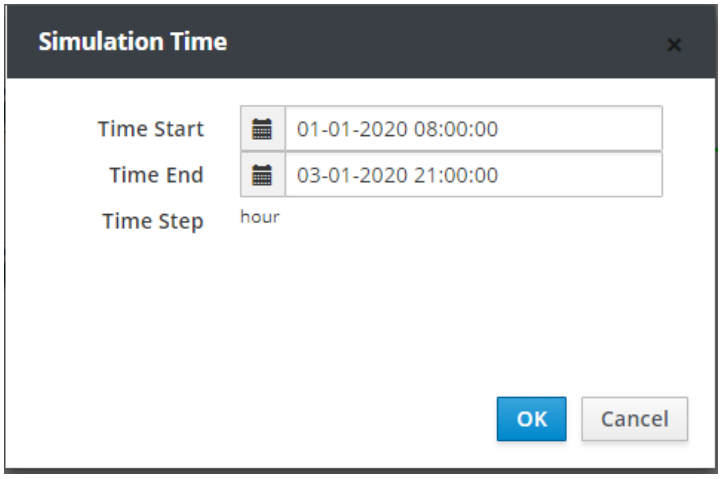
The first button in the tool bar is **Simulation Time**. Here, the user defines the time period of the simulation.

⓪ Set as:

Time Start 01-01-2020 and hour 08:00:00
Time End 03-01-2020 and hour 21:00:00

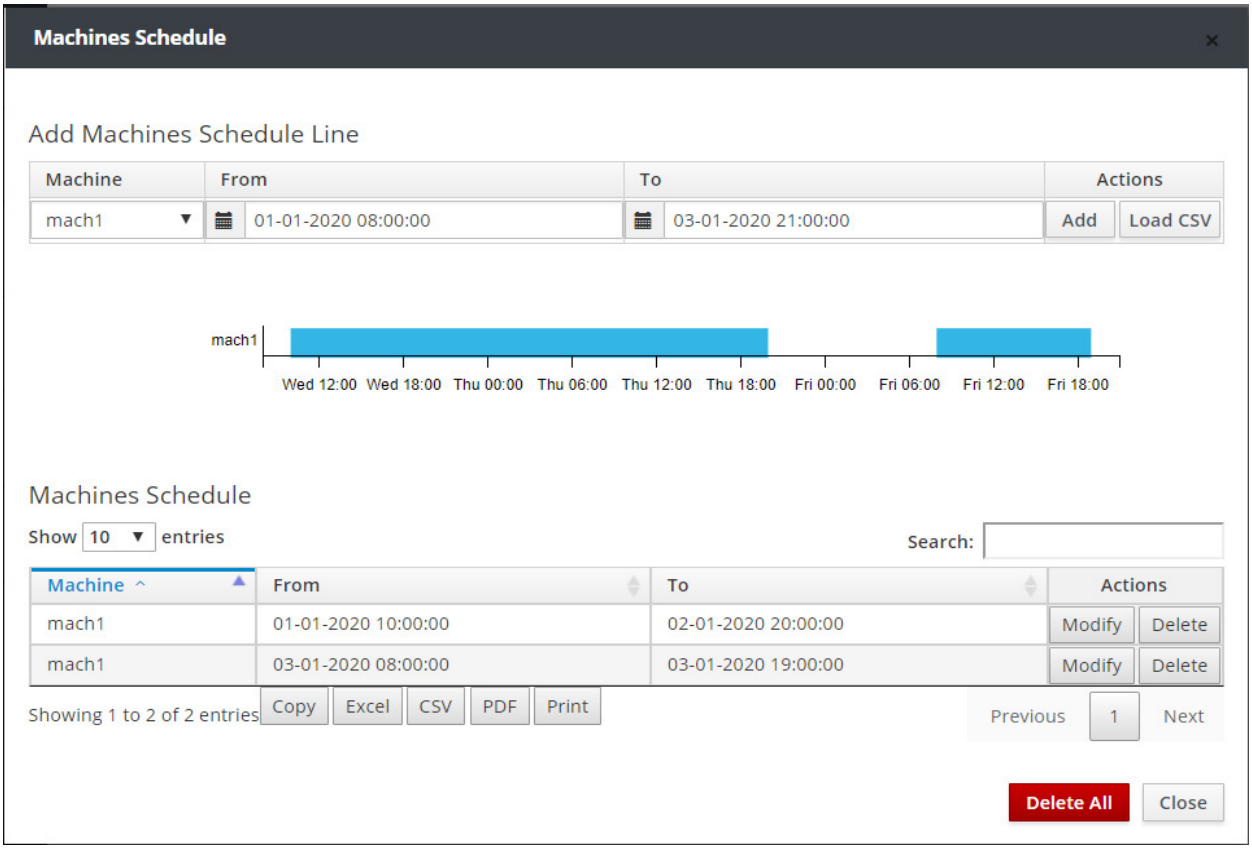
and press **OK**.

The **Time Step** which it was defined during the creating process of the Design, appears in the window.



Machines Schedule

The second button in the tool bar is the **Machines Schedule**. Press the **Machines Schedule** button. A window appears in which the user can define the operating schedule of each machine during the **Simulation Time**. The user selects the Machine, sets the starting date and time of its operation as well as the ending date and time of its operation and presses the **Add** button to enter the data into the system.

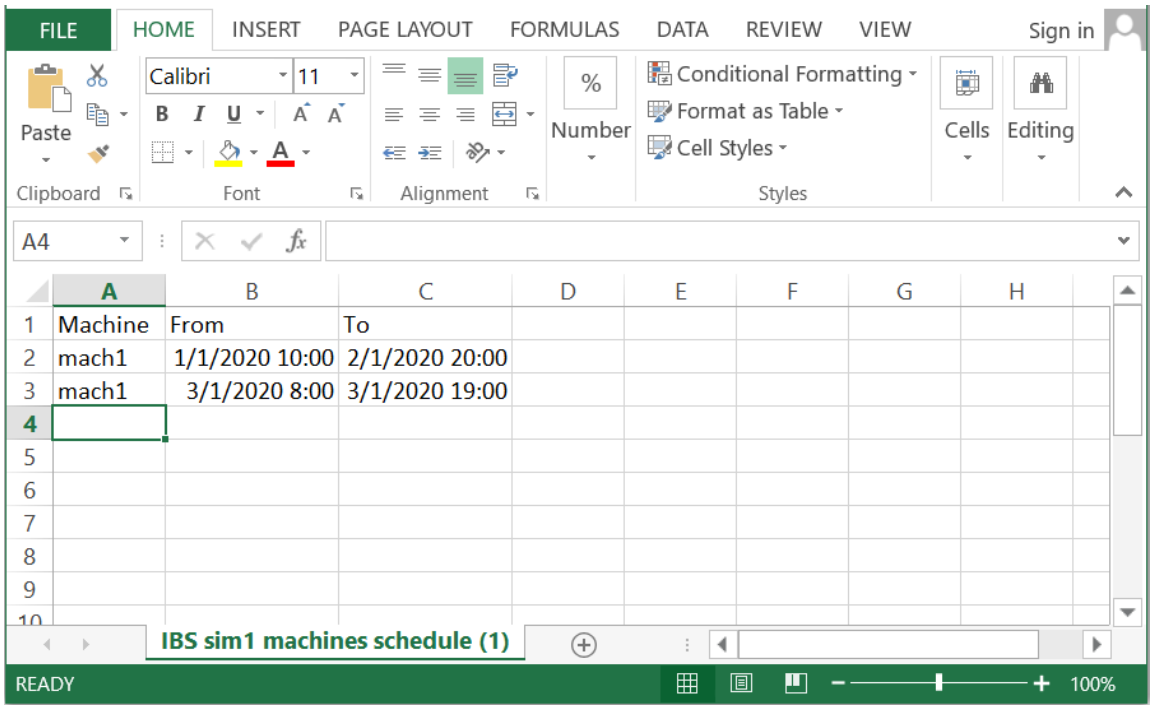


◎ Select the Machine mach1, starting and ending time 01-01-2020 and hour 10:00:00 and 02-01-2020 and hour 20:00:00 respectively and press **Add**.

◎ Select the Machine mach1, starting and ending time 03-01-2020 and hour 08:00:00 and 03-01-2020 and hour 19:00:00 respectively and press **Add**.

A graphical representation of the time period defined by the user, appears in the window. Simultaneously, a corresponding entry is added to the Machines Schedule table at the bottom of the window. The user is able to export the Machine Schedule in **Excel**, **CSV** and **PDF** format files with the use of the respective buttons. The **Load CSV** button allows the user to import the Machine Schedule through a CSV file. Moreover, the user is able to print the Machine Schedule with the **Print** button as well as to copy/paste it with the **Copy** button.

The format of the CSV file the system exports, is presented below.



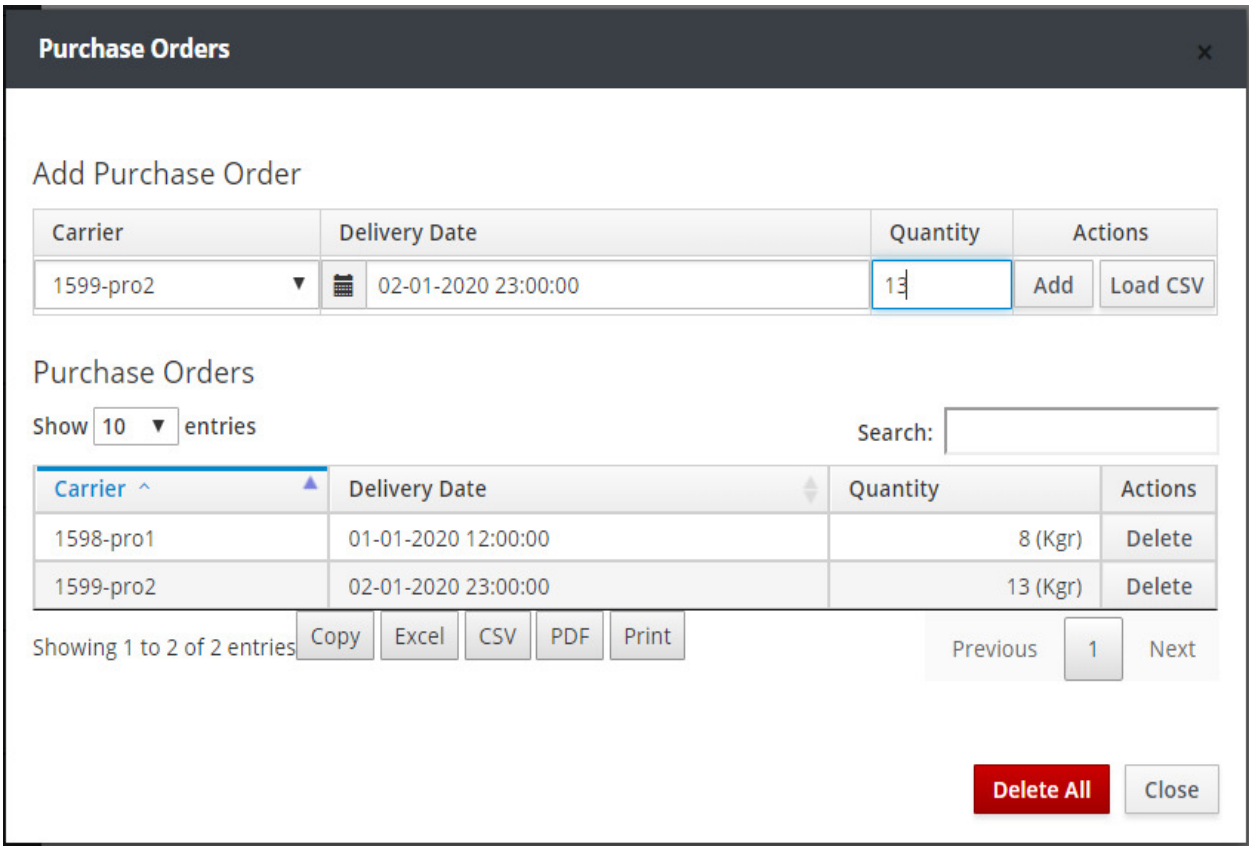
The **Modify** & **Delete** buttons cited in the Machine Schedule table at the bottom of the window, allow the user to modify or delete each entry of the schedule. The **Delete All** button allows the user to delete all entries to the schedule.

The system allows to search for entries containing the text that the user enters in the Search field. That text can be any field or part of the entries of the Machines Schedule table.

◎ Press the **Close** button to close the Machines Schedule window.

Purchase Orders

The third button in the tool bar is **Purchase Orders**. Press the **Purchase Orders** button. A window appears in which the user can set the purchase orders of raw materials during the **Simulation Time**. To import an entry in purchase orders, the user selects the Carrier that refers to a particular raw material/product, types the date and time of delivery, the purchased quantity and presses the **Add** button to import the data into the system.

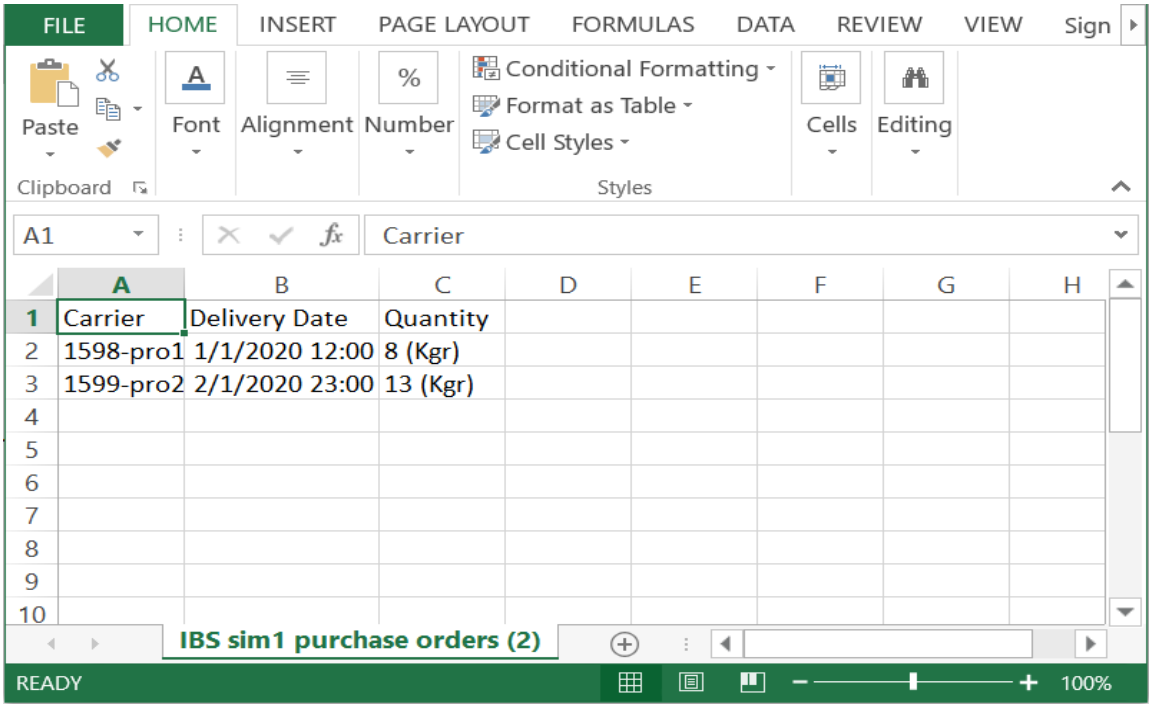


◎ Select the Product pro1, delivery date 01-01-2020 and time 12:00:00, purchased quantity 8 and then press **Add**.

◎ Select the Product pro2, delivery date 02-01-2020 and time 23:00:00, purchased quantity 13 and then press **Add**.

The user is able to export the Purchase Orders table in **Excel**, **CSV** and **PDF** format files with the use of the respective buttons. The **Load CSV** button allows the user to import the Purchase Orders table through a CSV file. Moreover, the user is able to print the Purchase Orders table with the **Print** button as well as to copy/paste it with the **Copy** button.

The format of the CSV file the system exports, is presented below.



The **Delete** button cited in the Purchase Orders table at the bottom of the window, allows the user to delete each entry of the table. The **Delete All** button allows the user to delete all entries to the table.

The system allows to search for entries containing the text that the user enters in the Search field. That text can be any field or part of the entries of the Purchase Orders table.

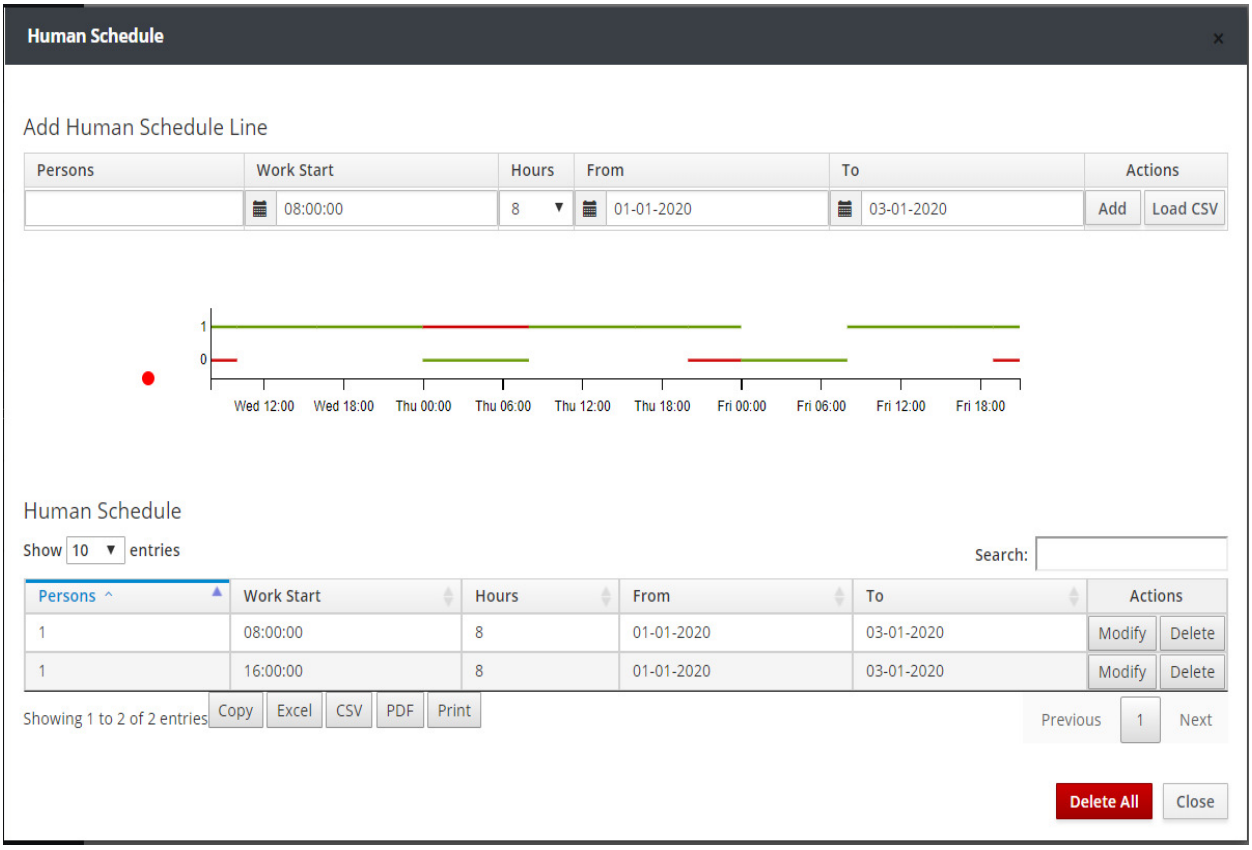
◎ Press the **Close** button to close the Purchase Orders window.

Human Schedule

The fourth button in the tool bar is **Human Schedule**. Press the **Human Schedule** button. A window appears in which the user can set the working schedule of human resources during the **Simulation Time**. To create a shift, the user sets the number of employees, the starting time of the shift, the amount of labor hours, the implementation period and presses the **Add** button to import the shift data into the system.

◎ In the field **Persons** type *1*, in the field **Work Start** set the time *08:00:00*, in the field **Hours** select *8*, in the field **From** set *01-01-2020*, in the field **To** set *03-01-2020* and press **Add**.

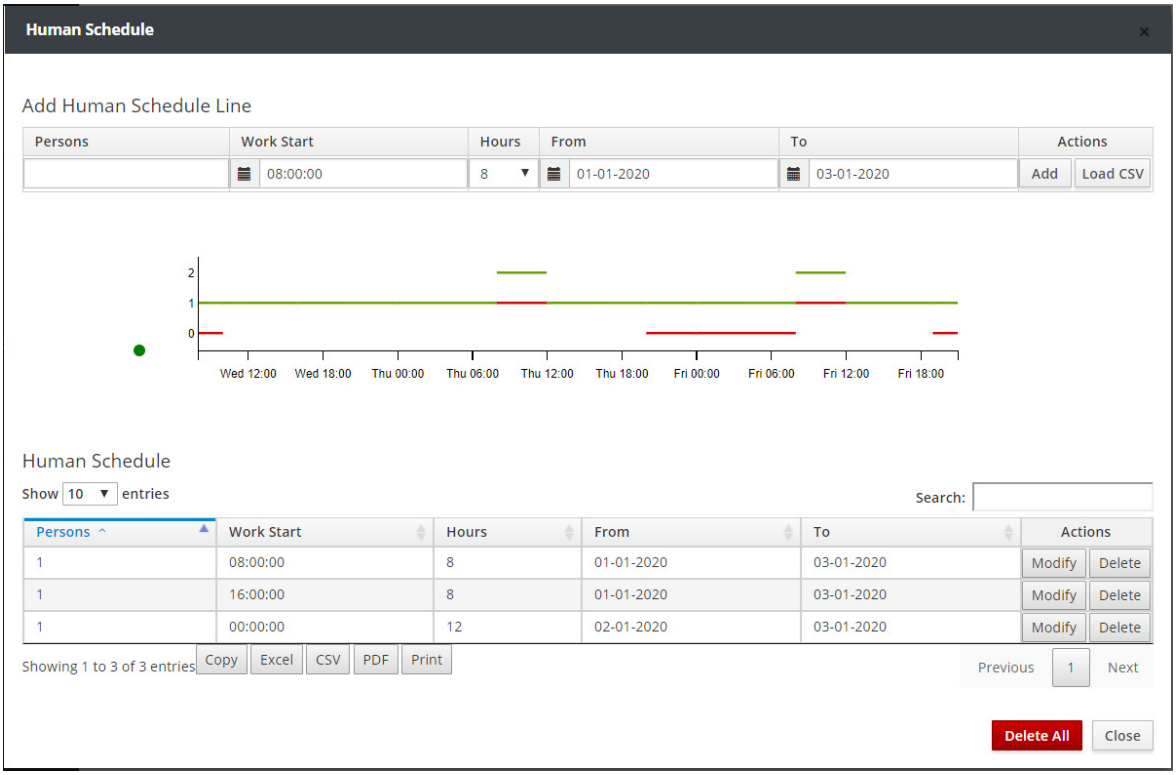
◎ In the field **Persons** type *1*, in the field **Work Start** set the time *16:00:00*, in the field **Hours** select *8*, in the field **From** set *01-01-2020*, in the field **To** set *03-01-2020* and press **Add**.



A summary chart of labor throughout the period of simulation, is presented in the window. The chart exhibits the number of available employees in green color and the number of employees required by the machines in red color. When the two colors coincide, the green color prevails. For example, from 08:00:00 to 10:00:00 on 01-01-2020 the machines do not require any employees (due to Machine Schedule – red line on 0) but one employee is available according to Human Schedule (idle human – green line on 1). On the contrary, from 00:00:00 to 08:00:00 on 02-01-2020 the machines require one employee (due to Machine Schedule – red line on 1) but no employee is available according to Human Schedule (green line on 0).

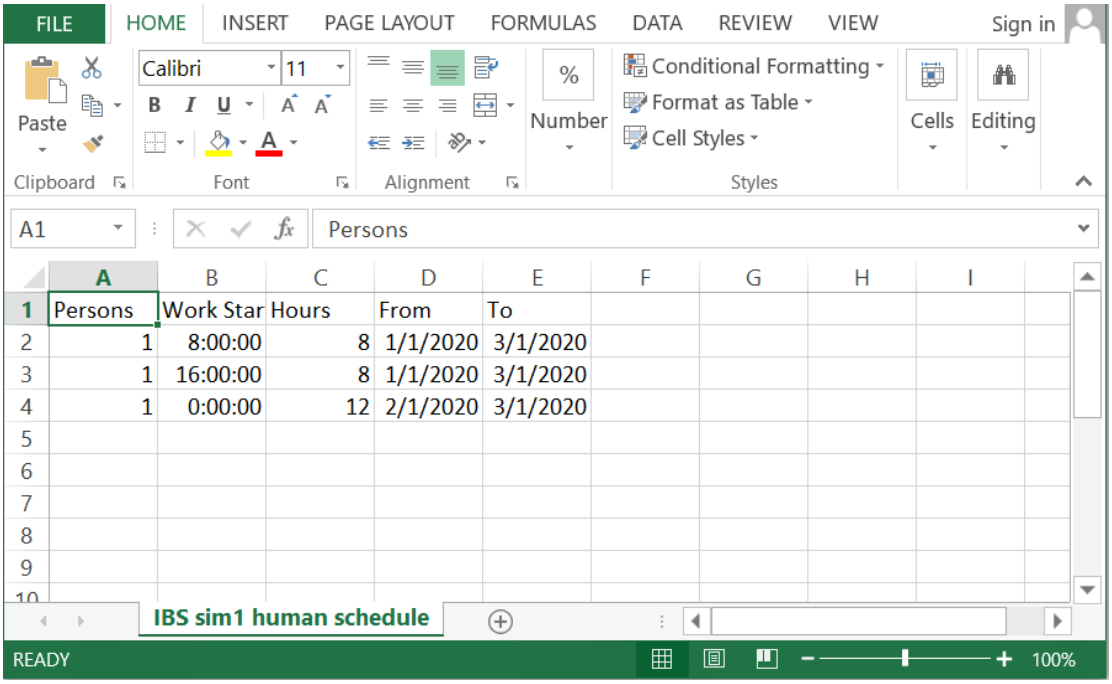
If the available employees do not suffice the requirements of the machines, a red mark appears on the left side of the chart. When the available employees suffice the requirements of the machines throughout the simulation period, the preceding mark becomes green. The simulation is feasible only in cases of green marking.

© In the field **Persons** type *1*, in the field **Work Start** set the time *00:00:00*, in the field **Hours** select *12*, in the field **From** set *02-01-2020*, in the field **To** set *03-01-2020* and press **Add**.



The new summary chart of labor throughout the period of simulation, is presented in the window with a green mark. The user is able to export the Human Schedule table in **Excel**, **CSV** and **PDF** format files with the use of the respective buttons. The **Load CSV** button allows the user to import the Human Schedule table through a CSV file. Moreover, the user is able to print the Human Schedule table with the **Print** button as well as to copy/paste it with the **Copy** button.

The format of the CSV file the system exports, is presented below.



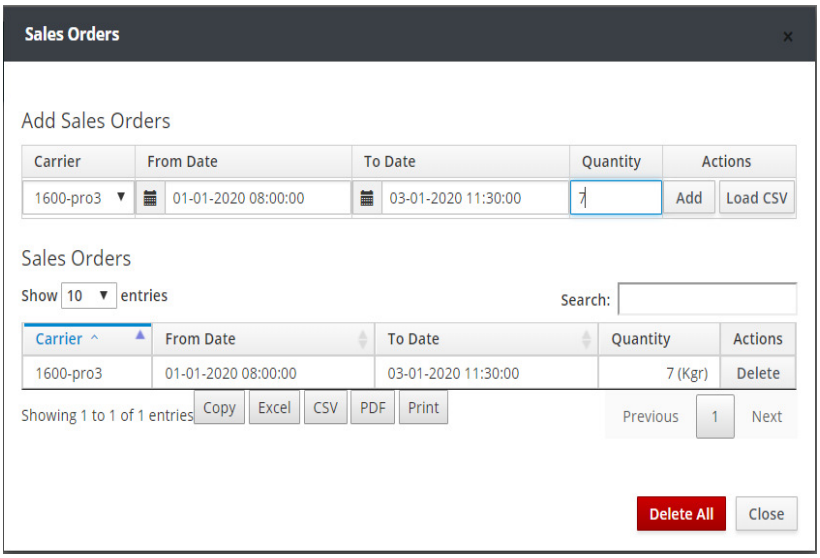
The **Modify** & **Delete** buttons cited in the Human Schedule table at the bottom of the window, allow the user to modify or delete each entry of the schedule. The **Delete All** button allows the user to delete all entries to the schedule.

The system allows to search for entries containing the text that the user enters in the Search field. That text can be any field or part of the entries of the Human Schedule table.

⊙ Press the **Close** button to close the Human Schedule window.

Sales Orders

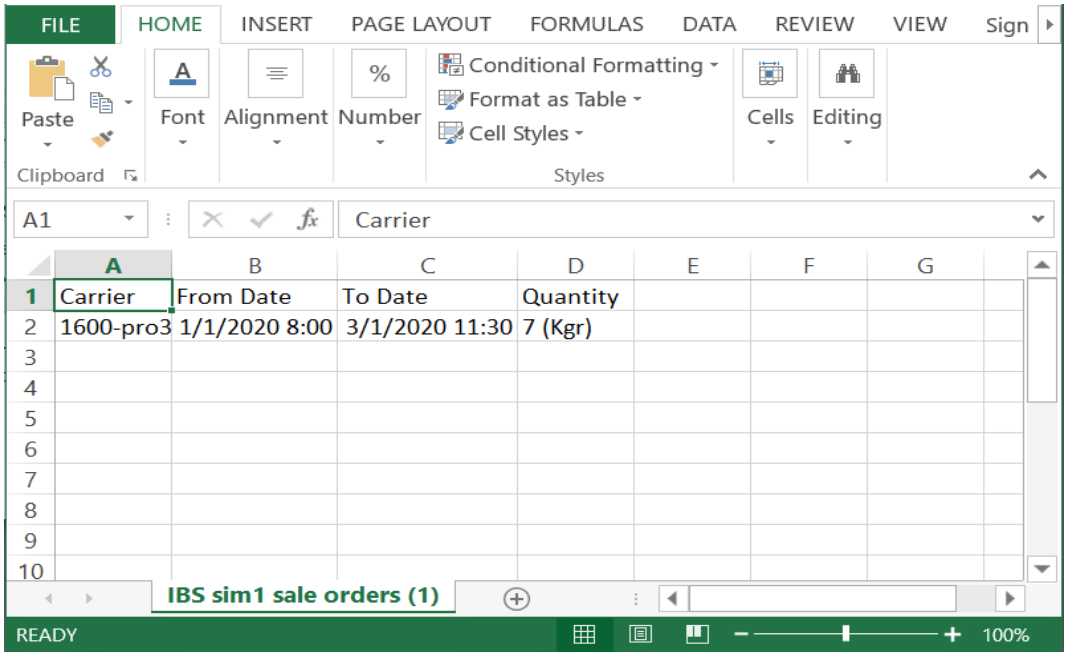
The last button in the tool bar is **Sales Orders**. Press the **Sales Orders** button. A window appears in which the user can set the Sales Orders during the **Simulation Time**. To import an entry in sales orders, the user selects the Carrier, the period during which the product sales are feasible, the quantity of goods sold and presses the **Add** button to import the data into the system.



⊙ Select the *Carrier* that transfers the product *pro3*, starting and ending date where the sale is feasible set *01-01-2020* and hour *08:00:00* and *03-01-2020* and hour *11:30:00* respectively, type quantity of goods sold *7* and press **Add**.

The user is able to export the Sales Orders table in **Excel**, **CSV** and **PDF** format files with the use of the respective buttons. The **Load CSV** button allows the user to import the Sales Orders table through a CSV file. Moreover, the user is able to print the Sales Orders table with the **Print** button as well as to copy/paste it with the **Copy** button.

The format of the CSV file the system exports, is presented below.



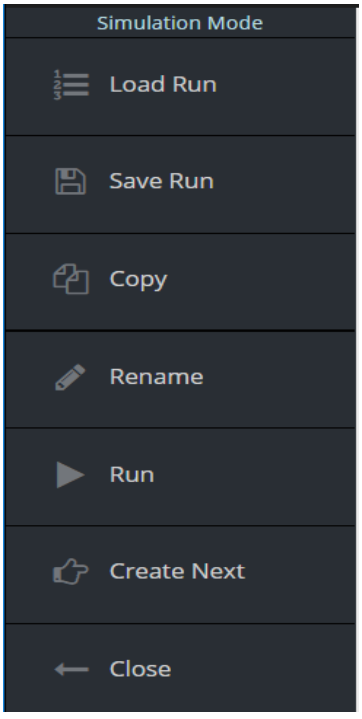
The **Delete** button cited in the Sales Orders table at the bottom of the window, allows the user to delete each entry of the table. The **Delete All** button allows the user to delete all entries to the table.

The system allows to search for entries containing the text that the user enters in the Search field. That text can be any field or part of the entries of the Sales Orders table.

◎ Press the **Close** button to close Sales Orders window.

5.4 Main Menu of the Simulation Mode

The main **Menu** of the Simulation **Mode** environment that appears on the left side of the screen, is presented in the following section:



Load Run: Load a saved run of the Simulator.

Save Run: Save current run of the Simulator.

Copy: Copy the Simulator with a different name.

Rename: Rename the Simulator.

Run: Perform a simulation run.

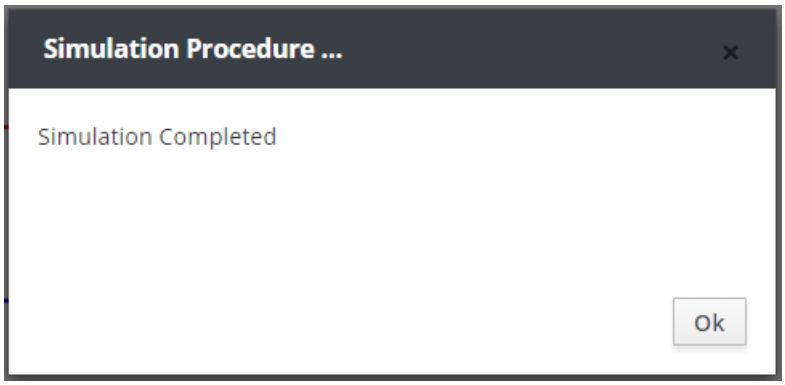
Create Next: Create a new simulator with the same Design and starting time, the ending time of the current Run.

Close: Exit the Simulator.

Perform a Simulation Run

⊙ Click on the **Run** button.

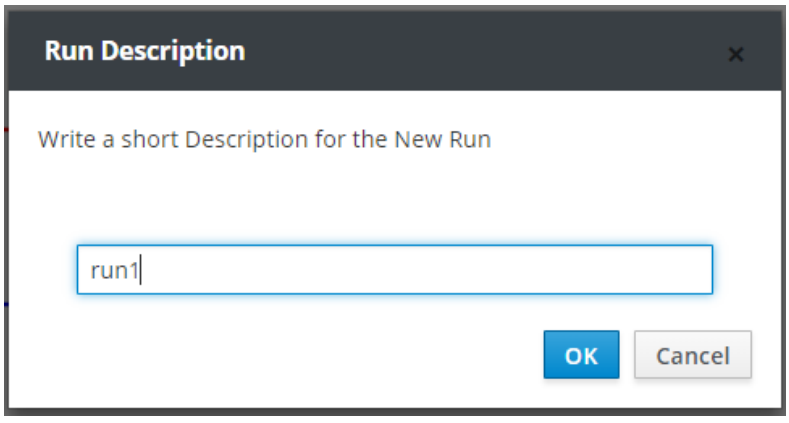
A window named *Simulation Procedure* appears. When the message *Simulation Completed* appears, the simulation is completed.



⊙ Press **OK**.

Save Current Run

⊙ Click on the **Save Run** button, type *run1* and press **OK**.

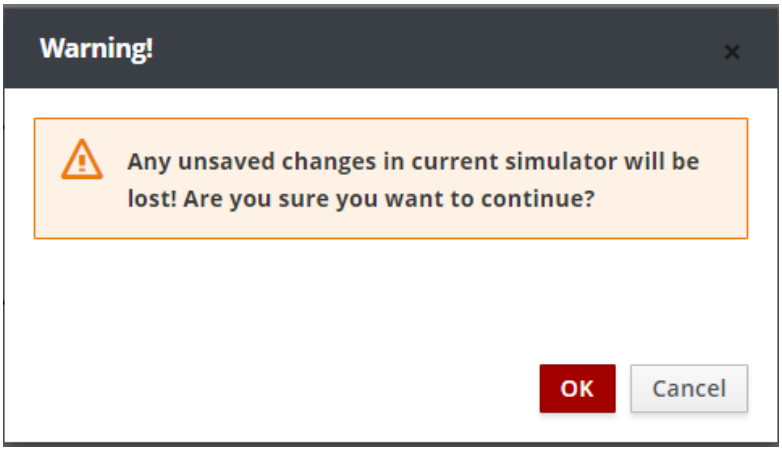


Upon this action, a saved copy of the Simulator *sim1* named *run1* is created. This saved Run belongs to the Simulator *sim1* and is referred as a Run of this particular Simulator. The user is able to continue modifying the simulation parameters and performing simulations in the environment of the Simulator without any effects on the state of the saved Run.

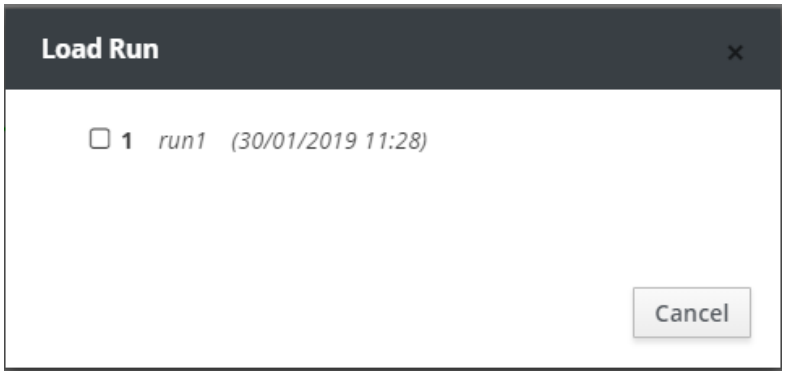
At any point, the user can also load any Run of the Simulator that was saved in a preceding time.

Load a Saved Run

⓪ Click on the **Load Run** button. A warning window appears, informing the user that upon the loading of the Run, any unsaved changes in the current Simulator will be lost.



⓪ Press **OK**.



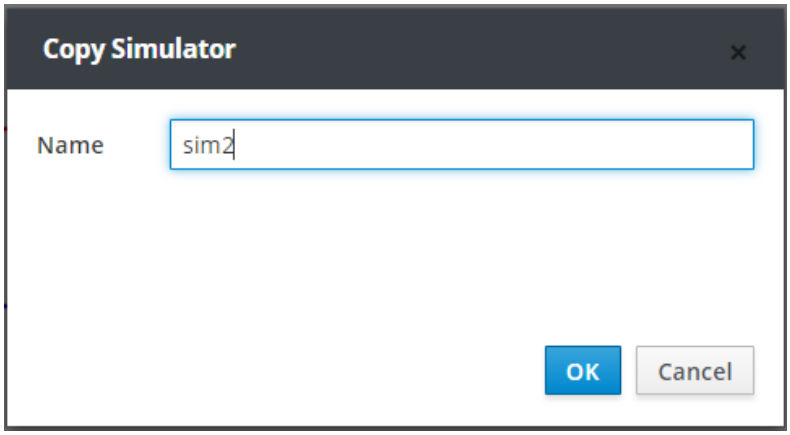
⓪ Select *run1*.

Upon this action, the saved Run *run1* of the Simulator *sim1* is loaded in the work environment.

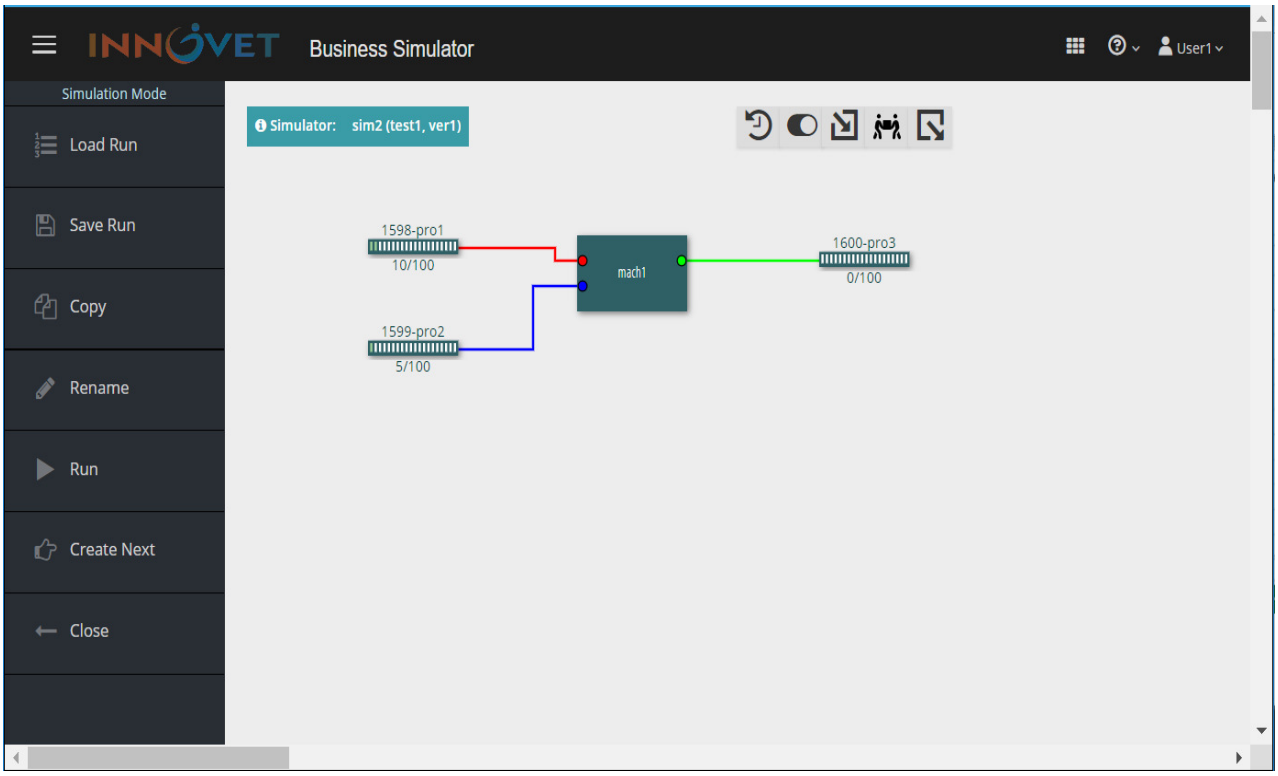
Create a Copy of a Simulator

⓪ Click on the **Copy** button. Type *sim*2.

Upon this action, a copy of the current Simulator named *sim2* is created.



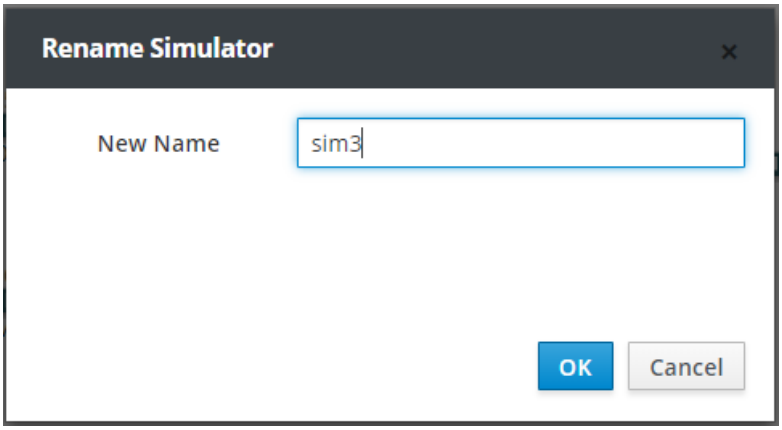
⓪ Press **OK**.



Rename a Simulator

⓪ Click on the **Rename** button. Type *sim3*.

Upon this action, the user renames the current Simulator named *sim2* to *sim3*.

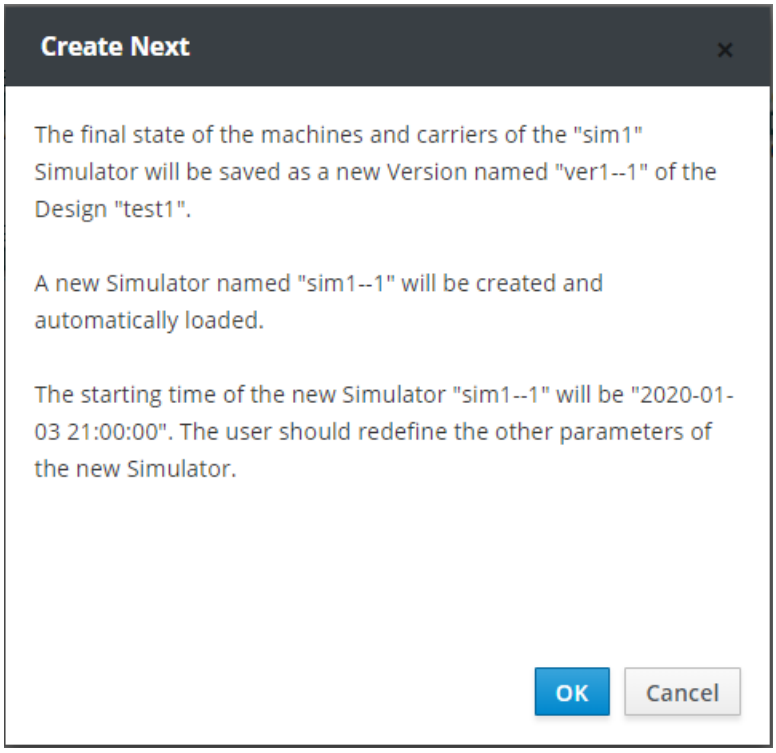


⊙ Press **OK** and in the menu of the Simulator select **Close**. In the main menu of the Simulation Mode, click on the **Open** button and select *sim1*.

⊙ Click on the **Run** button.

Create Next

⊙ Click on the **Create Next** button.



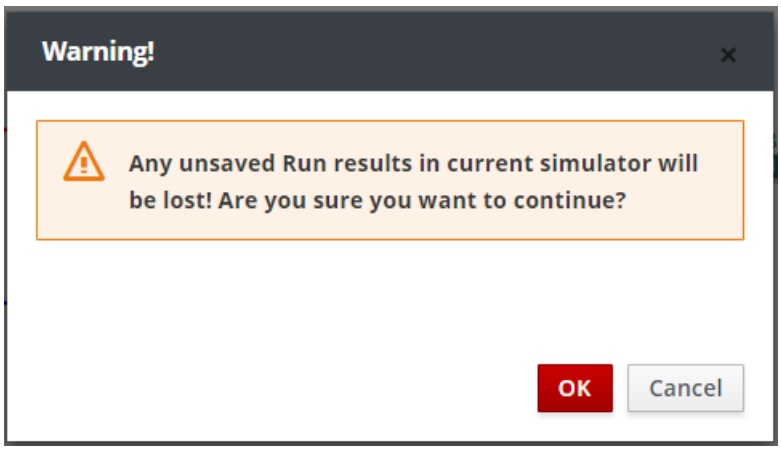
Upon this action, a window appears informing the user that the final state of the Machines and the Carriers of the Simulator *sim1* will be saved as a new Version named *ver1--1* of the Design *test1*. It also informs the user that a new Simulator named *sim1–1* will be created. The starting time of the

new Simulator *sim1--1* will be the same with the ending time of the current Run. The user should also redefine the other parameters of the new Simulator.

⓪ Press **OK**.

Exit Simulator

⓪ Click on the **Close** button.

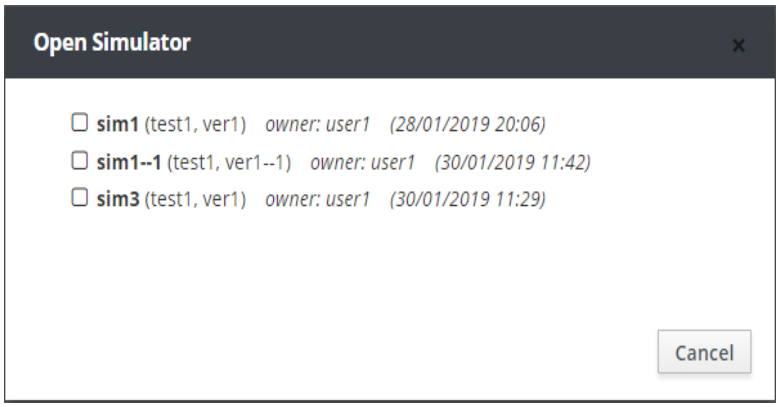


Upon this action, a window appears informing the user that in case of an exit from the Simulator, any unsaved Run results in the current Simulator will be lost.

⓪ Press **OK**.

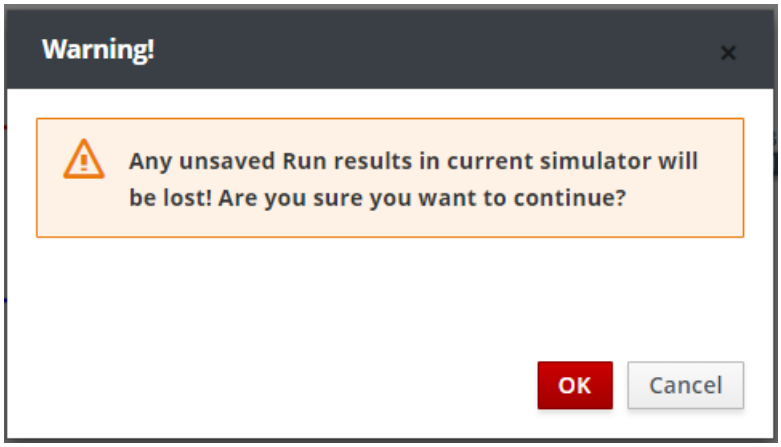
5.5 Open a Saved Simulator

Click on the *Open* button in the menu of the **Simulation Mode** and a window named **Open Simulator** appears.



⓪ Select the Simulator *sim1*.

⓪ Press **Close** to return to the main menu of the **Simulation Mode**.

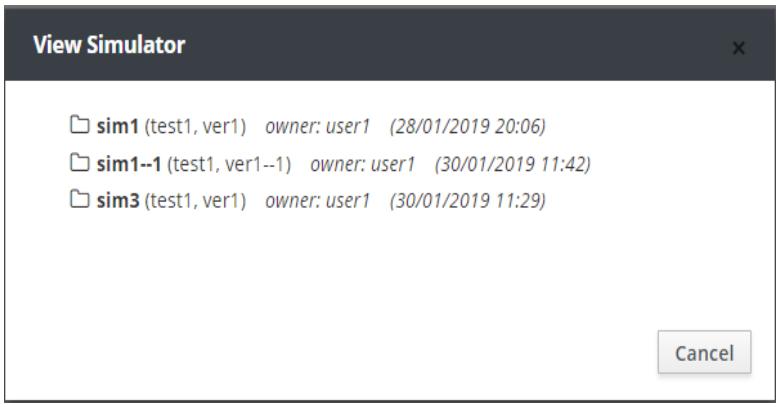


Upon this action, a window appears informing the user that in case of an exit from the Simulator, any unsaved Run results in the current Simulator will be lost.

⓪ Press **OK**.

5.6 View a Saved Simulator

The **View** button allows the user to view an existing Simulator. Click on the **View** button and a window named **View Simulator** appears.



⓪ Select the Simulator *sim1*.

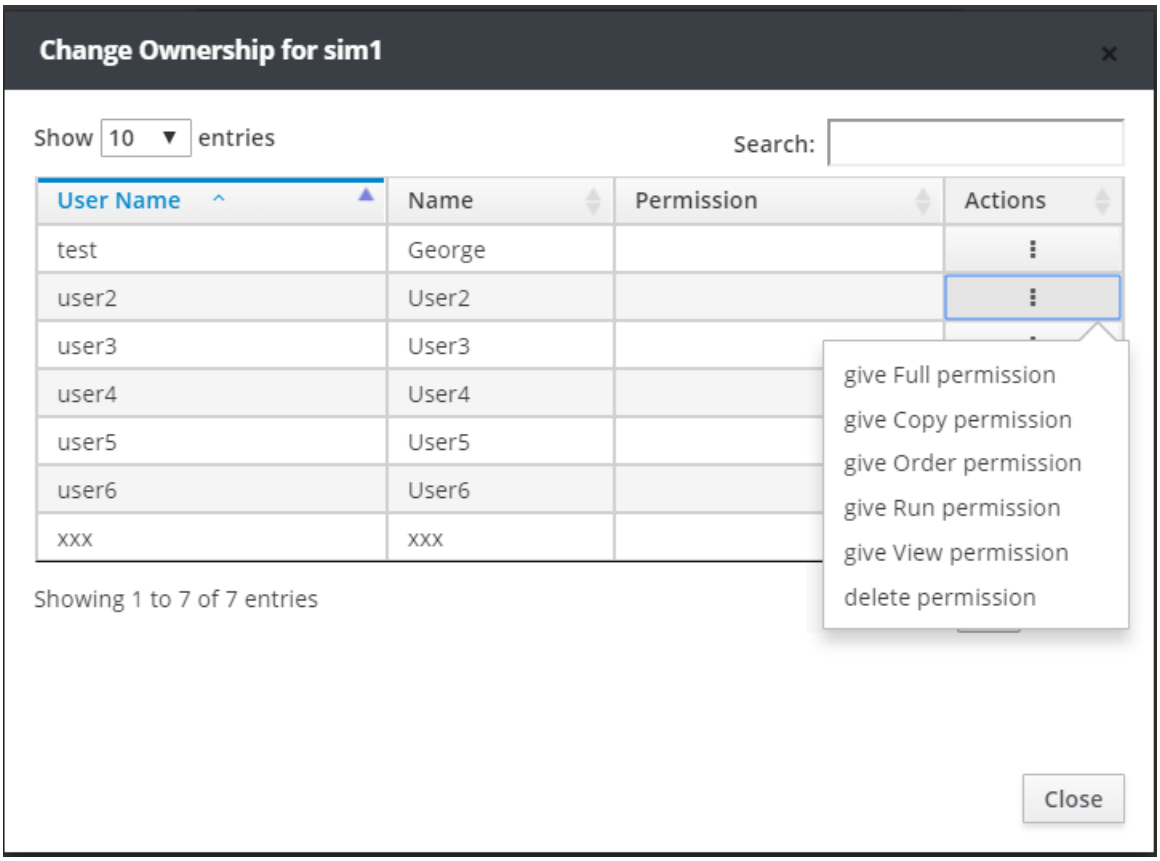
⓪ Press **Close** to return to the main menu of the **Simulation Mode**.

5.7 Share Management Rights of a Saved Simulator

The **Share** button allows the user to share management rights to the Simulators with other users. Click on the **Share** button and a window named **Share Simulator** appears.

⊙ Select the Simulator *sim1*.

A window named **Change Ownership for sim1** appears. Every user can share one of the following rights: Full, Copy, Order, Run and View or delete permission to deprive these rights by employing the corresponding selection from the Actions list.

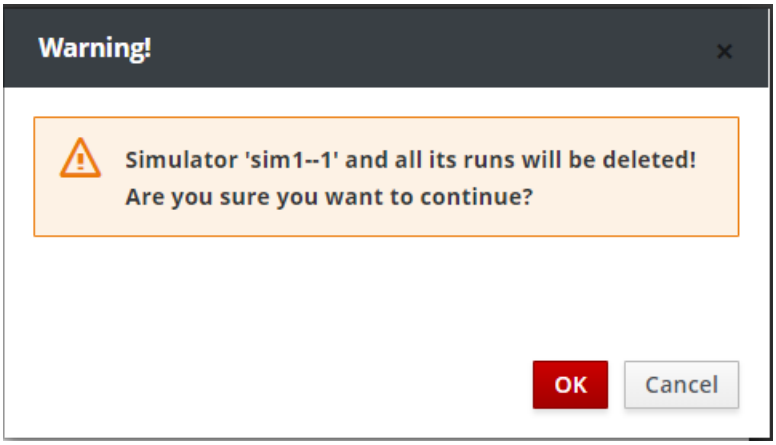


⊙ Press **Close** to close the window named **Change Ownership for sim1** and press **Cancel** in the window named **Share Simulator** to return to the main menu of the **Simulation Mode**.

5.8 Delete a Saved Simulator or Run

The **Delete** button allows the user to delete a Run of a Simulator or even the whole Simulator. Click on the **Delete** button and a window named **Delete Simulator or Run** appears.

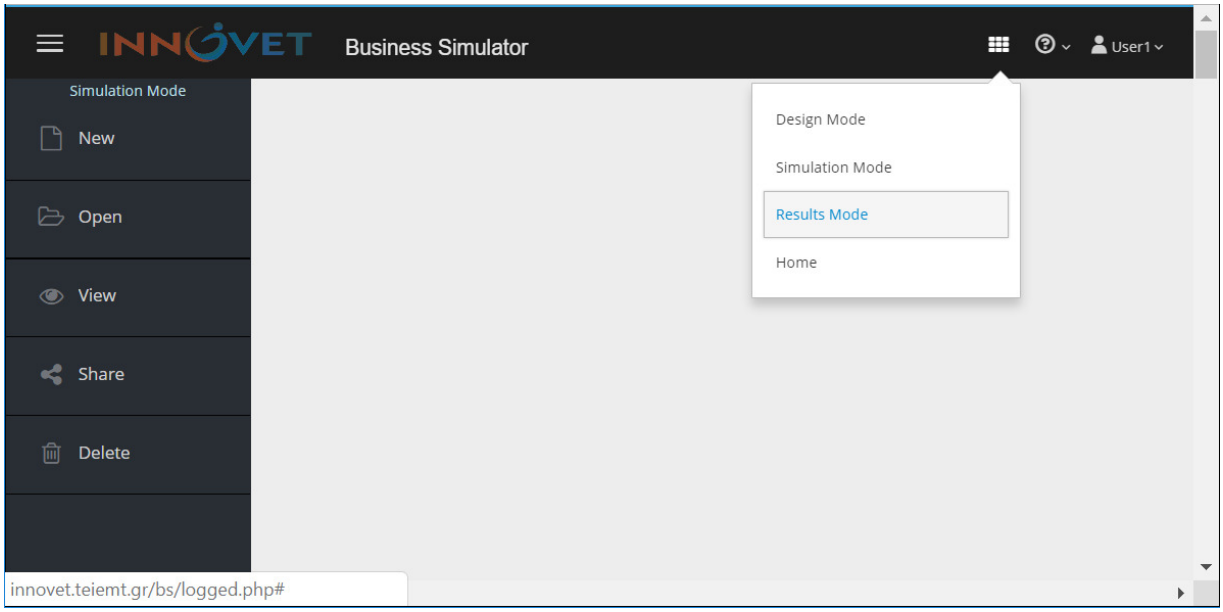
⓪ Select the Simulator *sim1--1*. The following window appears, warning the user that the preceding Simulator will be deleted.



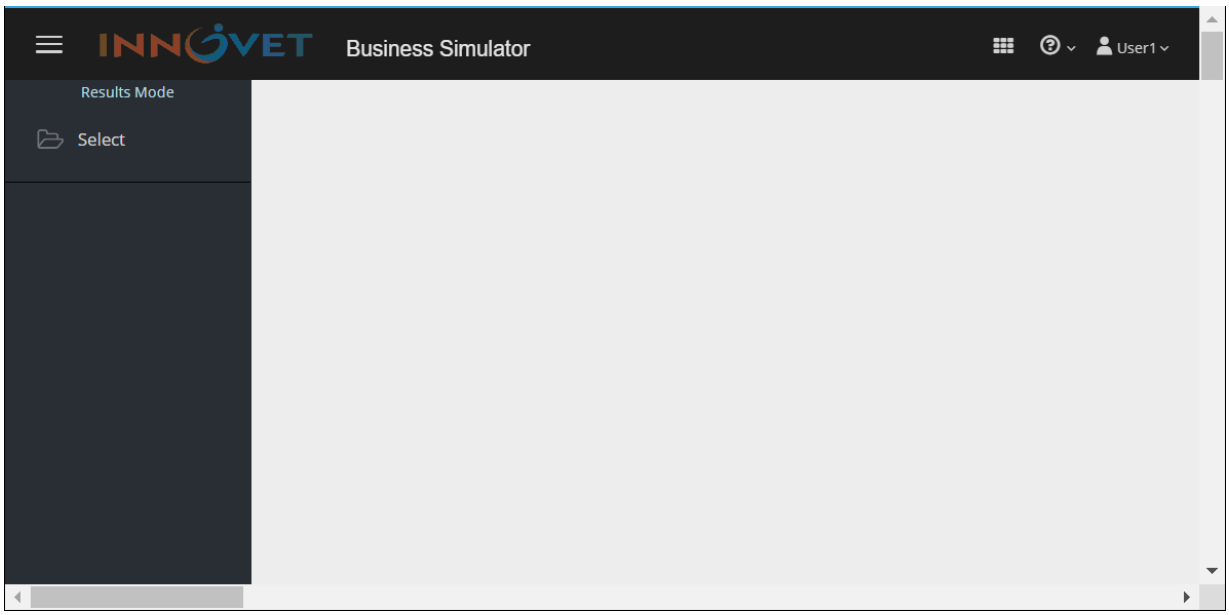
⓪ Press **OK** to delete the Simulator and return to the main menu of the **Simulation Mode**.

6. Results Mode

The **Results Mode** is a subsystem of the **Business Simulator** which allows the user to view and present the results of a Run. The user clicks on the button situated in the horizontal tool bar of the system and selects the field **Results Mode** from the pop-up list, to enter the results screen.

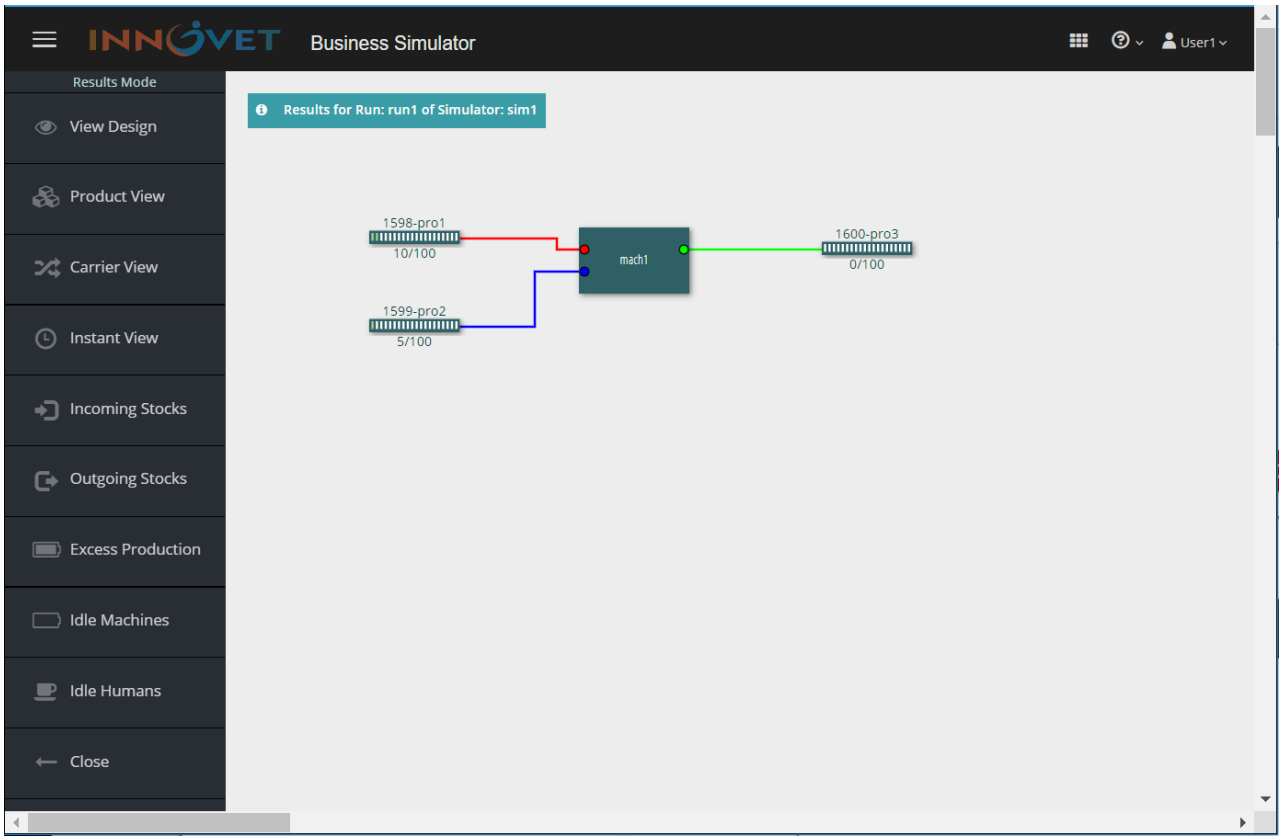


Upon this action, the user is transferred to the following screen.



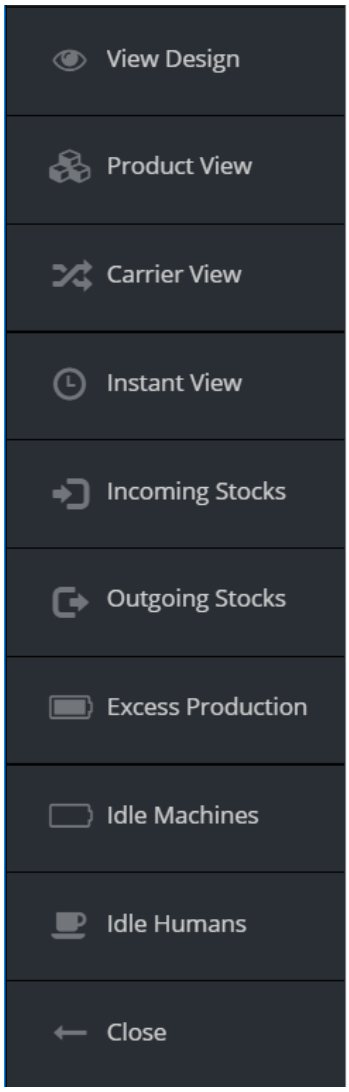
⓪ Press **Select** and a window named **Select Run** appears. In this window, select the Run *run1* of the Simulator *sim1*.

The environment of the **Results Mode** appears.



6.1 Main Menu of the Results Mode

The main **Menu** located on the left side of the screen in the environment of the **Results Mode**, is presented in the following section:



View Design: View the Design to which the simulation results refer.

Product View: View the product quantities throughout the simulation time.

Carrier View: View the quantities of the Carriers throughout the simulation time.

Instant View: View the quantities of the products and the Carriers at a specific time of the simulation.

Incoming Stocks: View the purchases of raw materials/products throughout the simulation time.

Outgoing Stocks: View the sales throughout the simulation time.

Excess Production: View the excess production throughout the simulation time.

Idle Machines: View the idle time of the Machines throughout the simulation time.

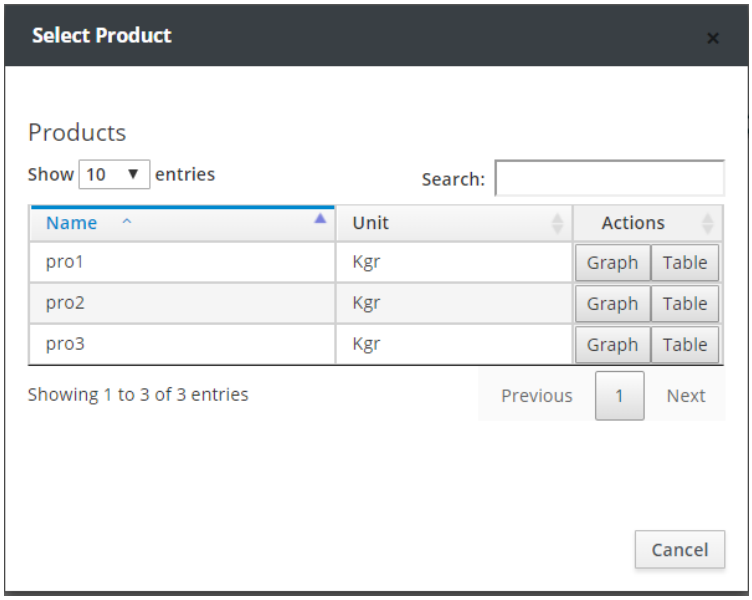
Idle Humans: View the idle time of the Humans (employees) throughout the simulation time.

Close: Exit the **Results Mode** environment of the current simulation.

6.2 Product View

⓪ Click on **Product View.**

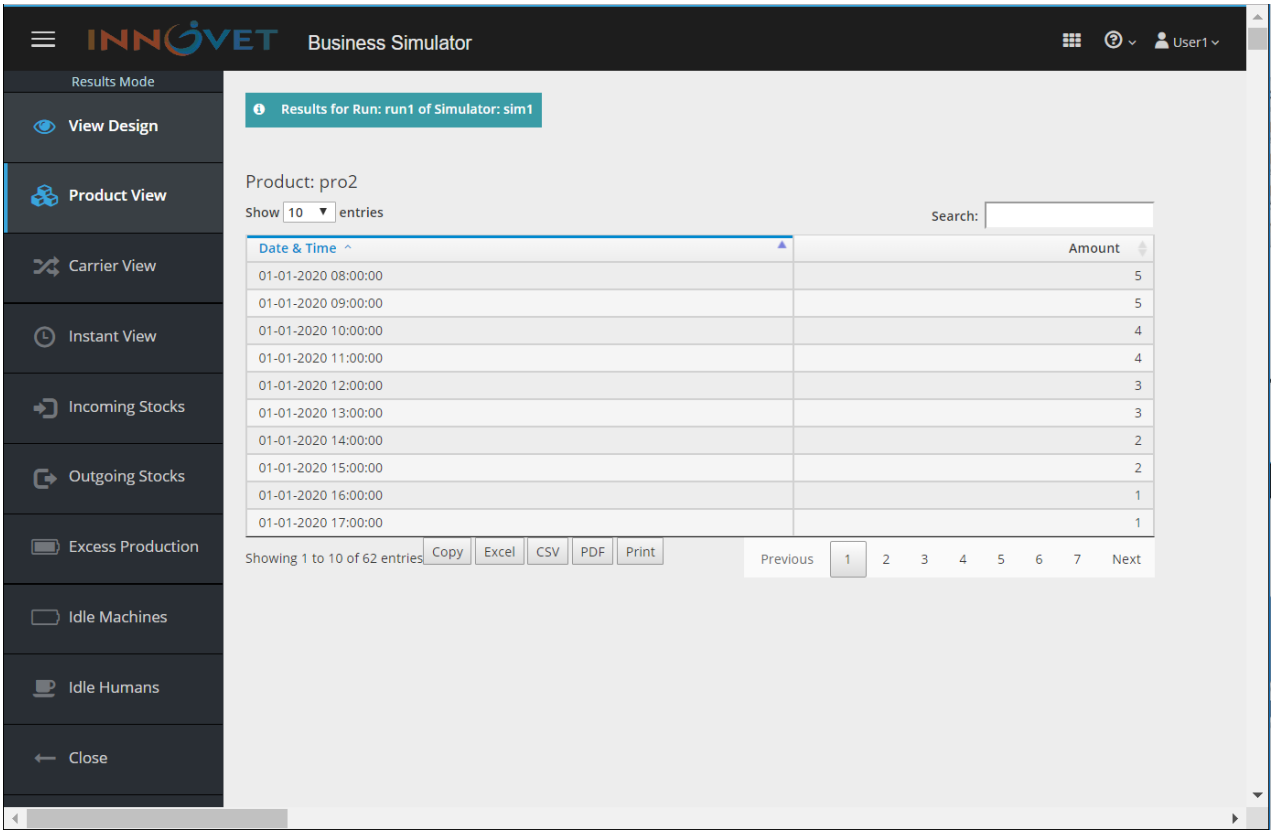
A window named *Select Product* appears, which lists all raw materials and products of the Design, in a customized layout. In this window, the user is able to search for any product through the **Search** field.



◎ Click on the **Graph** button of *pro2*.

In the environment of the system, a graphical representation of the product *pro2* quantities, appears. The vertical axis represents the product quantity and the horizontal axis represents the simulation time. The user is able to select the displayed time span by adjusting accordingly the dynamic frame situated under the graph.

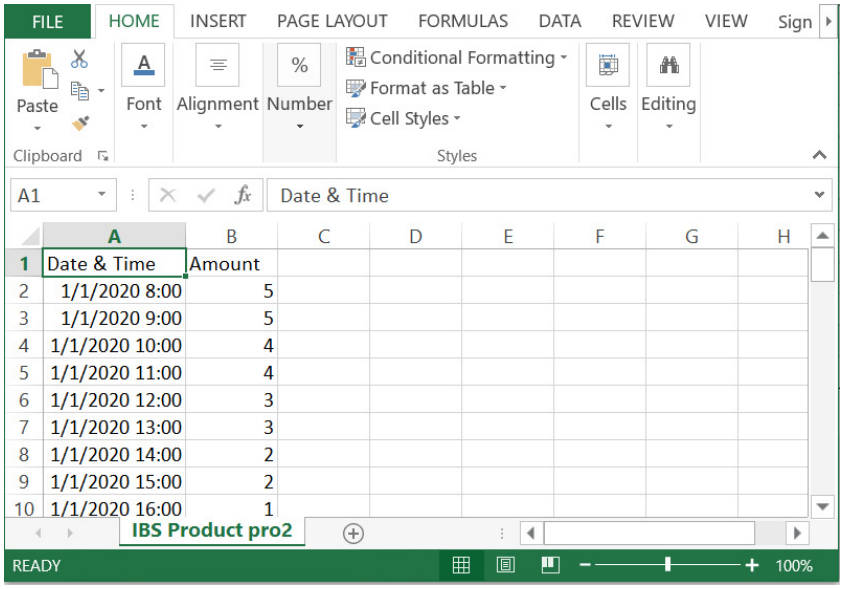
⓪ Click on **Product View** and then press the **Table** button of *pro2*.



In the environment of the system, a thorough ledger of the product *pro2* quantities appears, in a customized layout.

The user is able to export the preceding ledger of the product *pro2* quantities in **Excel**, **CSV** and **PDF** format files with the use of the respective buttons. Moreover, the user is able to print the ledger with the **Print** button as well as to copy/paste it with the **Copy** button.

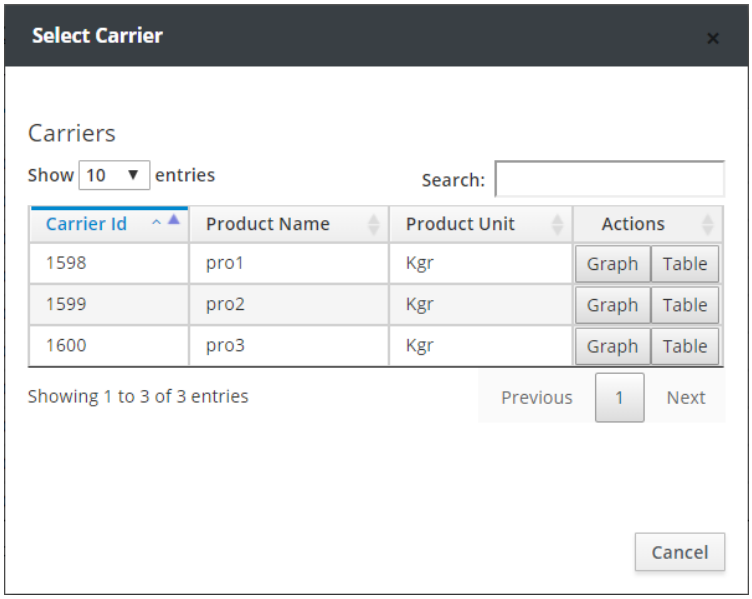
The format of the CSV file the system exports, is presented below.



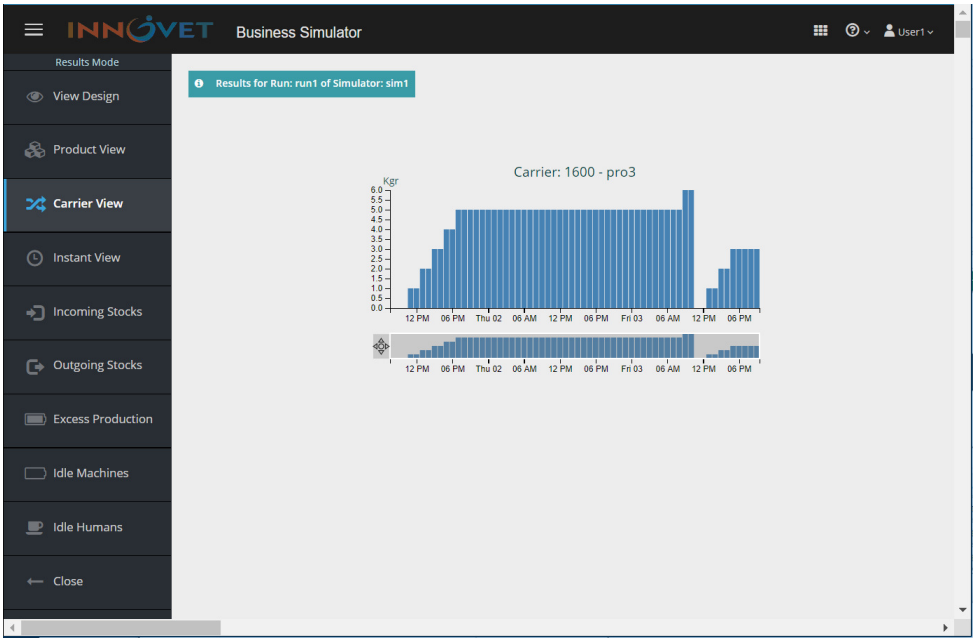
6.3 Carrier View

◊ Click on **Carrier View.**

A window named *Select Carrier* appears, which lists all the Carriers of the Design, in a customized layout. In the window, the user is able to search for any Carrier through the **Search** field.

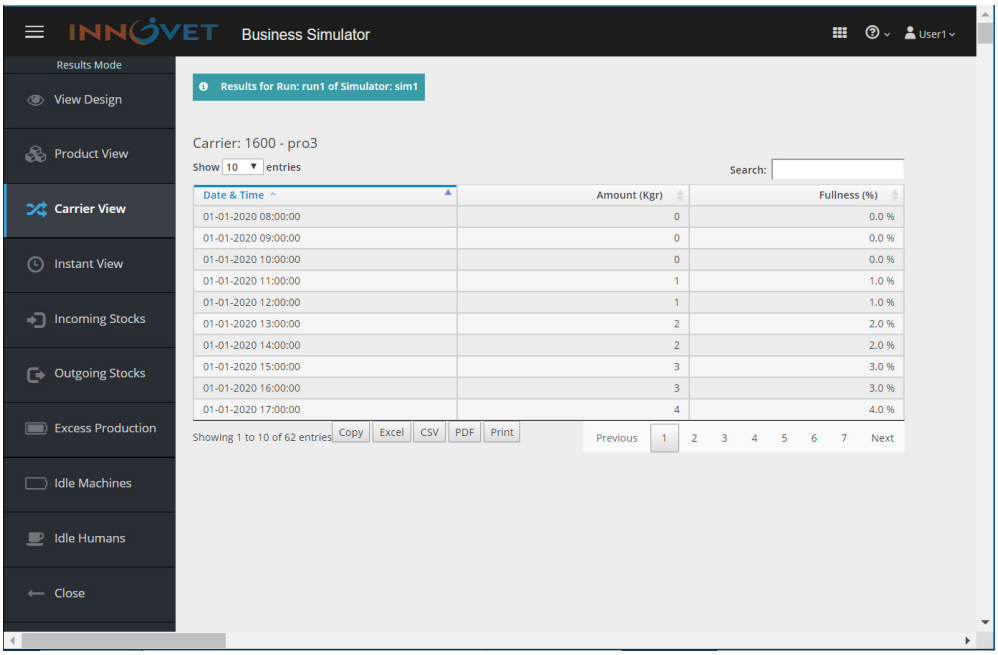


◊ Click on the **Graph** button of the Carrier *1600.*



In the environment of the system, a graphical representation of the product *pro3* quantities transferred by the Carrier *1600*, appears. The vertical axis represents the product quantity and the horizontal axis represents the simulation time. The user is able to select the displayed time span by adjusting accordingly the dynamic frame situated under the graph.

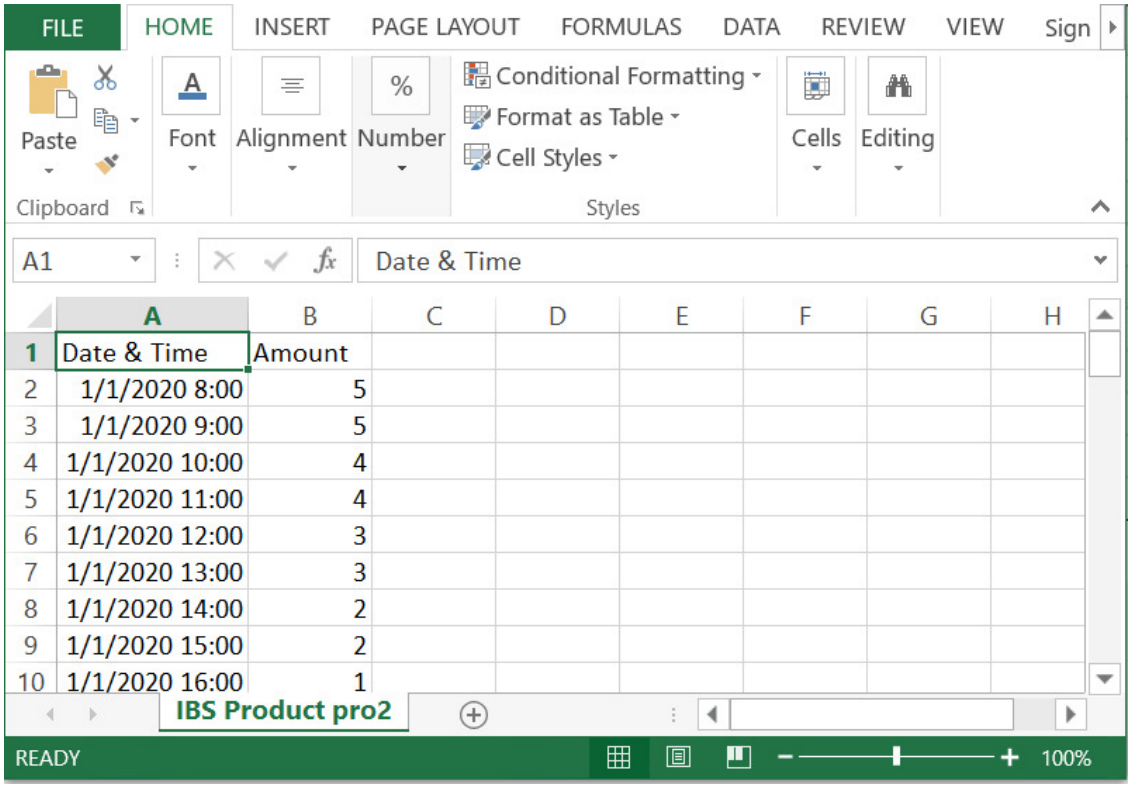
⓪ Click on **Carrier View** and then press the **Table** button of the Carrier *1600*.



In the environment of the system, a thorough ledger of the product *pro3* quantities transferred by the Carrier *1600* and the used capacity of the Carrier, appear in a customized layout.

The user is able to export the preceding ledger of the product *pro3* quantities transferred by the Carrier *1600* in **Excel**, **CSV** and **PDF** format files with the use of the respective buttons. Moreover, the user is able to print the ledger with the **Print** button as well as to copy/paste it with the **Copy** button.

The format of the CSV file the system exports, is presented below.

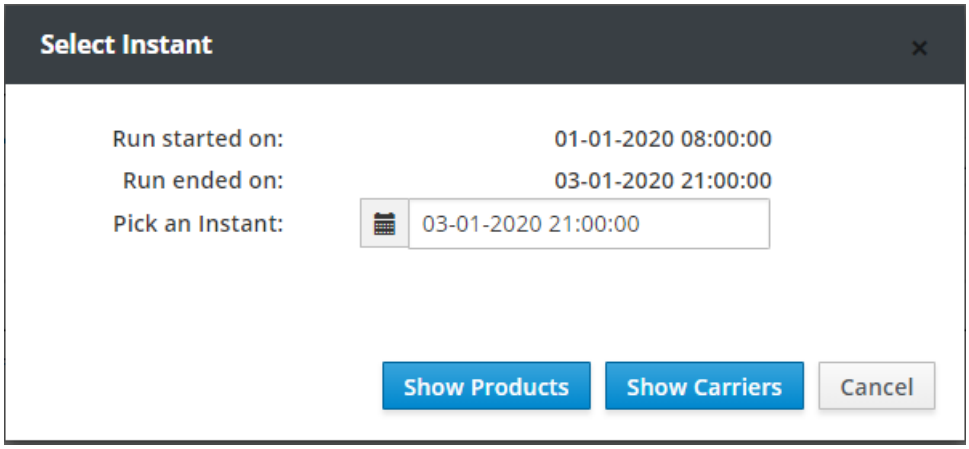


	A	B	C	D	E	F	G	H
1	Date & Time	Amount						
2	1/1/2020 8:00	5						
3	1/1/2020 9:00	5						
4	1/1/2020 10:00	4						
5	1/1/2020 11:00	4						
6	1/1/2020 12:00	3						
7	1/1/2020 13:00	3						
8	1/1/2020 14:00	2						
9	1/1/2020 15:00	2						
10	1/1/2020 16:00	1						

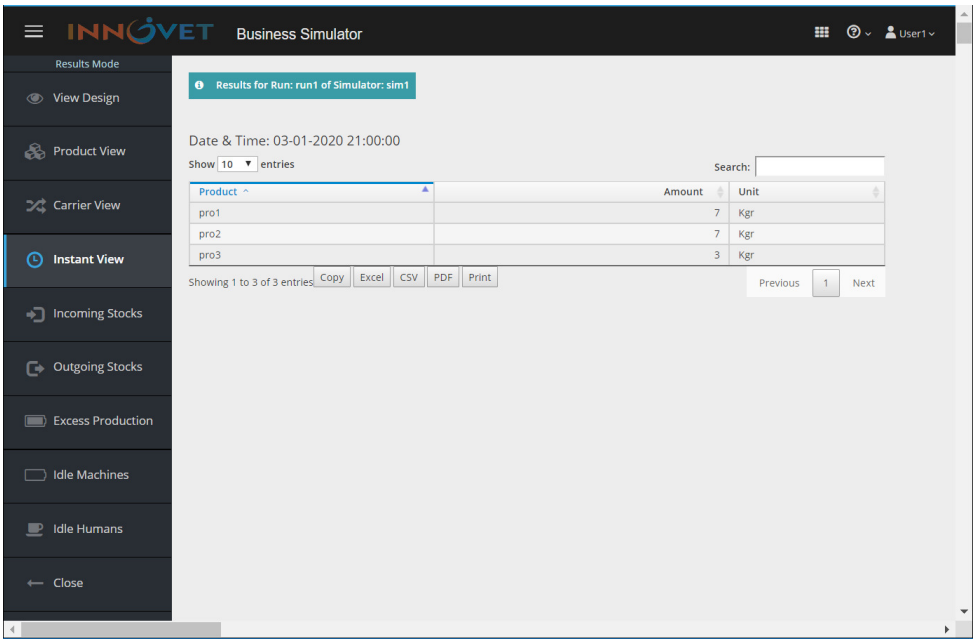
6.4 Instant View

⊙ Click on **Instant View.**

A window named *Select Instant* appears, in which the user is able to view the raw materials/products quantities and the quantities transferred by the Carriers of the Design at a selected point of the simulation time.



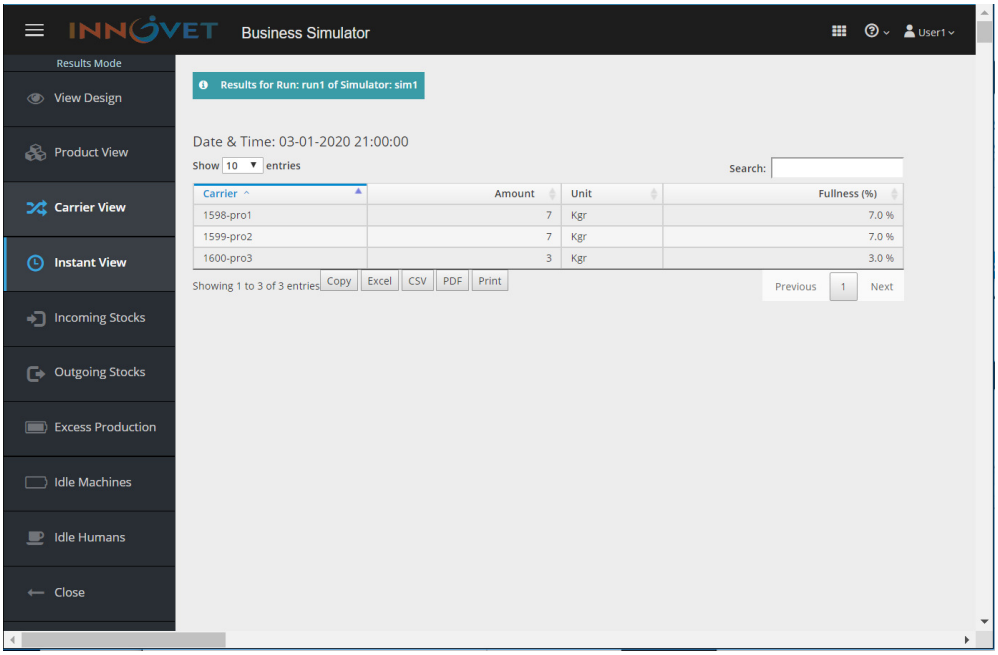
◎ Select date 03-01-2020 and time 21:00:00 and press the **Show Products** button.



In the environment of the system, the quantities of the products appear at the selected point of the simulation time, in a customized layout.

The user is able to export the data in **Excel**, **CSV** and **PDF** format files with the use of the respective buttons. Moreover, the user is able to print the data with the **Print** button as well as to copy/paste them with the **Copy** button.

◎ Click on **Instant View** and then select the same date and time and press the **Show Carriers** button.



In the environment of the system, the quantities of the products appear at the selected point of the simulation time, in a customized layout.

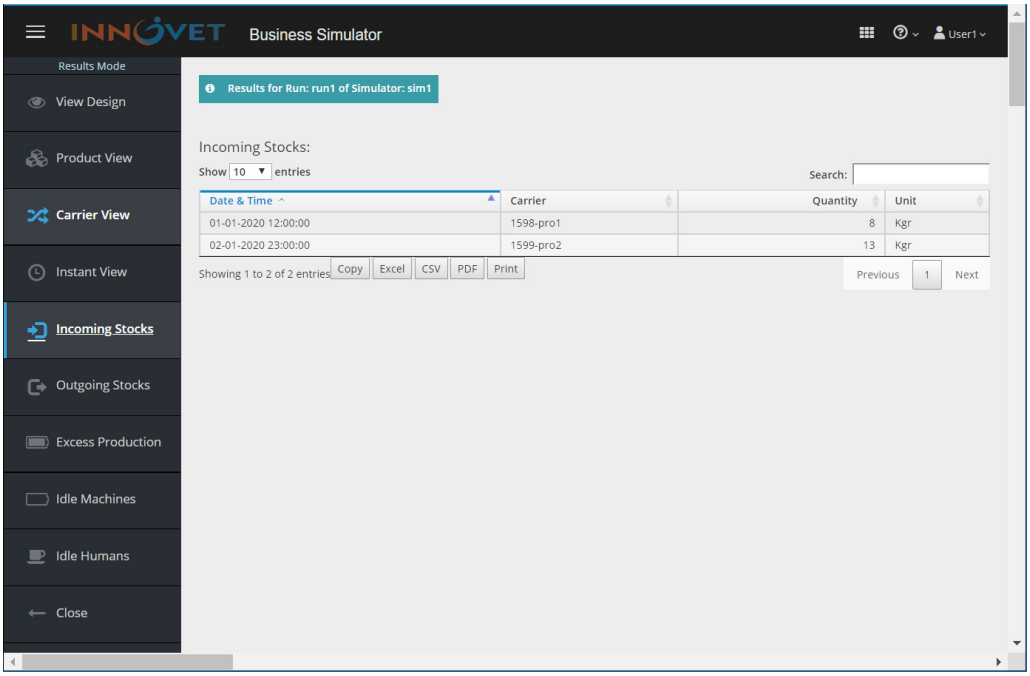
The user is able to export the data in **Excel**, **CSV** and **PDF** format files with the use of the respective buttons. Moreover, the user is able to print the data with the **Print** button as well as to copy/paste them with the **Copy** button.

6.5 Incoming Stocks

⓪ Click on **Incoming Stocks.**

In the environment of the system, a thorough ledger of the purchased inventories during the simulation time, appears in a customized layout.

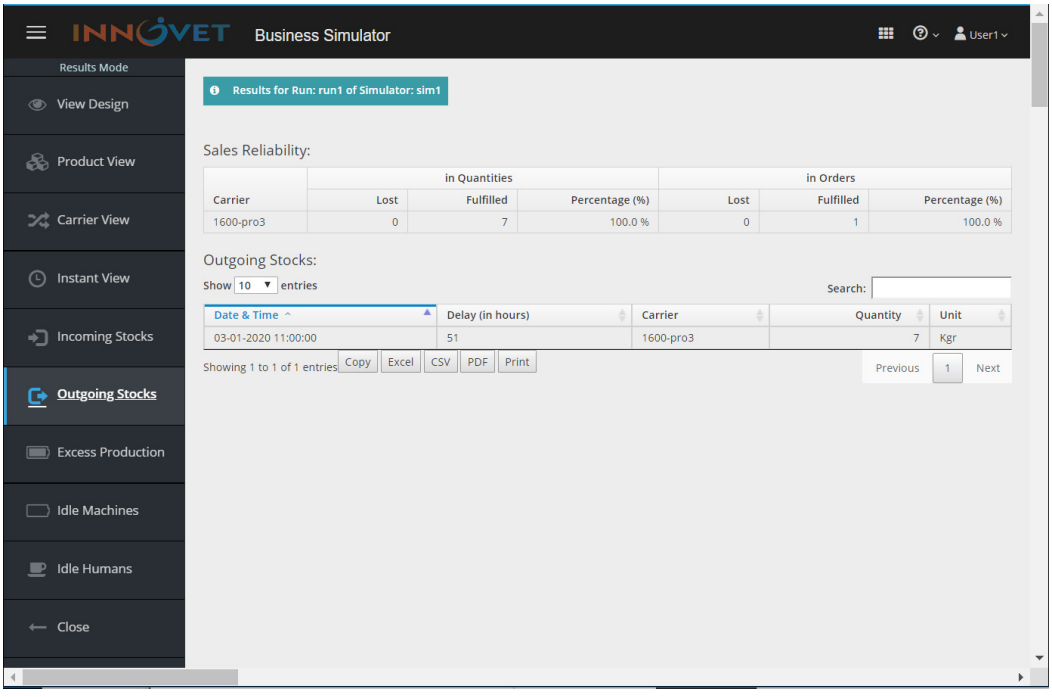
The user is able to export the preceding ledger of the purchased inventories in **Excel**, **CSV** and **PDF** format files with the use of the respective buttons. Moreover, the user is able to print the ledger with the **Print** button as well as to copy/paste it with the **Copy** button.



6.6 Outgoing Stocks

⓪ Click on **Outgoing Stocks.**

In the environment of the system, a thorough ledger of the realized sales during the simulation time, appears in a customized layout.



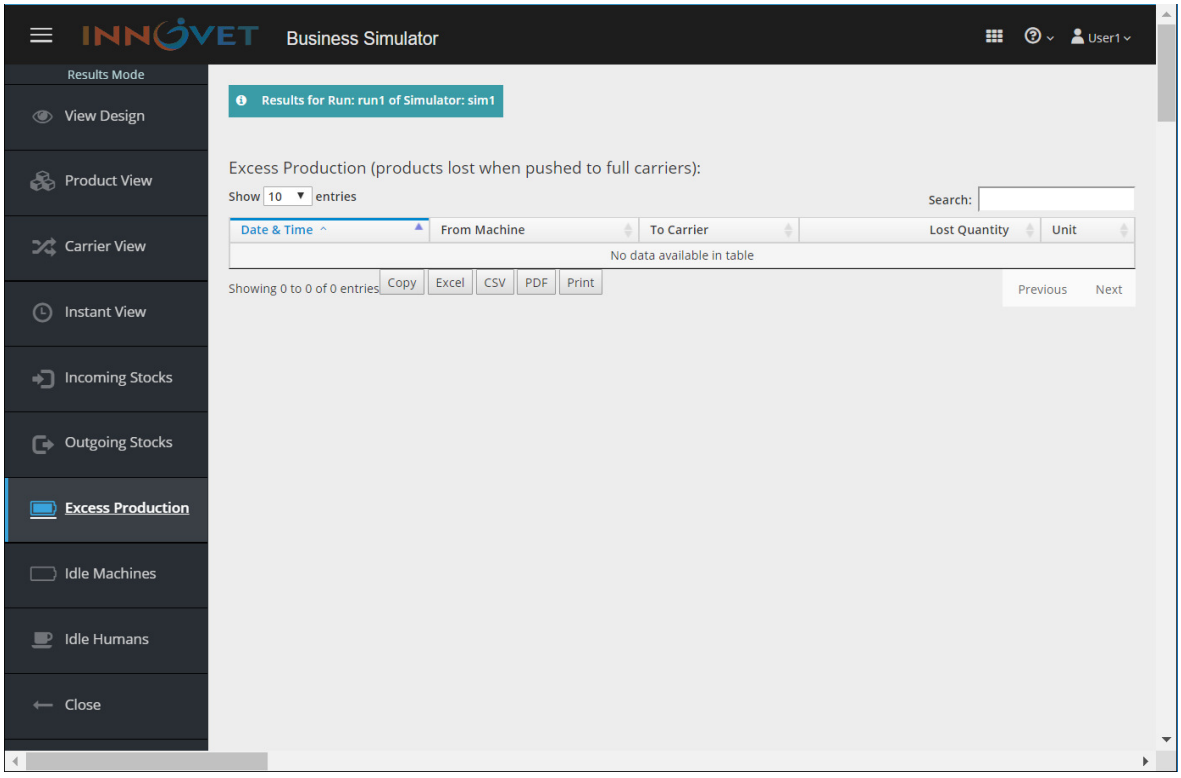
Moreover, a Sales Reliability table appears, providing evidence of efficiency with respect to sales management e.g. percentage of accomplished sales orders.

The user is able to export the preceding ledger of the realized sales in **Excel**, **CSV** and **PDF** format files with the use of the respective buttons. Moreover, the user is able to print the ledger with the **Print** button as well as to copy/paste it with the **Copy** button.

6.7 Excess Production

⓪ Click on **Excess Production.**

In the environment of the system, a thorough ledger of the lost (defective) product quantities due to overload of the Carriers during the simulation time, appears in a customized layout.



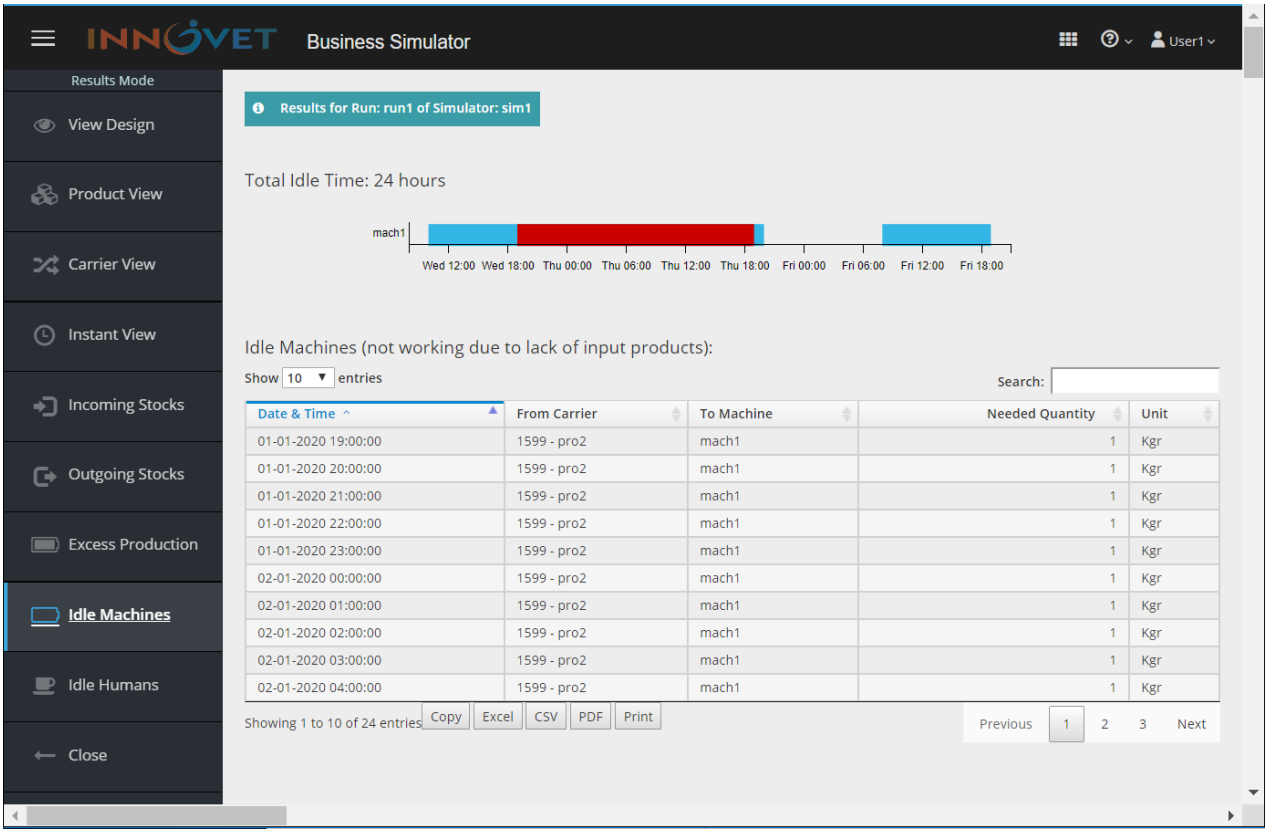
The preceding ledger appears vacant without any entries, indicating there are no product losses.

The user is able to export the preceding thorough ledger of the lost product quantities in **Excel**, **CSV** and **PDF** format files with the use of the respective buttons. Moreover, the user is able to print the ledger with the **Print** button as well as to copy/paste it with the **Copy** button.

6.8 Idle Machines

⓪ Click on **Idle Machines.**

In the environment of the system, a thorough ledger of the idle time of the Machines due to lack of raw materials/products in the input Carriers during the simulation time, appears in a customized layout. A summary chart of labor throughout the period of simulation, is presented in the window. The chart exhibits the idle time of each Machine in red color and the operating time in blue color. The vacant time periods represent the non operating time of the Machines.



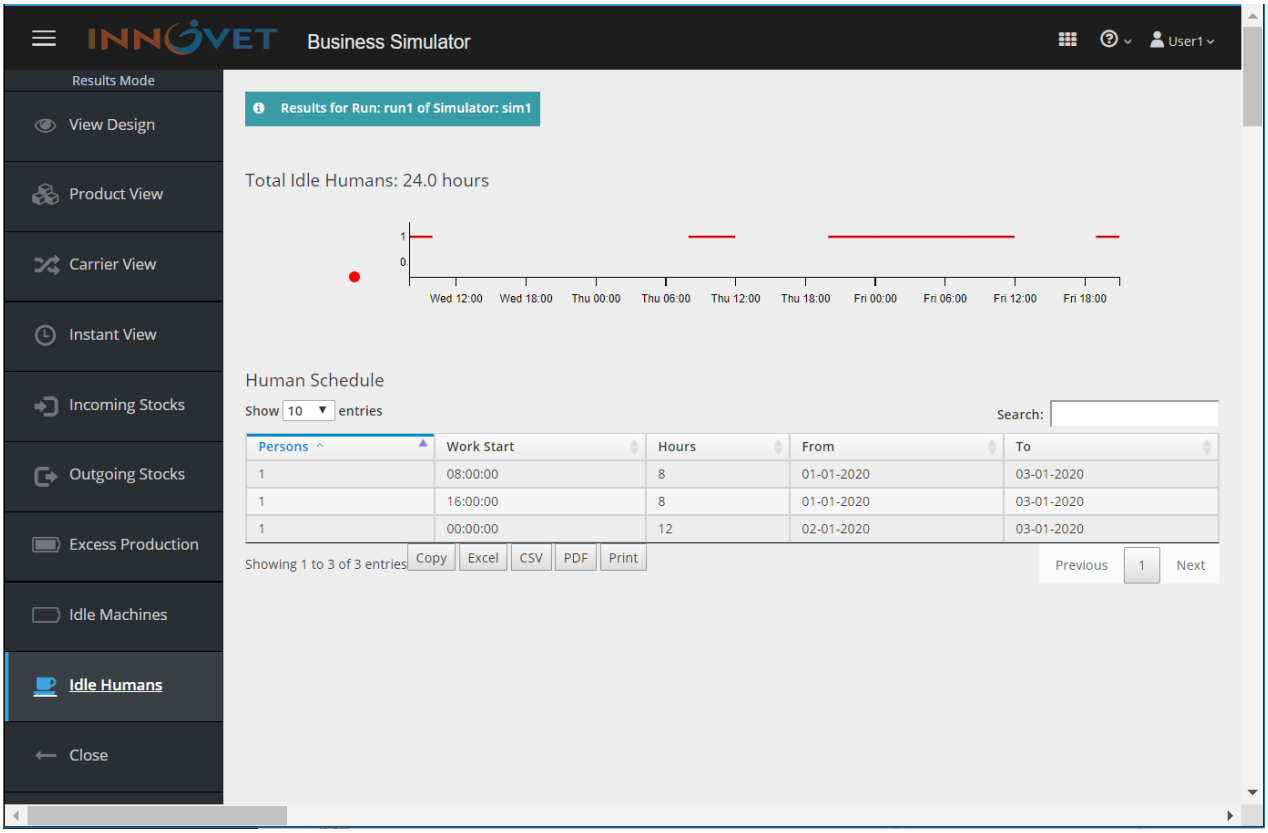
The user is able to export the preceding thorough ledger of the idle time of the Machines in **Excel**, **CSV** and **PDF** format files with the use of the respective buttons. Moreover, the user is able to print the ledger of the idle time of the Machines with the **Print** button as well as to copy/paste it with the **Copy** button.

6.9 Idle Humans

⓪ Click on **Idle Humans.**

In the environment of the system, a thorough ledger of the idle time of the Humans due to non operating Machines during the simulation time, appears in a customized layout. A summary chart of

the amount and the idle time of labor, is presented in red color. Moreover, the total idle time of labor throughout the period of simulation, appears in the field **Total Idle Humans**. For this particular example, the total idle time of labor is 24 hours.



The user is able to export the preceding thorough ledger of the idle time of the Humans in **Excel**, **CSV** and **PDF** format files with the use of the respective buttons. Moreover, the user is able to print the ledger of the idle time of the Humans with the **Print** button as well as to copy/paste it with the **Copy** button.

6.10 View Design

If the user wishes to view the Design of the simulation in the environment of the system, it is feasible by pressing the **View Design** button.

⓪ Click on **View Design.**

7. Case Study: Modeling and Simulation of a Natural Juice Bottling Company

7.1 Overview

A major advantage of the modeling and simulation process of a system is the ability to analyze and study various alternatives to a problem and to evaluate their implementation, without requiring the actual (even pilot) implementation of these alternatives. In addition to modeling, another important stage in the simulation process is the validation of the model, where its behavior is controlled against the real situation it imitates and involves comparison with the theoretically expected or actually observed results.

In the case study that follows, the production process of a bottling plant for natural juices is modeled and simulated. The study includes three stages. The first is the stage of creating a model (Design) that models the production line. The second stage involves the creation of the Simulator, which defines the simulation parameters and its running which calculates the Results. The Results are evaluated on the basis of the theoretical expectations. The third stage involves the presentation, analysis and interpretation of the simulation Results.

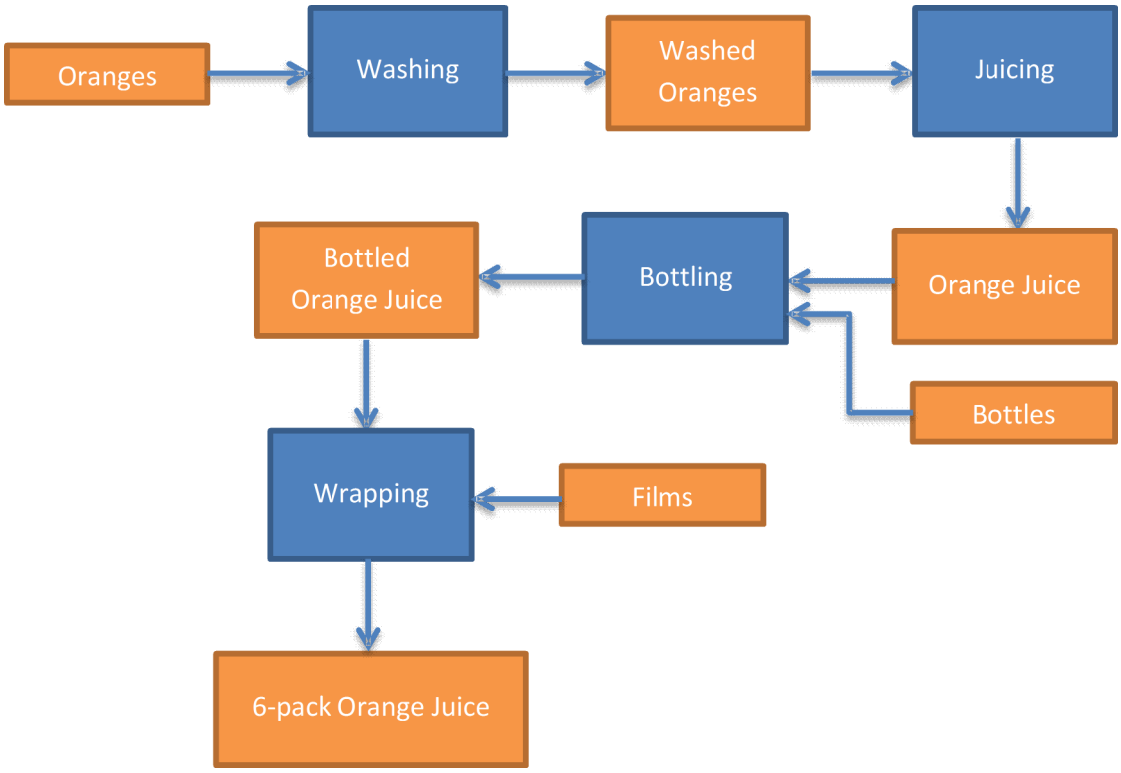
7.2 Create a Model

7.2.1 Operation Structure Analysis of the Company

The steps of the company's production line are as follows. The company purchases oranges which are considered as the raw material. Oranges are washed and then squeezed and their natural juice is created. The juice is then bottled in bottles, which are finally packaged with a special film in six-packs.

From the above description of the company operation in processing steps, it appears that for the operation of the company, the following are required: Oranges as the basic raw material, and Bottles and Films as auxiliary raw materials for packaging. The end product of the company is the six-packs of Orange Juice Bottles. During the processing steps, the following intermediate products are also produced: washed Oranges, Orange Juice, and Orange Juice Bottles. The processing steps of the company's production line are shown in detail in the following Production Process Diagram (Flow Chart).

Note: A model may be as detailed or as abstract as the designer wants. If we wanted to describe the operating model of the particular business with more details, we could include the water used in Washing or even the electricity used by the machines at the various processing stages. Considering that both water and electricity are always available in sufficient quantities, we do not include them in this model. Also, we have not included in the model products that are considered not usable and are discarded such as juicing wastes (peelings etc).



Production Process Diagram

7.2.2 Products

From the analysis so far, the user is able to record the Products / Raw Materials involved in the various stages of the model and the appropriate Unit of Measurement for each of them as shown in the following table.

Products / Raw Materials	Unit of Measurement
Oranges	Kg (kilogram)
Bottles (empty)	pc (piece)
Film	m (meter)
Washed Oranges	Kg (kilogram)
Orange Juice	L (liter)
Bottled Orange Juice	pc (piece)
6-pack Orange Juice	pc (piece)

7.2.3 Carriers

For each product / raw material involved in the model, a procedure of transfer or distribution or simply waiting for a next stage of processing is required. This procedure is described in Design by the term Carrier. Such a procedure can be carried out either from or to a product storage site or in a temporary gathering of products between processing steps.

From the Production Process Diagram the user is able to determine the different types of transfer / distribution / standby processes of the products involved in the model. All of them will be described using Carriers as follows:

Transfer from raw material storage: This Figure describes the transfer from a storage site of basic or auxiliary raw materials as well as the process of distributing them for further processing.

Transfer, temporary gathering and distribution of intermediate products: This Figure describes a temporary intermediate storage site between two processing steps as well as the process of transfer from a previous stage and distribution to a subsequent stage.

Transfer of a final product to a warehouse: This Figure describes the transfer to a final product storage site from a previous processing step.

The characteristics of each Carrier are:

- The product / raw material being transferred.
- The maximum quantity of products that can be served at the point.

The initial condition a Carrier can take is:

- The initial quantity of products that exists at the point.

Note: Carrier transfers as used in this model, is considered to be immediate and without the need for personnel. It essentially describes how the processes are connected to each other, or else the company's internal distribution network for materials.

Then, the Carriers participating in the different stages of this case study model and their features (maximum and initial quantity) are recorded in the table below.

Carrier	Maximum Quantity	Initial Quantity
Oranges	500	500
Bottles	1000	1000
Film	1000	1000
Washed Oranges	100	0
Orange Juice	200	0
Bottled Orange Juice	1000	0
6-pack Orange Juice	200	0

Note: The name of the product / raw material being transferred is used as an indication of each Carrier. The Units of quantities has been defined in the table of products.

7.2.4 Machines

The term Machine corresponds to any form of process that receives raw materials from at least one input and produces products at at least one output. Generally, a Machine is able to have multiple inputs or outputs, depending on the number of different raw materials at the input and the different products in the output respectively.

All inputs and outputs of a Machine are connected to Carriers. It is not allowed to connect two Machines without interfering with a Carrier.

From the Production Process Diagram, it is easy to see that in this example we have the following Machines: Washing, Juicing, Bottling and Wrapping. Washing and Juicing have one input and one output, while Bottling and Wrapping have two inputs and one output.

The characteristics of each Machine are:

- Name (e.g. Washing).
- Number of inputs.
- Number of outputs.
- Minimum number of people required for operation.
- The time interval between two consecutive imports of products to be processed (common to all inputs).
- For each input
    - The quantity of Products imported at an input time (different for each input).
- For each output
    - The time interval that processing takes place, from the time the raw material enters the Machine, until the output of the products at each output (different for each output).
    - The quantity of Products produced at each output when the above time interval is completed (different for each output).

The initial state of the Machine is:

- The initial processing state for the production of each product (usually takes a zero value but can be set differently to cover the case a Machine has started working before the start time of the simulation).

Note: In special cases, products may not be modified within a Machine. For example, a long-term storage can be modeled as a Machine, as it has the following features: time interval between consecutive imports, input quantities, output time intervals, output quantities, and required human resources. Also, a material transfer that requires a considerable amount of time and human resources can be modeled as a Machine.

We then assume that the Processes taking place at the various stages of the case study model are implemented with appropriate Machines whose characteristics are presented in the following table.

Process	Inputs	Outputs	Human Resources	Input Time Interval	Input Quantity	Output Time Interval	Output Quantity
Washing	1	1	0.2	1 min			
	Oranges				10		
		Washed Oranges				1 min	10
Juicing	1	1	0.3	5 mins			
	Washed Oranges				3		
		Orange Juice				3 mins	1
Bottling	2	1	0.3	2 mins			
	Orange Juice				10		
	Bottles				10		
		Bottled Orange Juice				2 mins	10
Wrapping	2	1	0.2	1 min			
	Bottled Orange Juice				60		
	Film				5		
		6-pack Orange Juice				1 min	10

During the first Process (Washing), we assume that a washing machine is used which can wash 10 kg of oranges in 1 minute and is immediately ready to take the next batch.

The second Process is Juicing. Here we assume that the machine at our disposal can process 3 kg of oranges per batch and it takes 3 minutes to produce 1 liter of orange juice. It takes another 2 minutes to discard the wastes of the oranges, so we conclude that it can take the next batch every 5 minutes.

The third Process is Bottling, in which we assume that the machine can bottle every 2 minutes, 10 liters of juice in 10 bottles respectively.

Finally, the fourth Process Wraps within a minute, 10 six-packs of bottles, using 60 bottles and 5 meters of film.

Assuming that all Machines are initially empty, we consider zero the initial state condition of all the above processes.

7.2.5. Model Design in Innovet Business Simulator

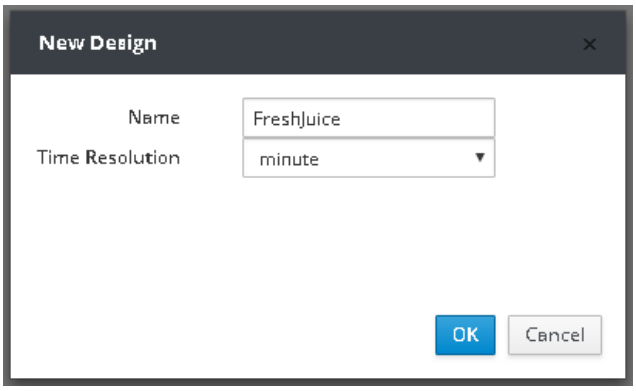
7.2.5.1. Create a New Design

From the INNOVET Business Simulator home page, select Design Mode. Then we start creating a new Design by clicking the New button on the left menu. In the window that appears, we need to enter values for two parameters: Name and Time Resolution.

The Name parameter refers to the name we will give to the new Design and it is not allowed to be the same as another name we use. We select and type "FreshJuice".

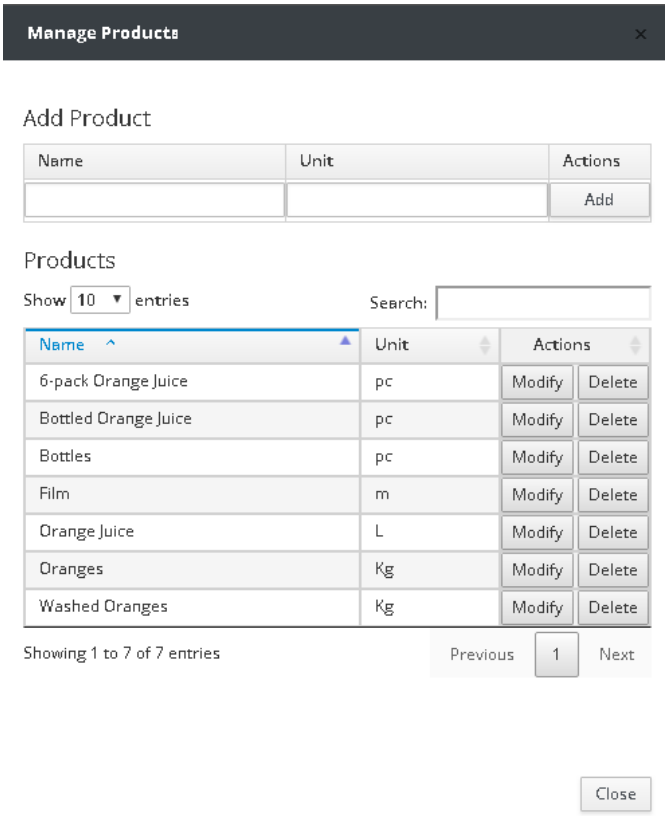
The Time Resolution parameter is particularly important as it is related to the time analysis of the simulation that will be applied to the model that will be created. The possible choices are second, minute, hour, day and week. The right choice is usually determined by the Process parameters and the degree of details that we want the simulation to give. A simulation per second in processes that are evolving on a day level will be very time consuming and the study of the results will be tedious because it will repeat thousands of identical values. Typically, the time intervals of the Process characteristics give a first indication of the Time Resolution to be used. The selection can then be modified but it is directly related to the Process characteristics, so any change in Time Resolution must be accompanied by appropriate adaptation of the characteristics of the Machines.

In this case study, all of the time intervals in the Processes are given in minutes, so, as shown in the following figure, we select as Time the "minute" option. If in a Process the time intervals are set in other time units smaller (e.g. seconds) or higher (e.g. hours) they should be converted to the selected time unit by modifying accordingly the corresponding quantities. By clicking the OK button the new Design is created.



7.2.5.2. Inserting Products into Design

Products that should be inserted into Design are those that have been identified as being involved in the production process during the operation analysis of the company and are listed in the Product Table along with their characteristics. By pressing the button the Manage Products window is displayed, where we type Name and Unit for each product and click the Add button. At the end, we must have inserted all the products as shown in the following figure:

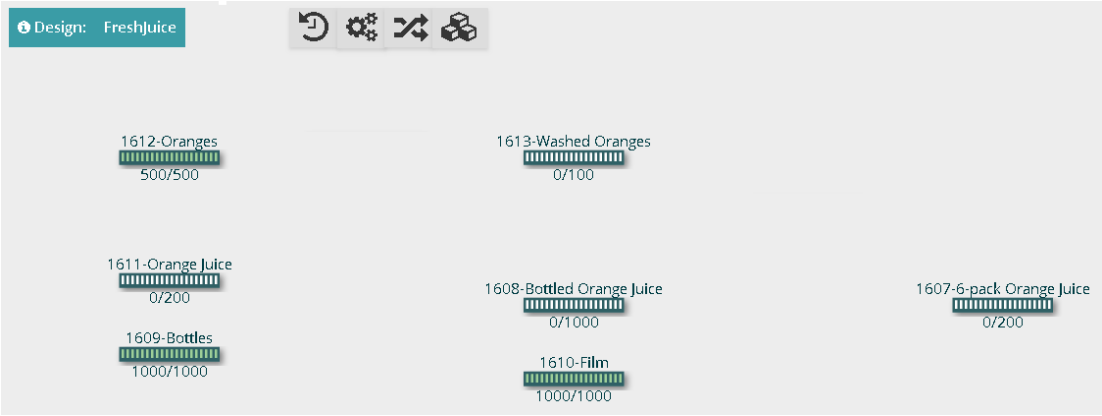


7.2.5.3. Inserting Carriers into Design

The Carriers that should be inserted into Design are those that have been identified to be involved in the production process during the operation analysis of the company and are listed in the Carriers Table along with their characteristics. By clicking on the button the Insert Carrier window is displayed, where we select the Product to carry from a list, the Initial Amount, the Max Amount, and a Line Color that will be used as the color of the Carriers connection lines on the Design drawing.

After completing the process of inserting all Carriers into Design, with the appropriate values for their characteristics and initial conditions, the Design as it should have been drawn is shown in the following figure:

Note: The numbers appearing in front of the name of each Product and characterizing each Carrier may be different.

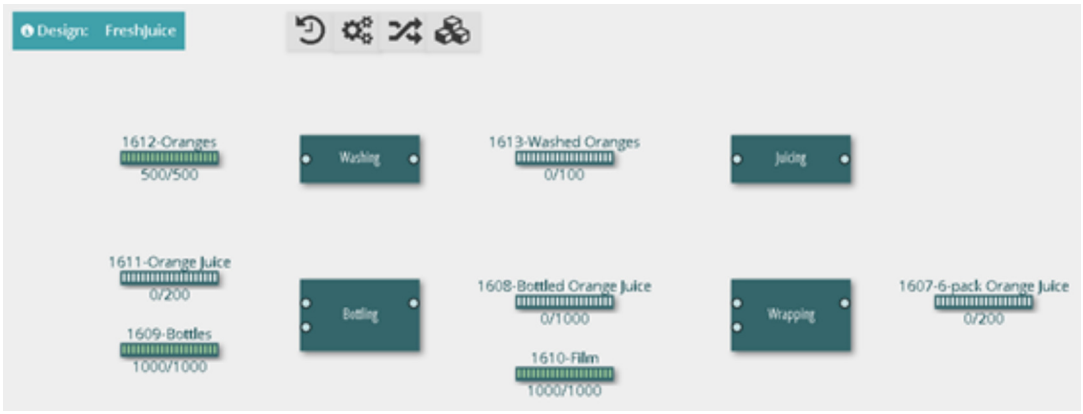


7.2.5.4. Inserting Machines into Design

Each Process is represented in Design with a Machine. The Machines that should be inserted into Design are those that have been identified as being involved in the production process during the operation analysis of the company and are recorded in the Process Table along with their characteristics. First we will insert the Machines together with their characteristics and then the characteristics of their inputs and outputs as follows:

a) By pressing the button the Insert Machine window is displayed, where we select a Machine Name that characterizes the process that it implements, the Machine Inputs number, the Machine Outputs number, the time interval between two inputs (Next Input Time) and the Required Humans for the operation of the Machine.

After completing the process of inserting all Machines into the Design with the appropriate values for their characteristics, the Design as it should have been drawn is shown in the following figure:

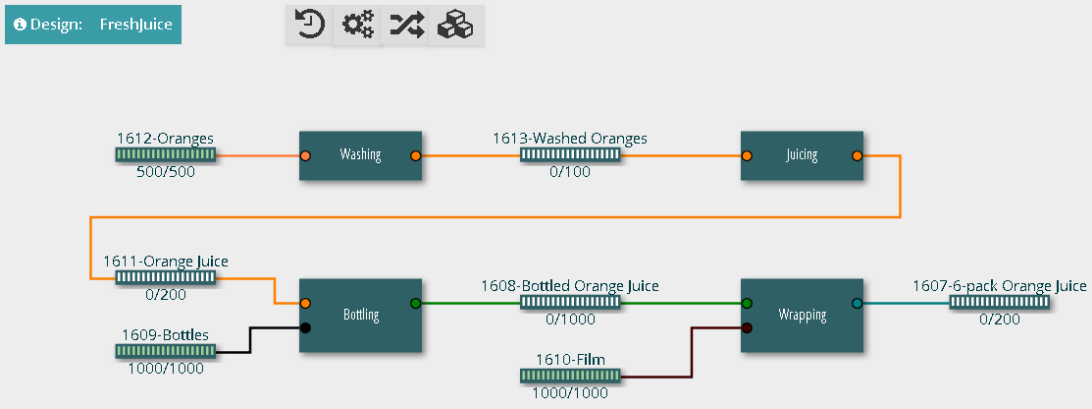


b) Next, the characteristics of the inputs and outputs of each Machine must be determined and the connections between the Machines and the Carriers should be made. The circles on the left side of each Machine are connections for inputs, while those on the right side are output connections.

By right-clicking on an input connection the Update Machine Pad window is shown, where it should be selected from the list of Connectors with which Carrier the specific input will be connected. In this way, it is specified what kind of product the Machine will enter in that input. Also, the input characteristic for Amount to Input is determined. For this case study, the proper values and connections have been recorded in the Process Table.

Similarly, by right-clicking on an input connection the Update Machine Pad window is shown, where it should be selected from the list of Connectors with which Carrier the specific output will be connected. In this way, it is specified what kind of product the Machine will export in that output. Also, the output characteristics for Production Time, Production Amount, and initial state of the Machine is determined. For this case study, the proper values and connections have been recorded in the Process Table (we also consider that the initial state is zero, which means that all machines are initially empty).

After completing the process of defining the input and output connections and their characteristics for all Machines, the Design as it should have been drawn is shown in the following figure:



7.2.5.5. Save Version of a Design

During the creation of the model in Design Mode the changes are stored immediately. When finished, the design must be Saved as a Version so that it can then be used later in a Simulation.

This is done by pressing the Save Version button in the left menu. In the window that appears we need to type a description for this version. We type the text "test1" and press the OK button.

7.3. Create and Run a Simulation

7.3.1. Description and Objectives

The goal of each simulation is to predict the results of a particular process before the process takes place in real. In this case study, we want first to estimate the maximum output of the final product using the specific amount of raw materials. In these simple cases this calculation can also be made theoretically.

In the following, based on the Process Diagram and the data given for this case study, an initial theoretical analysis of the problem is made:

Considering that we have 500 kg of oranges and that the Washing Machine processes 10 kg at a time, it will need to work 50 times to wash all oranges. Each wash takes one minute, so 50 minutes of operation is needed.

The second machine, the Wrapping Machine, processes 3kg of washed oranges each time and produces 1 liter of juice. So, we can calculate that it will need to work 166 times (the integer part of division 500/3), it will use 498 kg (166 × 3) oranges and it will produce 166 liters of juice. Every time of operation takes 5 minutes, so it will take in total 830 minutes of operation (less than 14 hours).

Observing that we have enough bottles we conclude that all liters of juice can be bottled in 166 bottles. But, the Bottling Machine needs at least 10 liters and 10 bottles per batch, so it will work 16 times (the integer part of 166/10), it will process only the 160 liters of juice and will bottle them in 160 bottles. Each batch operation takes 2 minutes, so it will take up to 32 minutes of operation for bottling.

The 160 bottles could create 26 6-packs and 4 bottles of juice will be left over (observing that we have enough packaging film, we could wrap all 6-packs). But, the Wrapping Machine can process the bottles in batches of 60 pieces. So it will only work twice, pack 120 bottles in total and will create 20 6-packs. Every time of operation takes 1 minute, so it will take only 2 minutes to complete the process.

So, the optimal theoretical result is 20 6-packs of bottles. The process will left over 40 bottles of juice, 6 liters of juice and 2 kg of washed oranges.

This theoretical analysis while correct does not take into account two significant factors: time and space. Problems that can arise in a real situation are:

a) a machine wants to import products into one or more inputs but they do not exist (not yet produced or not purchased) or

b) surplus products are produced by a machine but there is no space to be stored and thus they are destroyed.

For example, in this case study, we see that the space for washed oranges in the Carrier between the Washing and the Juicing Processes as well as the space for juice between the Juicing and the Bottling Processes are relatively small compared to the others and is likely to create a problem. Also, the Juicing Machine is relatively slow compared to the others while the Wrapping Machine is very fast.

Whether these data would cause problems in the operation of the production line can not be easily estimated with a theoretical analysis but can be immediately highlighted when performing a simulation. The simulation also identifies the causes of the problems and can help in finding ways to correct them, by defining an appropriate design of machinery and human resources operation and by executing purchases and sales of products at the right times.

7.3.2. Simulation

7.3.2.1. Create a New Simulator

From the Innovet Business Simulator home page, select Simulation Mode. Alternatively, if we are in another Mode of Operation, we use the button at the top right of the page to go to Simulation Mode. Then we start creating a new Simulator by pressing the New button on the left menu. In the window that appears, we need to enter a value for the Name parameter and choose the Version of the Design that the Simulator will use.

The Name parameter refers to the name we give to the new Simulator and should not be the same as any other name we use in Simulators. We choose to name the Simulator as "FreshJuice_sim". Then we find the Design “FreshJuice” in the list, click to display its Versions and select Version “test1”, which is the version we saved in the previous section.

7.3.2.2. Defining the Simulator Parameters

Defining the Simulator parameters is done by using the menu . The parameters that should be defined are:

- Simulation Time: the start and the end time of the simulation,
- Machine Schedule: the time schedule of machines operation,
- Human Schedule: the time schedule of human resources,
- Purchase Orders: the orders for purchasing products (usually raw materials) and
- Sales Orders: the orders for selling products (usually final products).

Defining Simulation Time:

According to the preceding analysis, we need approximately 14 hours of operation for the Juicing Process, and because this process is the most time-consuming, it is indicative of the time that the simulation should last. So let's just choose 16 hours of simulation. To determine the Simulation Time we click on the corresponding button and in the window that appears we choose Time Start: 28-01-2019 06:00:00 and Time End: 28-01-2019 22:00:00. In the same window we see that the selected Time Step is the minute as defined in Design. Overall, the simulation will consist of 16 × 60 = 960 samples (minutes).

Defining Machine Schedule:

a) Washing. The Washing Process takes Oranges as an input and exports Washed Oranges. Because there is not enough space in the output Carrier to manage the entire amount, you should be careful not to overload the Carrier with the Washed Oranges. For this reason we initially put the machine to work for 10 minutes so that based on its characteristics it will wash 100 Kg of Oranges and fill the Washed Oranges Carrier.

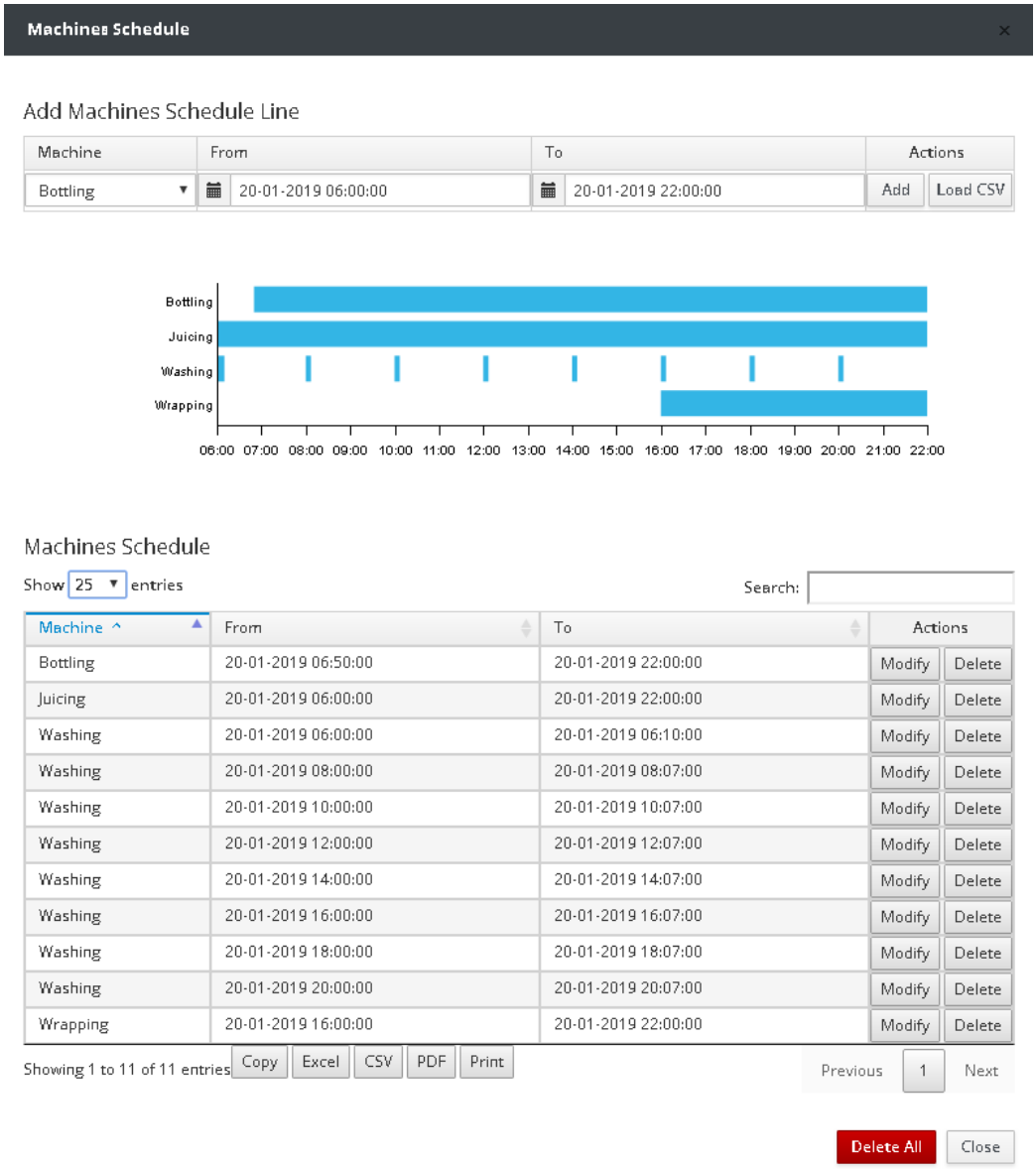
This Carrier empties at the pace of the Juicing Machine, which is 3 Kg per 5 minutes, so in 120 minutes (2 hours) it will use 72 Kg of Washed Oranges. So, we ca^{n} state that the Washing Machine after the first activation that fills the Carrier will work every 2 hours for 7 minutes in order to refill the Carrier - in a satisfactory pace - with Washed Oranges needed to be imported into the Juicing Machine.

b) Juicing. This Process is the slowest of all, as studied in the previous section. So, we set the machine to operate continuously throughout the simulation.

c) Bottling. This Process may delay its start because it requires at least 10 liters of juice to be produced. This will definitely be done after the 50th minute since Juicing Machine produces 1 liter every 5 minutes. So, we define that the Bottling Machine will operate from the 50th minute until the end of the simulation.

d) Wrapping. This process may delay its start because it requires at least 60 bottles of juice to be produced. This will definitely happen after the 300th minute since the Juicing Machine produces 1 liter every 5 minutes. Because the Wrapping Machine is too fast compared to the others and the Carrier at its input is large enough and it is not in danger of overflowing, we can choose to wait two batches of sixty bottles of juice and to specify that the Wrapping Machine will work from the 600th minute ie the 10th hour of simulation until its end.

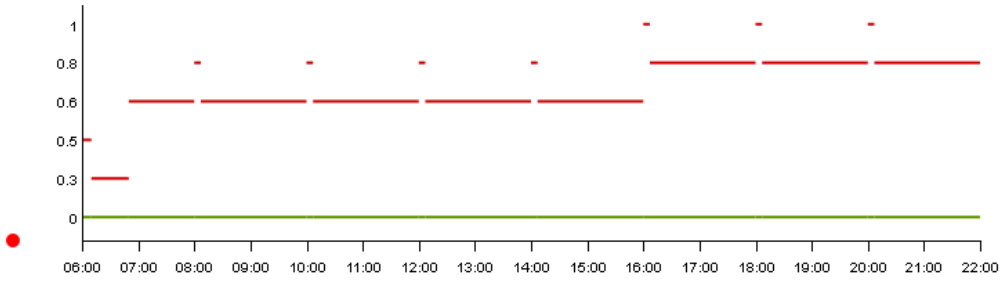
We click on the Machine Schedule button and in the window that appears we add the above entries sequentially to create the machines operation schedule as shown in the following figure:



Defining Human Schedule:

The definition of Human Resource Schedule is very simple for this simulation since all machines require cumulative 1 person staff to operate.

We click on the button that corresponds to the Human Schedule and in the window that appears we see the personnel requirements according to the machine schedule we have set in the previous step and are shown with the red line in the following figure.



We add successively the two records that appear in the next image to meet the personnel requirements for the entire simulation. The green line expresses the working staff and should be higher than the red line so that the simulation can run.

This simulation does not include Purchase Orders or Sales Orders.

7.3.2.3. Run of Simulator

After defining the parameters, the Simulator may run by pressing the Run button in the left menu. The "Please Wait" message appears in the pop-up window as long as the simulation is running. Once the simulation is completed, the message changes to "Simulation Completed".

7.3.2.4. Saving the Results

After completing the simulation, its results must be saved. Saving the Results of a Run is done by pressing the Save Run button in the left menu. In the window that appears, a description indicative of the executed Run should be typed. Type "run1" and press the OK button.

7.4. Analysis and interpretation of the Results

7.4.1 Show and Comment the Results

As has been emphasized at the previous sections, the objective of every simulation is to predict the results of a particular process before the process becomes real. Moreover, the simulation may also indicate shortcomings and redundancies in materials, machine failures, undue delays, redundancy in human resources, and many other details that can not be identified theoretically.

In this case study, we first wanted to estimate what is the maximum possible output of the final product using the specific amount of raw material. The optimal result that was theoretically calculated is 20 6-packs of bottles and a surplus of 40 bottles of juice, 6 liters of juice and 2 kilograms of oranges.

In the following, we will check whether this result has been achieved using the simulation, thus we will evaluate the correctness of the modeling. At the same time, we will identify and comment on problems and ways to improve the production process.

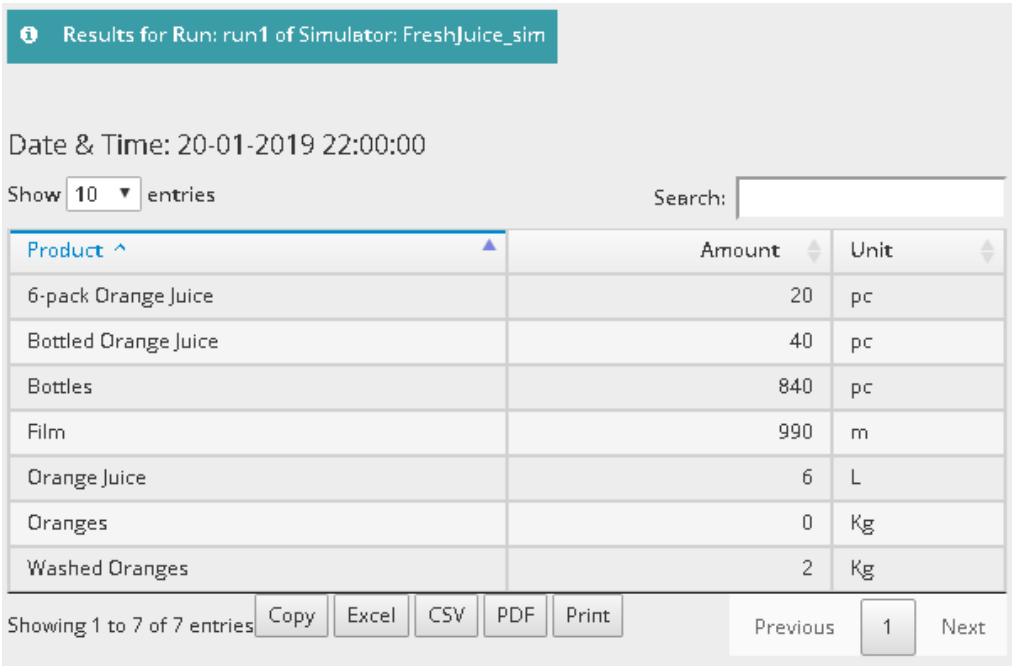
7.4.1.1 Selection of Simulator Run

From the Innovet Business Simulator home page, select Results Mode. Alternatively, if we are in another Mode, we use the button , located at the top right of the page, to go to Results Mode. Then, we select the results of the Run that we want to see by pressing the Select button on the left menu. From the list that appears, select the Simulator "FreshJuice_sim" and the Run "run1".

7.4.1.2 Instant View

Using the left menu, several simulation results can be displayed in both graphical and tabular formats. The "Instant View" option can show us in tabular form, the amount of Products that are in Carriers for a specific time either per Carrier or cumulatively per Product. If we select the end of the simulation as the specific time, we get the final results.

We click on the 'Instant View' button and in the window that appears we check that the value in 'Pick an Instant' is the time of the end of the simulation, ie '20-01-2019 22:00:00'. Then we press the "Show Products" button and the following result is displayed:


Results for Run: run1 of Simulator: FreshJuice_sim

Date & Time: 20-01-2019 22:00:00

Show 10 entries Search:

Product	Amount	Unit
6-pack Orange Juice	20	pc
Bottled Orange Juice	40	pc
Bottles	840	pc
Film	990	m
Orange Juice	6	L
Oranges	0	Kg
Washed Oranges	2	Kg

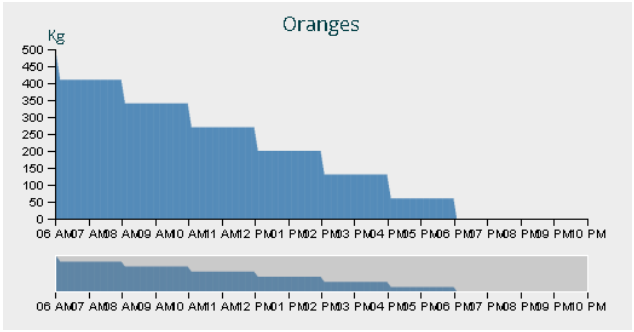
Showing 1 to 7 of 7 entries Copy Excel CSV PDF Print Previous 1 Next

From the simulation result, it is easy to see that the optimal theoretical result has been achieved. 20 6-packs of orange juice bottles have been produced, while 40 bottles of juice, 6 liters of non-bottled orange juice and 2 kilograms of washed oranges have been remained in the intermediate Carriers.

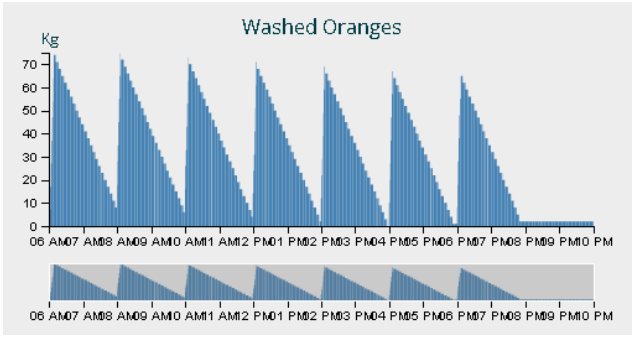
We also observe that the quantities of auxiliary raw materials have not been significantly consumed since 840 empty bottles have remain (1000-840 = 160 bottles have been used) and 990 meter film remain (1000-990 = 10 meters film have been used). It is thus concluded that the quantities of auxiliary raw materials are too large for the specific quantity of the basic raw material.

7.4.1.3 Product View

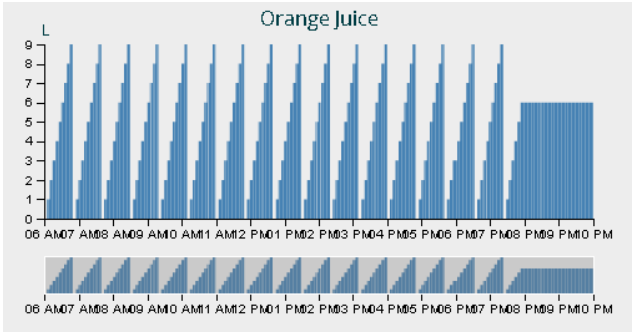
It is interesting to see the way of change of Products quantities throughout the simulation time. The following figures show the changes in the quantities of products, especially for the raw material (Oranges), the intermediate products (Washed Oranges, Orange Juice, Bottled Orange Juice) and the final product (6-pack Orange Juice).



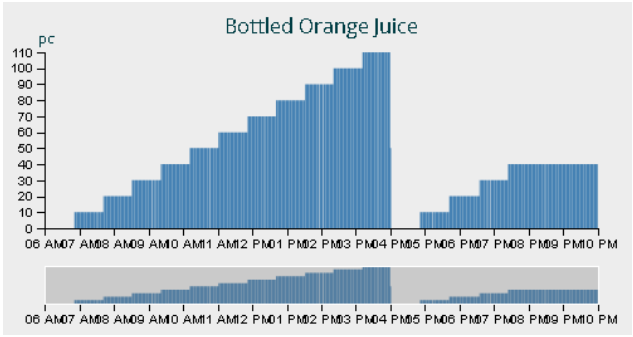
(a)



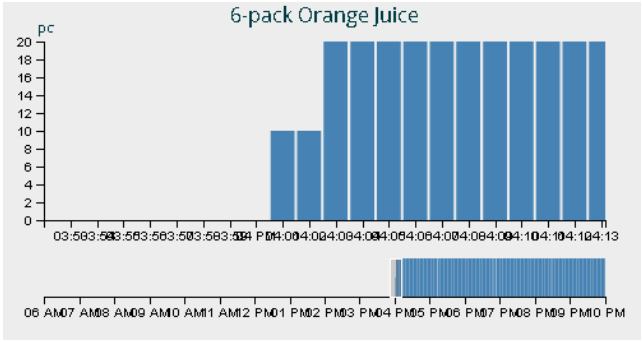
(b)



(c)



(d)



(e)

Figure (a) shows the change in the amount of Oranges (raw material). From the initial quantity of 500 Kg gradually decreases to zero. The decrease occurs when the Washing Machine operates, ie at the beginning of the simulation for 10 minutes and then every 2 hours for 7 minutes.

Figure (b) shows the change in the amount of Washed Oranges (intermediate product). The amount of this product increases when the washing machine operates and decreases at a slower rate when the Juicing Machine operates.

Figure (c) shows the change in the amount of Orange Juice (intermediate product). The amount of this product increases slowly when the Juicing Machine operates and decreases at a very fast rate when the Bottling Machine operates. This is done when 10 liters of juice is collected in Carrier (this value is not shown in the figure because this quantity is imported directly into the Bottling Machine).

Figure (d) shows the change in the amount of Bottled Orange Juice (intermediate product). The amount of this product gradually increases each time the Bottling Machine operates and decreases when the Wrapping Machine operates. This is done only once when 120 bottles are collected in Carrier (this value is not shown in the figure because this quantity is imported directly into the Wrapping Machine).

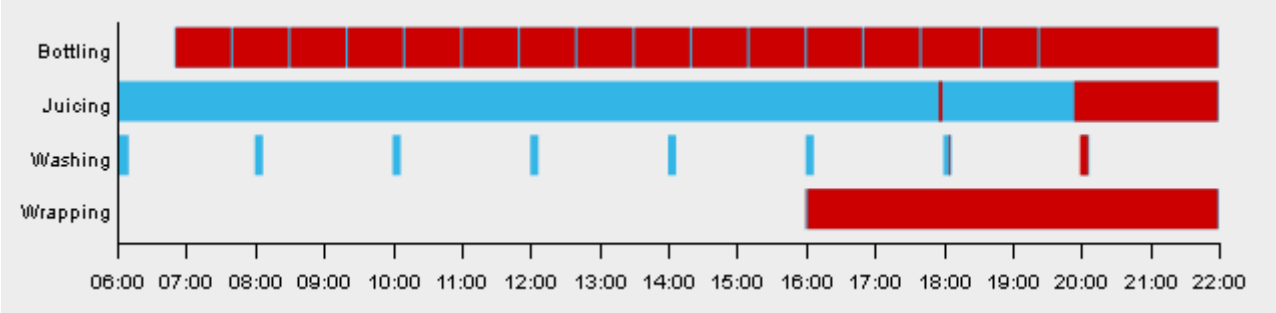
Finally, figure (e) shows the critical time of the simulation when the amount of the final product, 6-pack Orange Juice changes. The amount of this product increases when the Wrapping Machine is in operation. The final result is 20 6-packs of orange juice bottles.

More analytical results (exact values for quantities and time) are offered in the selection of presenting results in table format.

7.4.1.4 Idle Machines

Another also very useful result for the future improvement of production line operation is the identification of time intervals when machines are idle, ie while they are programmed to operate, but their operation is not feasible due to lack of required products at their inputs.

In this simulation the result is shown in the following figure:



This figure presents: a) in blue color the time intervals at which the machines were programmed to operate and worked normally; b) in red color the time intervals when the machines were programmed to operate but did not work due to shortcomings of the necessary quantities of products at one or more of their inputs.

From the figure we can see that the Washing Machine has operated smoothly until the amount of the basic raw material (Oranges) has been exhausted.

The Juicing Machine worked almost seamlessly until the raw materials were exhausted. Exclude the red spot at about 18:00 when Washed Oranges appear to be exhausted for a short time.

Although Bottling Machine was scheduled to operate continuously for the time from the 50th minute onwards, most of the time it did not work (red area) due to lack of an input product.

Finally, the Wrapping Machine operates for 2 minutes at the beginning of its programmed operation, completes the wrapping of 120 bottles and then does not operate again (red area) until the end of the simulation, due to lack of the necessary pieces of the input product.

From the above, it is understood that at least the last two machines could have been better scheduled so as not to expect input for such a long time.

7.4.1.5 Issues and Future Extensions

This simulation can be extended in time and enriched with purchases of raw materials or sales of final products. The system can be controlled at its limits and the maximum ability to satisfy sales orders for specific periods of time could be estimated. In addition, better scheduling of machine operation can be made to reduce idle time and also better job scheduling for exploiting company's human resources.

A number of options present the results of simulations in various forms so that conclusions can easily be drawn.

In addition, it is possible to modify the model. From the foregoing analysis and the simulation results, it is easily understood that an additional Juicing Machine would improve the performance of the production process. But at what rate? A new version of Design with two parallel Juicing Machines, possibly with different operating characteristics, is a challenge to study.

7.5. Conclusions

In the case study developed in the previous sections, a model of a production process was created and its operation was simulated, based on specific characteristics and initial conditions. The model was evaluated by comparing the results of the simulation with the theoretical expectations.

This makes it easy to see that simulations give the possibility to analyze and study various alternatives to a problem. A simulation can essentially replace the experimental approach and addresses the potential problem of being unable to access a system. It leads to a better understanding of a system, it is a prediction tool but can also be used as a training mechanism.

8. Appendices

8.1 First Educational Paradigm

The first educational paradigm involves a small water bottling company with one production line. The final product of the production process is 1 liter bottles of water, wrapped in packages of 6 items. The production line is quite simple and it entails the following features:

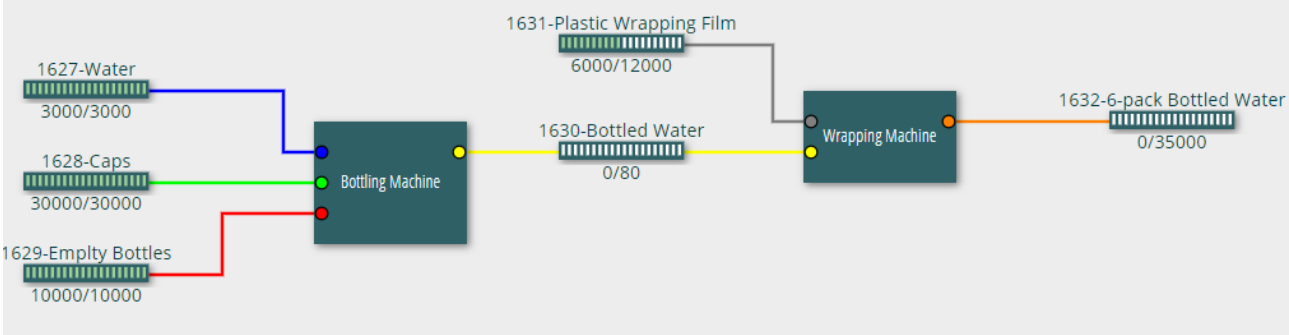
- The storage container of 3000 liters capacity, of refined water ready for bottling.
- The filling and sealing machine (bottling) of the bottles.
- The wrapping machine in packages of 6 bottles.
- The warehouse for the storage of empty bottles, caps, plastic wrapping film.
- The warehouse of the final products.

Moreover, there is a requirement of refilling the container of refined water as well as to sell specific product quantities during the simulation time.

Specifications Table

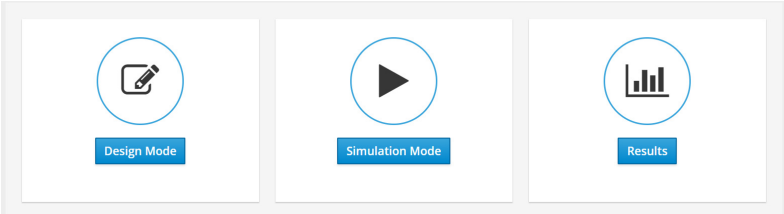
Carriers Max Capacities	**Machines Specifications**
Water: 3000 liters **Empty Bottles:**10000 units **Caps:** 30000 units **Plastic Wrapping Film:** 12000 meters **Finished Products:** 35000 units of 6-pack Bottled Water **Bottled Water:** 80 bottles.	**Bottling Machine**: Inputs: 3 30 empty bottles/batch 30 liters of water/batch 30 caps Outputs: 1 30 units of bottled water/batch Next Input Time: 1 minute Process Time 1 minute Required Human: 1 **Wrapping Machine:** Inputs: 2 30 units of bottled water/batch 6 meters plastic wrapping film/batch Outputs: 1 5 units/batch Next Input Time: 1 minute Processing Time: 2 minutes Required Humans: 0

The following figure exhibits the structure of the referred production line.

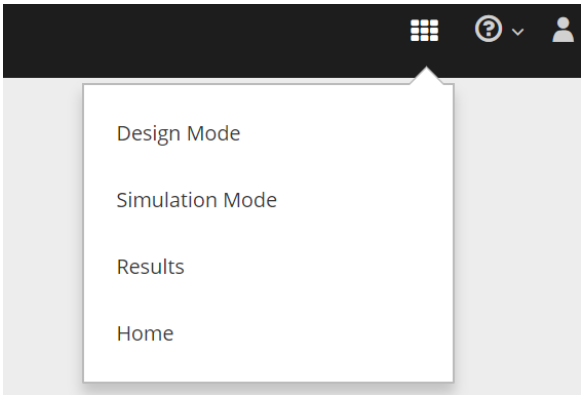


Design of the Bottling Water Production Line in the Business Simulator

⊙ Select **Design mode** from the starting menu or from the relative icon at the top right corner in the work environment of the Business Simulator.

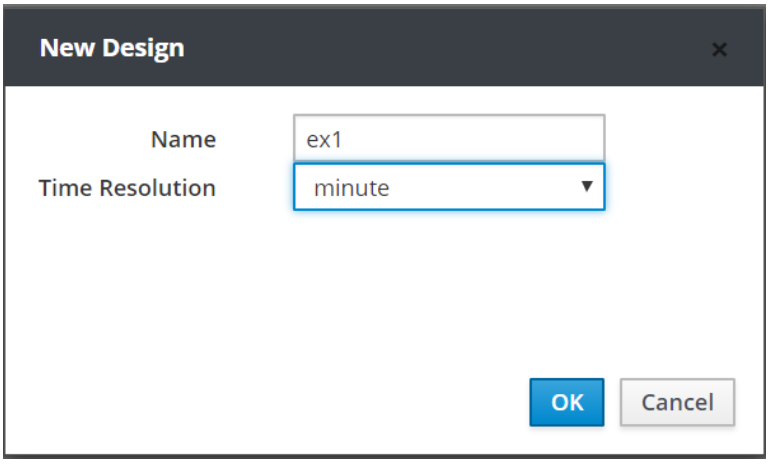


or



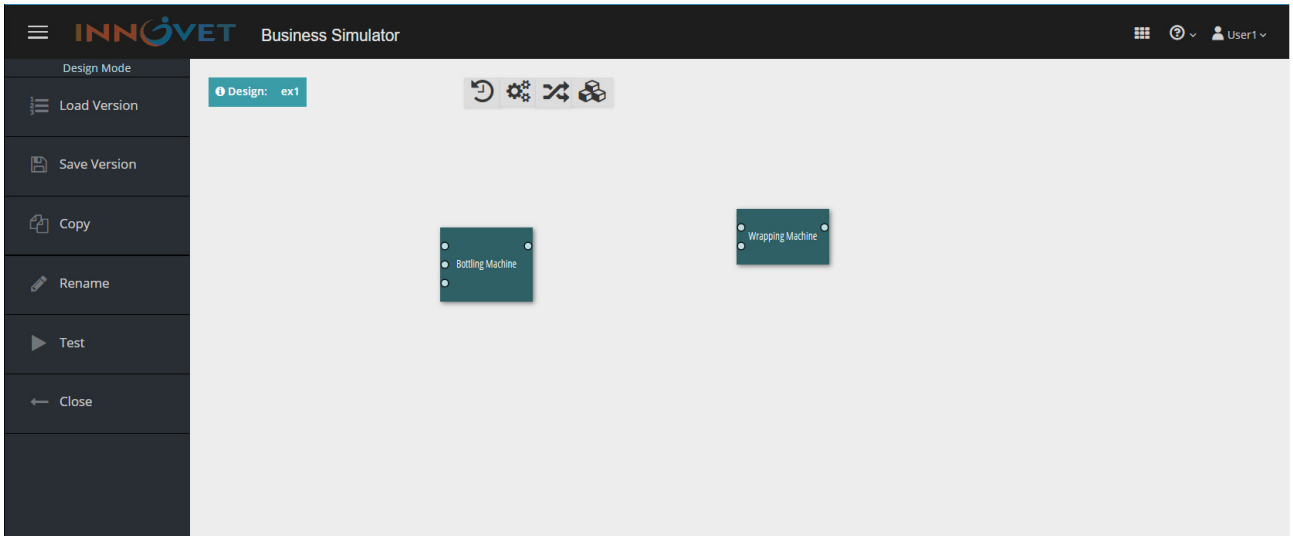
⊙ Press the **New** button from the main menu of the Design Mode.

⊙ Set **Name** *ex1* and **Time Resolution** *minute* and press **Ok**.

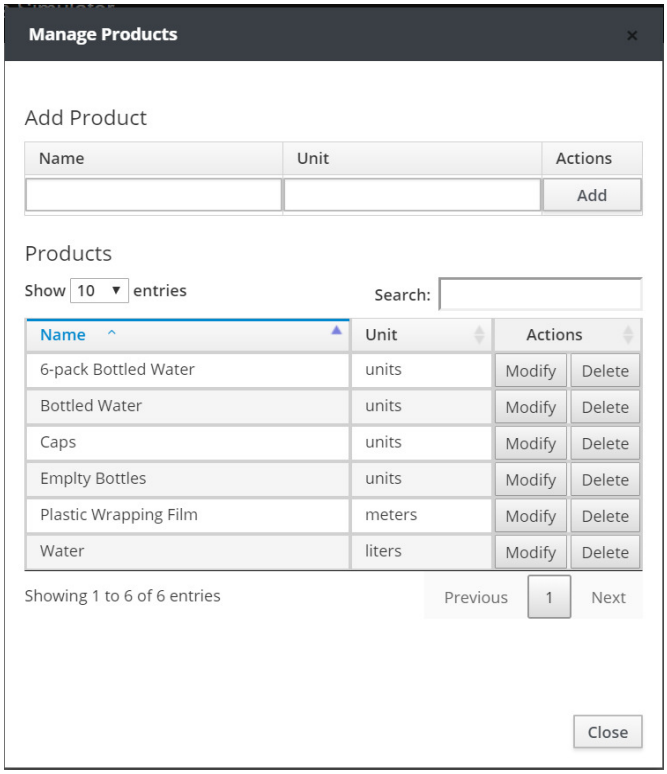


⓪ Press the button and create the Machines "*Bottling Machine*" and "*Wrapping Machine*" in accordance with the features embedded in the Specifications Table.

The following window shows the work environment after the creation of the Machines.



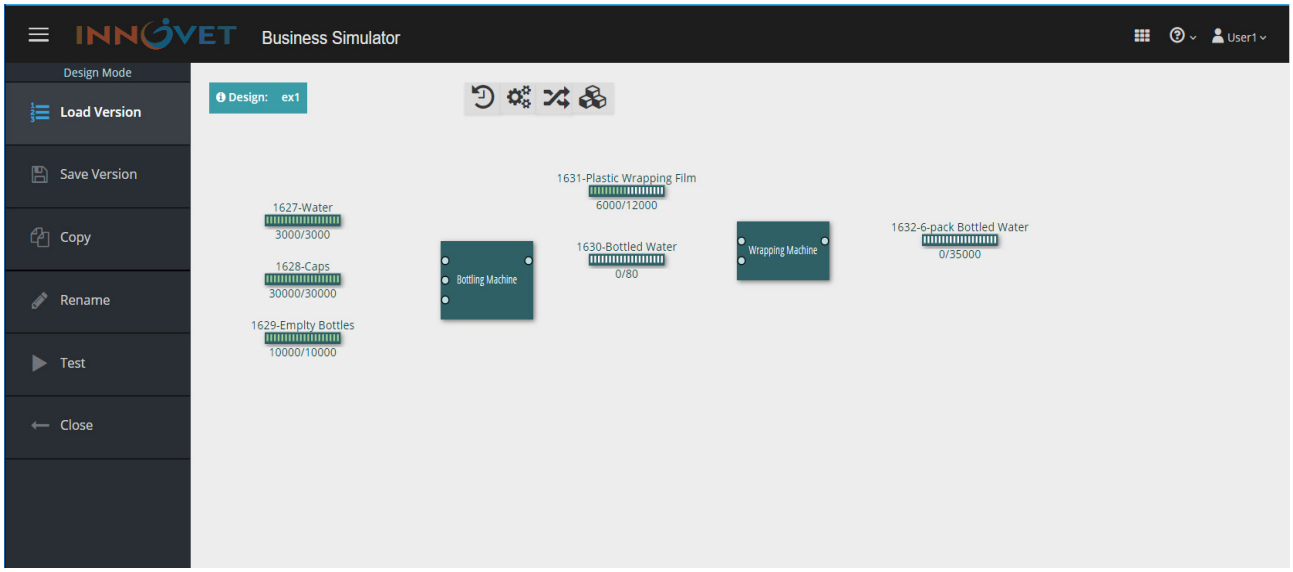
⓪ Press the button and and create all the products of the production line (raw materials, semi-finished products and final products) in the Design as they are presented in the following window.



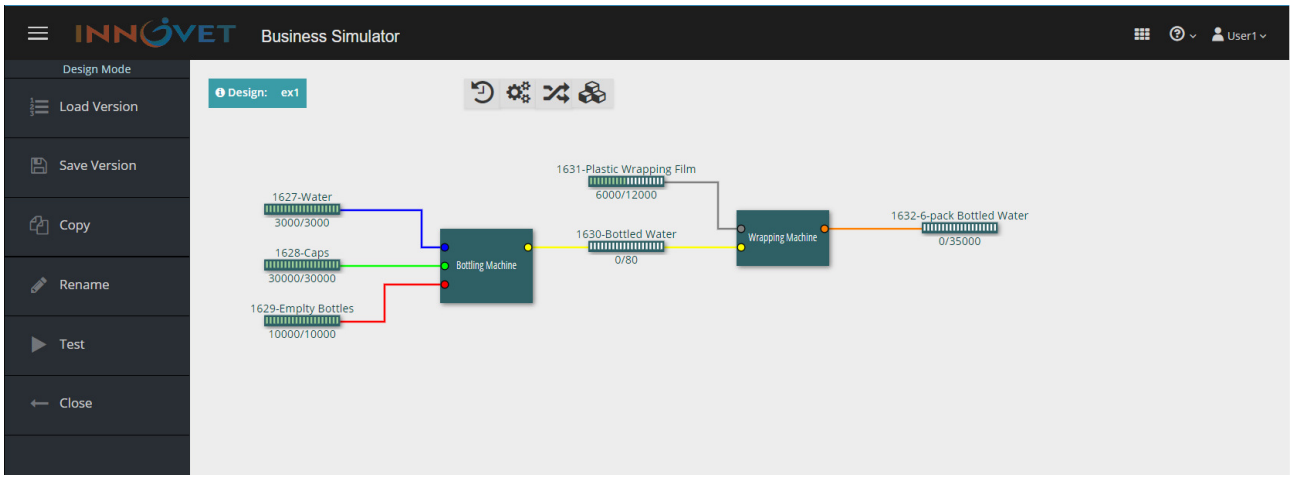
⓪ Press the button and create six Carriers in the Design with the following features:

Product to carry	Initial Amount	Max Amount	Line Color
Water	3000	3000	blue
Caps	30000	30000	green
Empty Bottles	10000	10000	red
Bottled Water	0	80	yellow
Plastic Wrapping Film	6000	12000	gray
6-pack Bottled Water	0	35000	orange

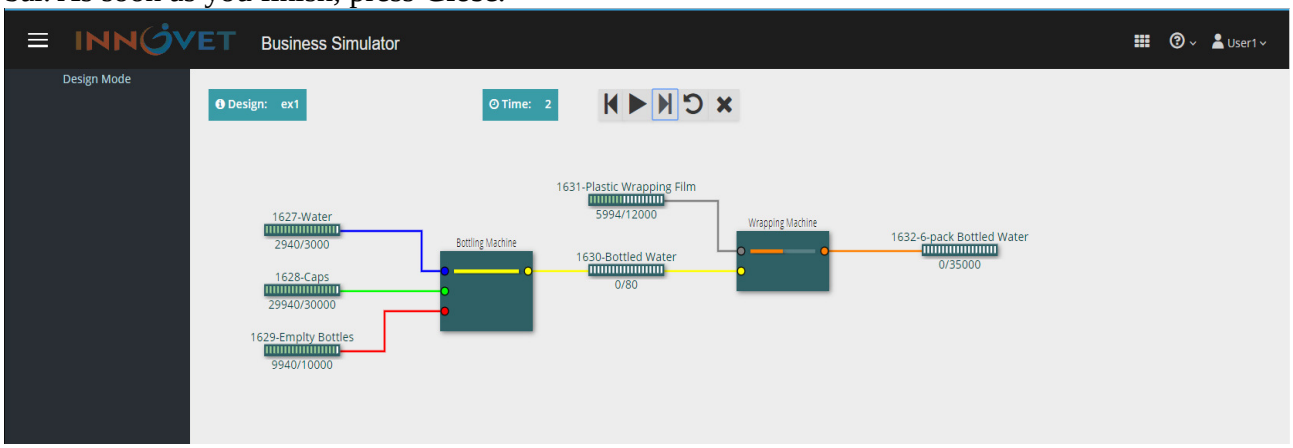
The following window shows the work environment after the creation of the Carriers.



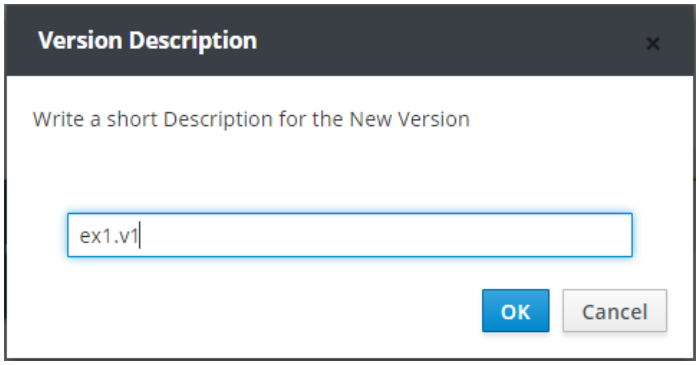
⓪ Click on the right button of the mouse on the input/output pads of the Machines and import their features in accordance with the Specifications Table. The results of the preceding action, appear in the following window.



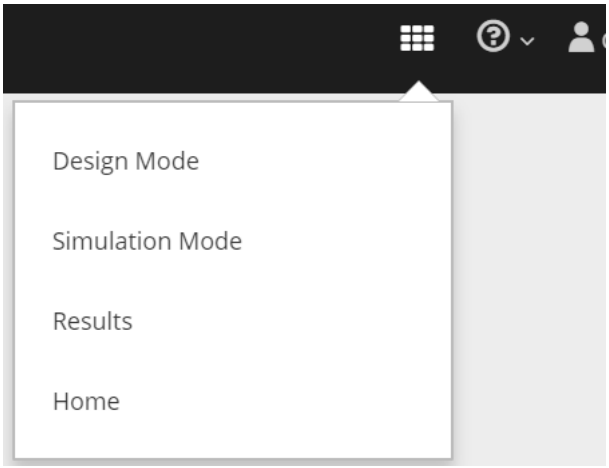
⓪ Press the Test button and then check the behavior of the Design with the assistance of the tool bar. As soon as you finish, press **Close**.



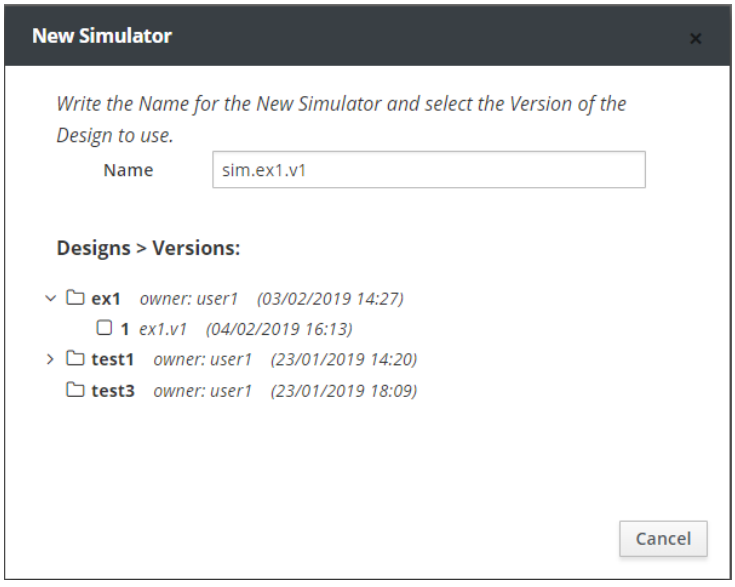
⓪ Save this Version of the Design named *ex1.v1*



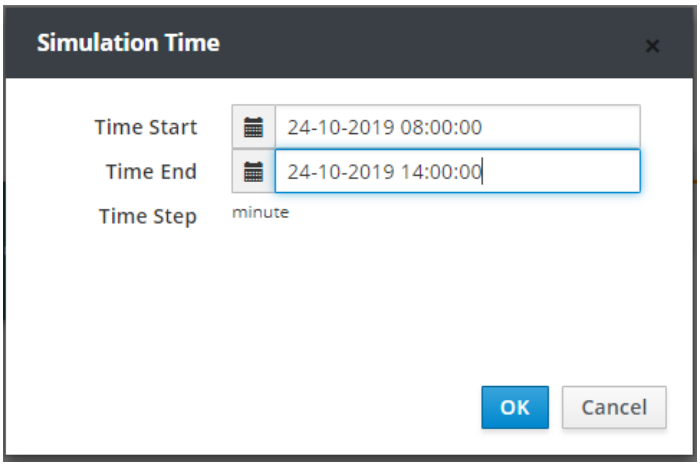
⓪ Then enter into the Simulation Mode.



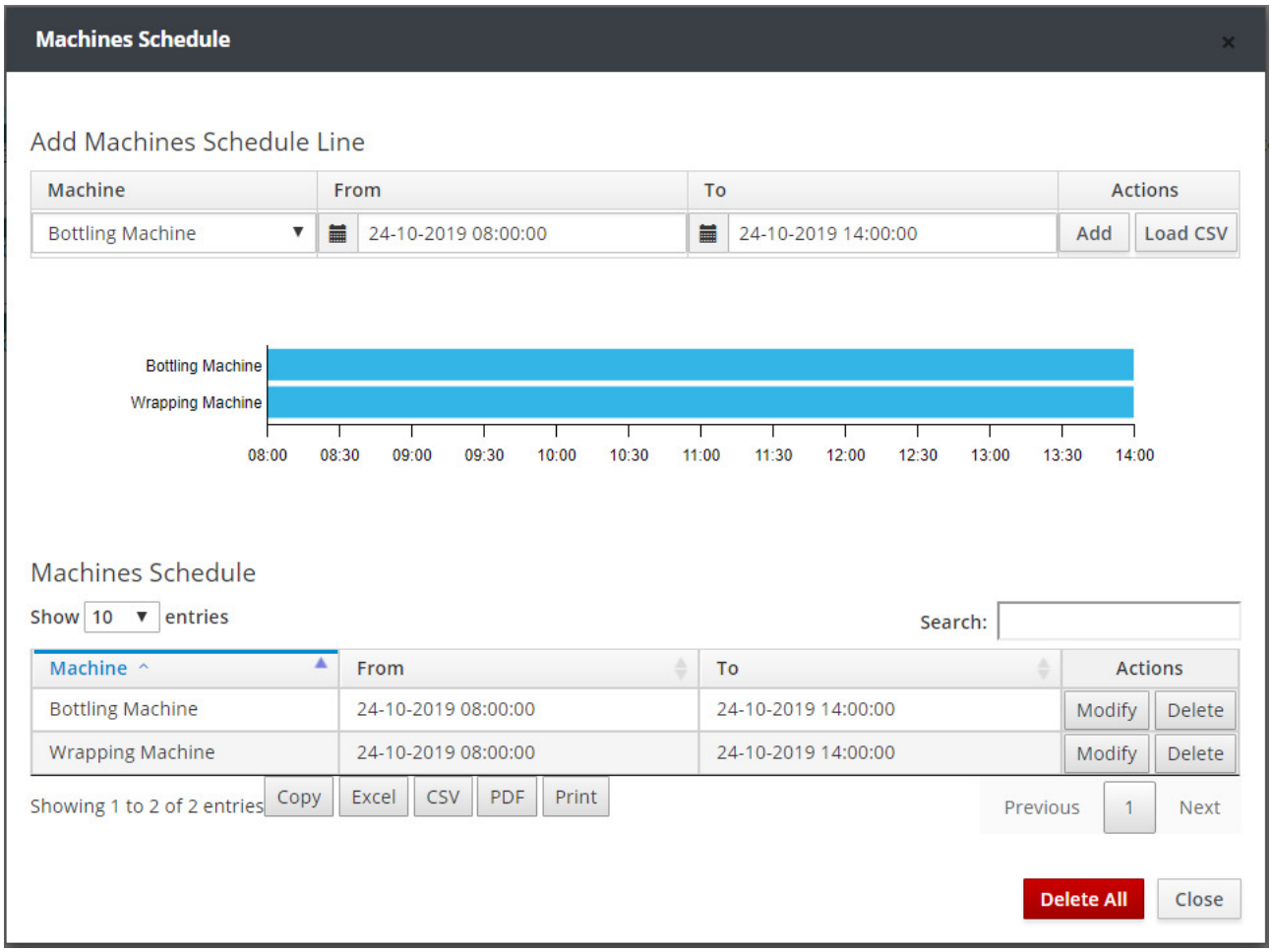
⓪ Create a new Simulator named *sim.ex1.v1* that refers to the Version *ex1.v1* of the Design *ex1*.



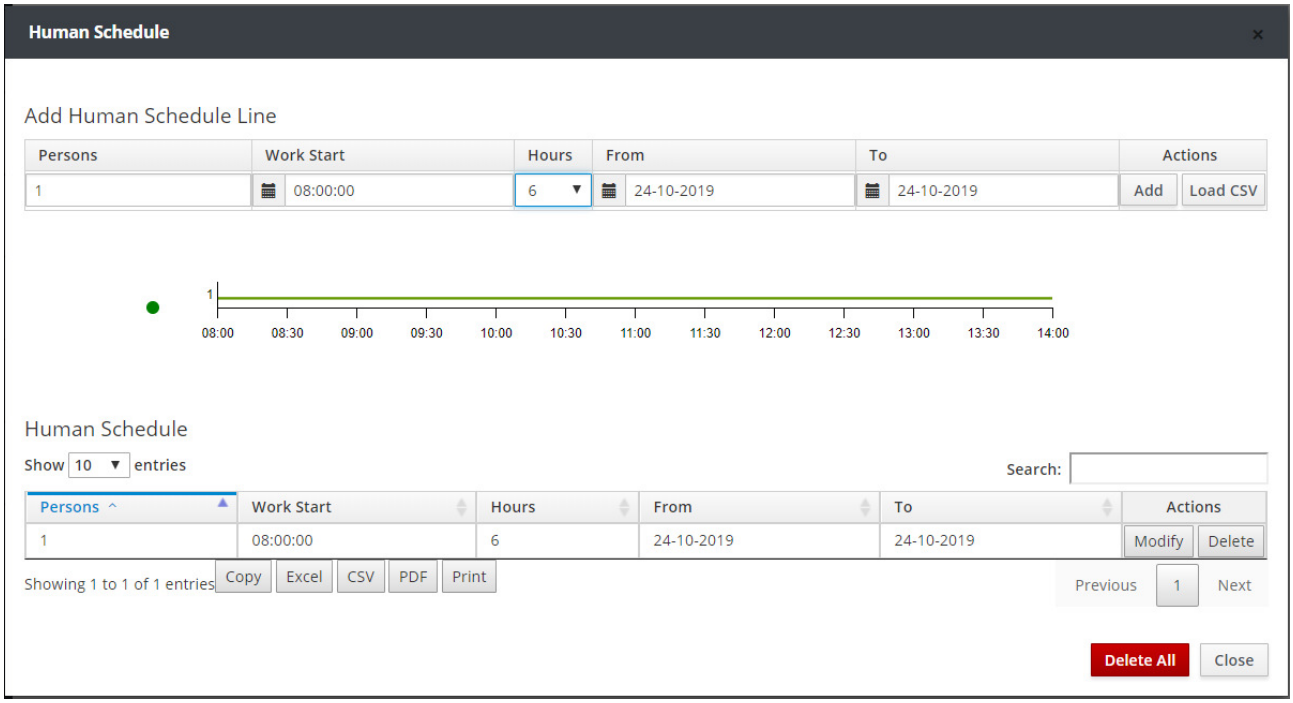
◎ Import the simulation parameters with the use of the tool bar in the environment of the Simulation Mode. First, set Time Start and Time End by pressing the button.



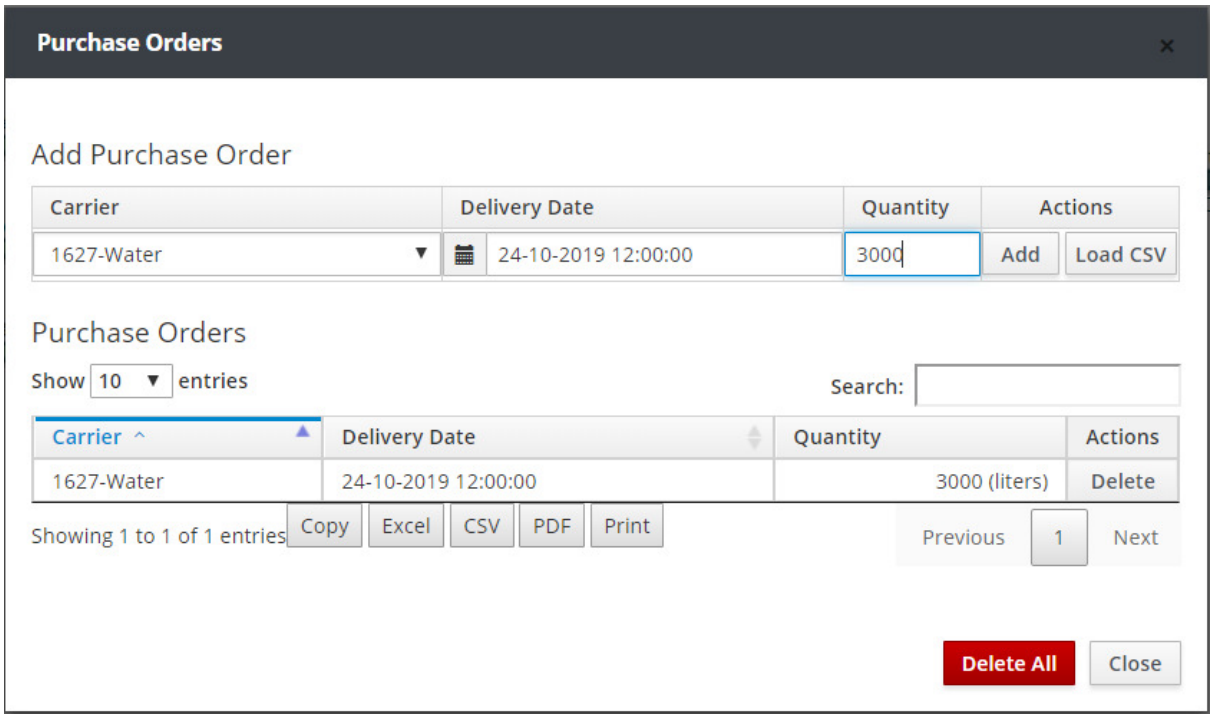
◎ Define the Machine Schedule as it is presented in the following window.



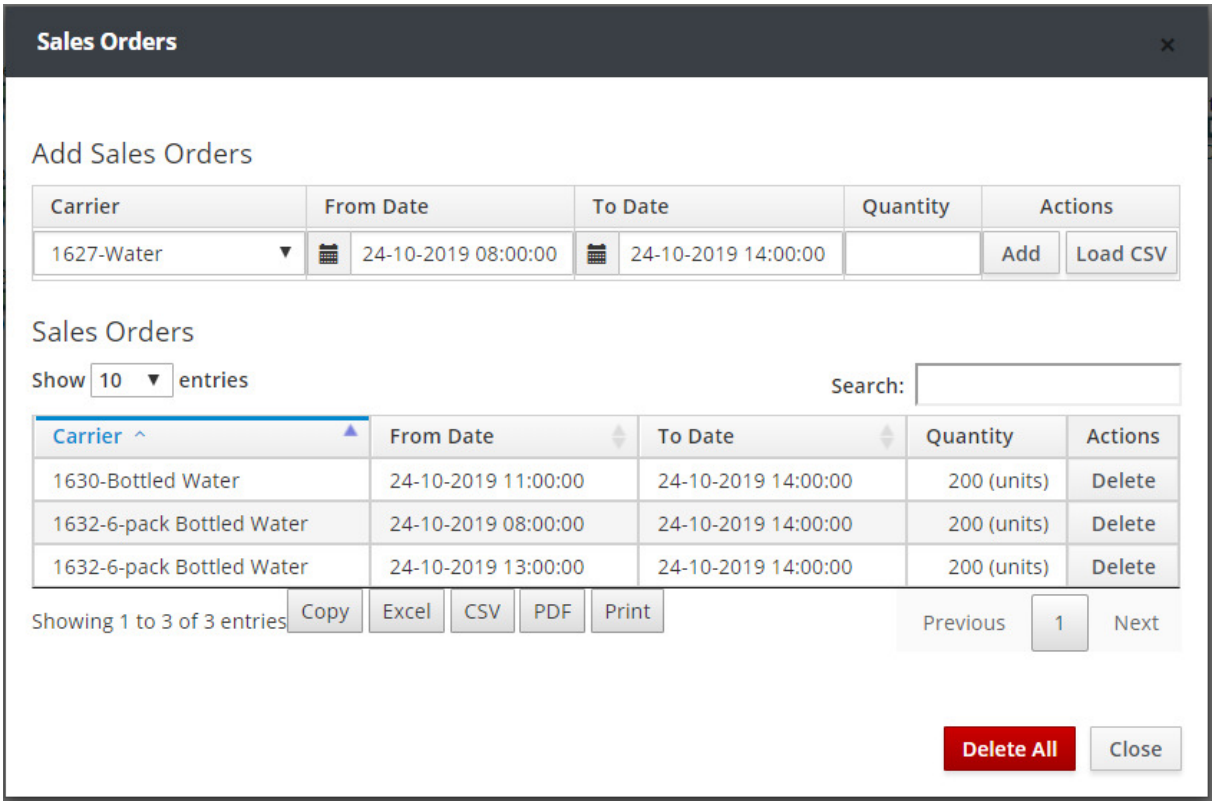
◎ Click on the **Human Schedule** button and define the work schedule of employees as it is presented in the following window.



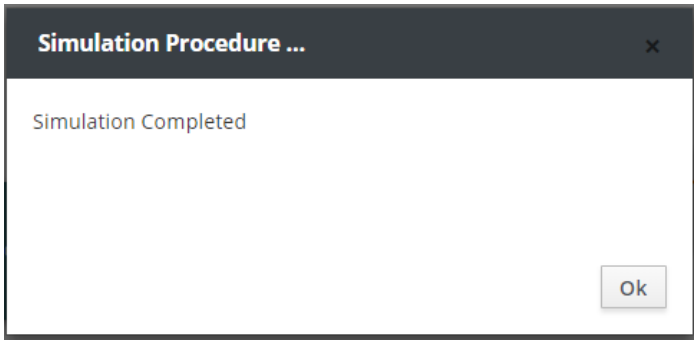
© Click on the **Purchase Orders** button and define the purchases plan as it is presented in the following window.



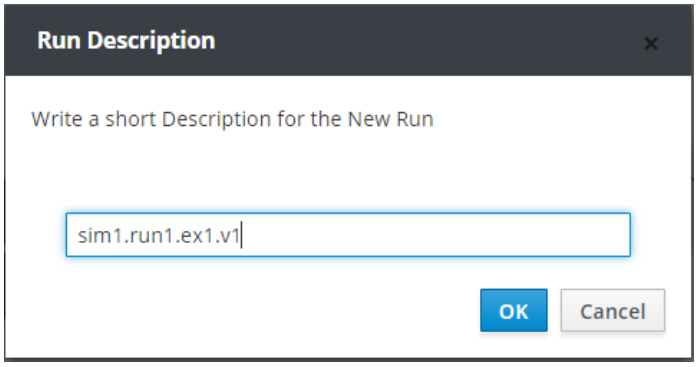
⊙ Click on the **Sales Orders** button and define the sales plan as it is presented in the following window.



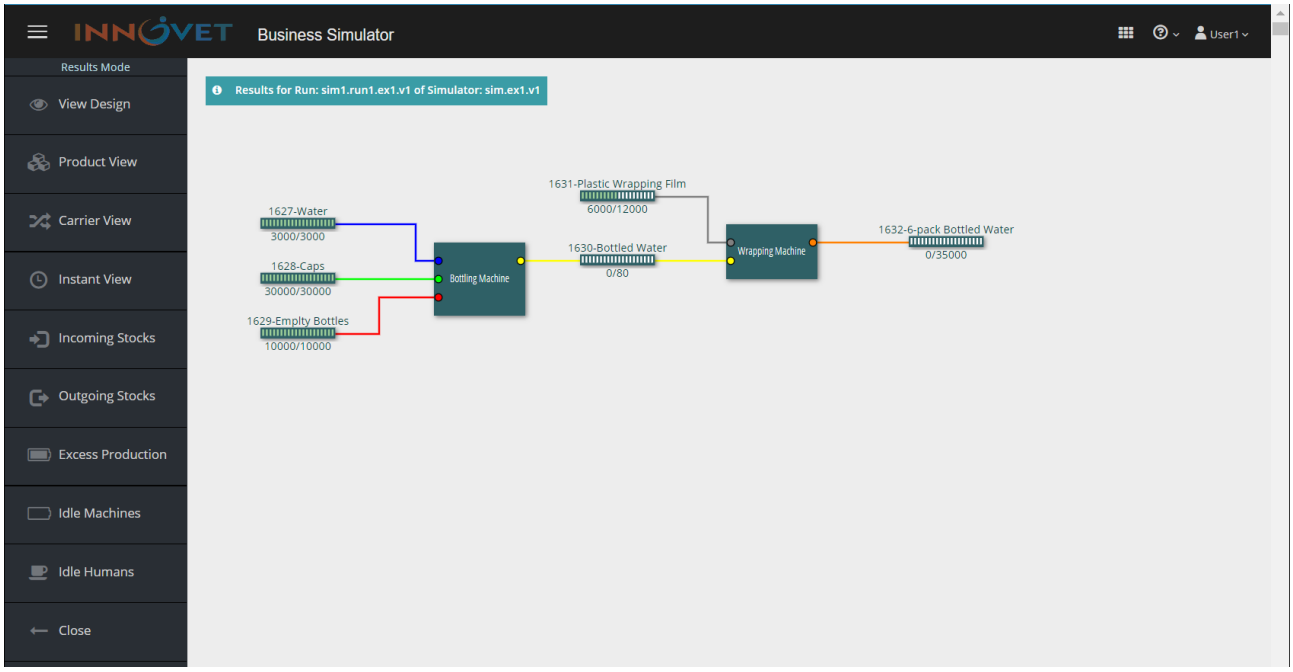
⊙ Click on the **Run** button in the main menu of the Simulator, to perform the simulation.



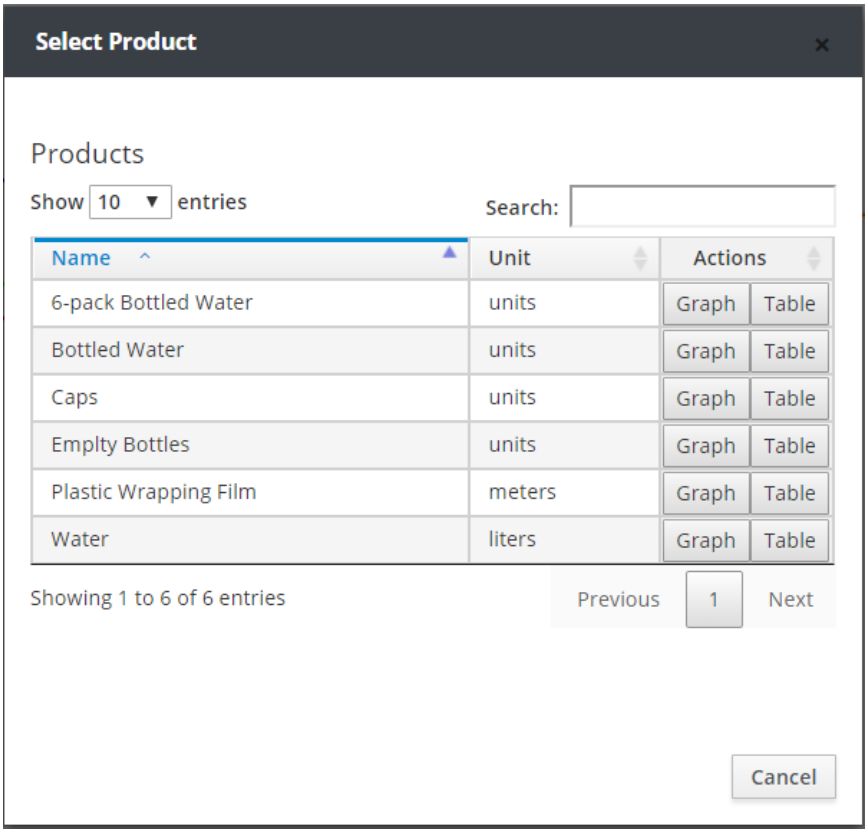
⊙ As soon as the simulation is completed, save the current Run of the Simulator named *sim1.run1.ex1.v1* with the assistance of the **Save Run** button.



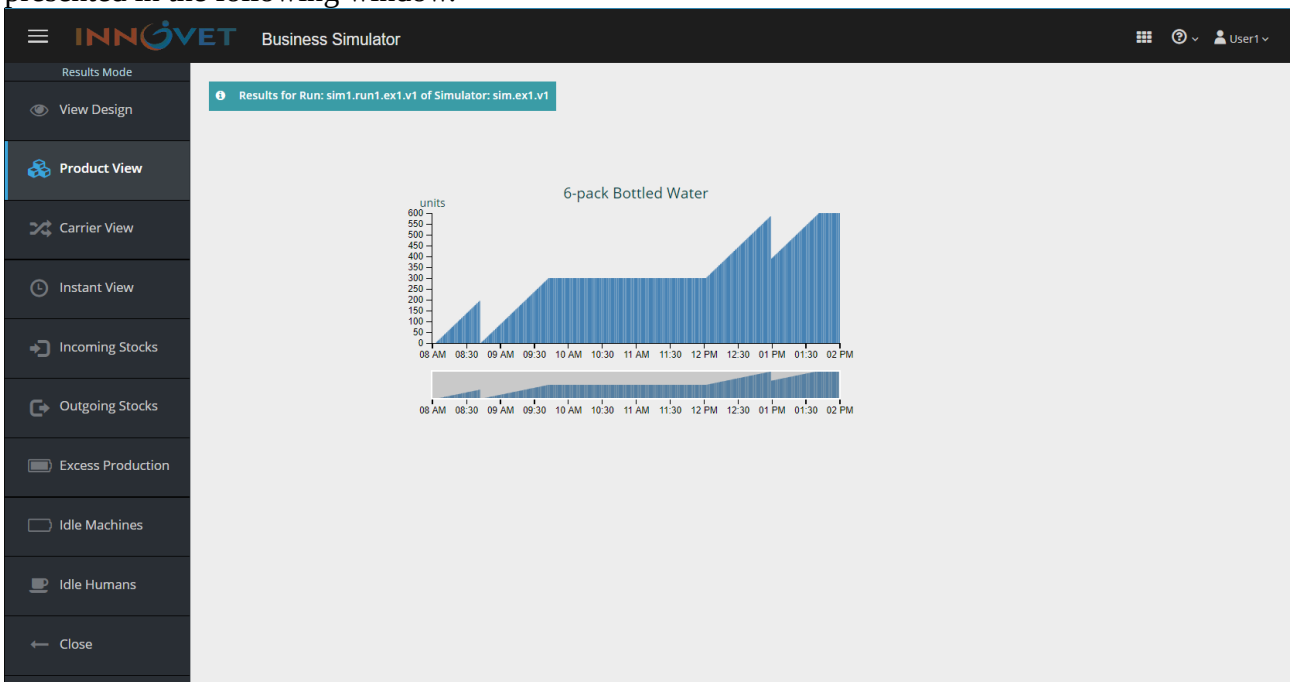
⓪ Then, enter into the Results Mode and select the Run *sim1.run1.ex1.v1*



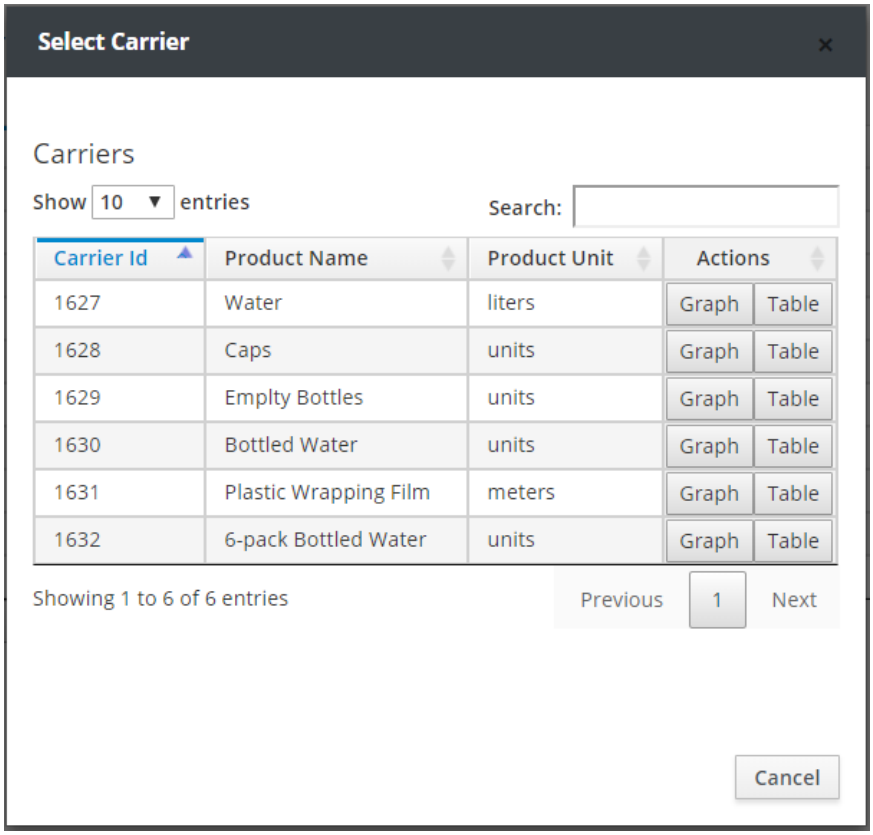
⓪ Press the **Product View** button and then press **Graph** or **Table** at the products you wish to review.



The graph of the final product quantities of the production line for this particular simulation, is presented in the following window.

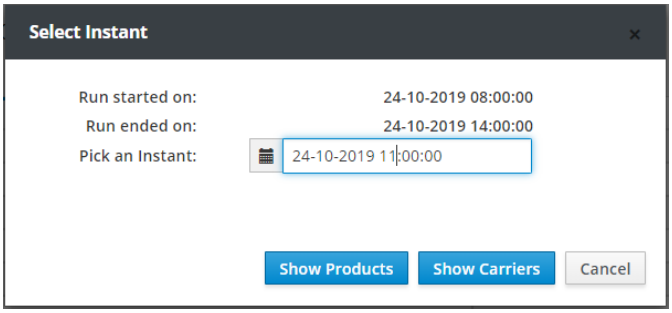


◎ Click on the **Carrier View** button and then press **Graph** or **Table** at the Carriers you wish to review.

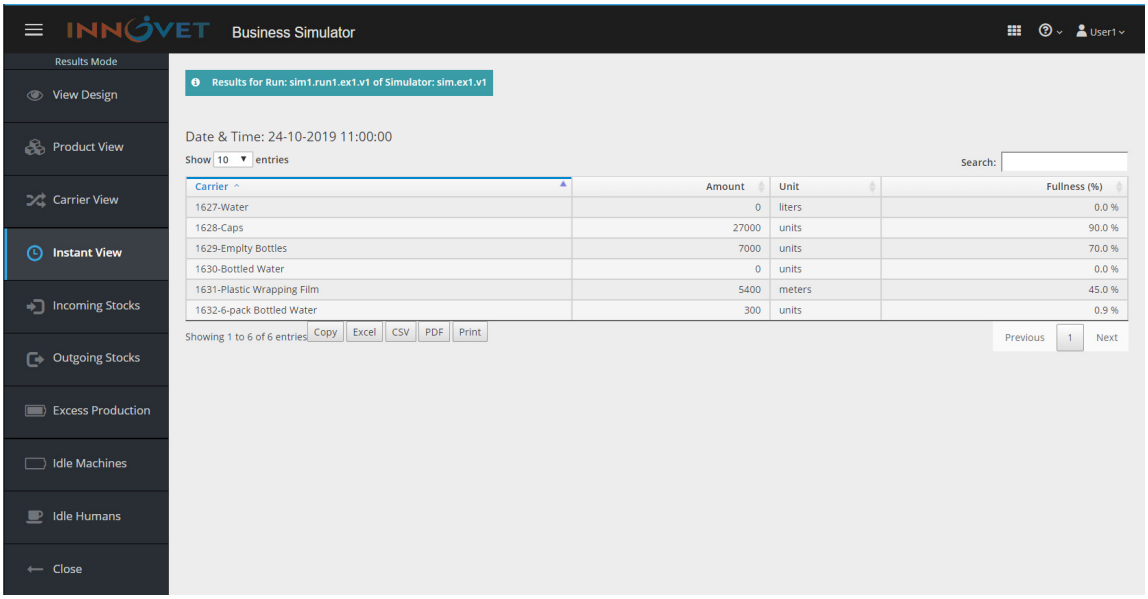


The graph of the Water raw material quantities in the production line for this particular simulation, is presented in the following window.

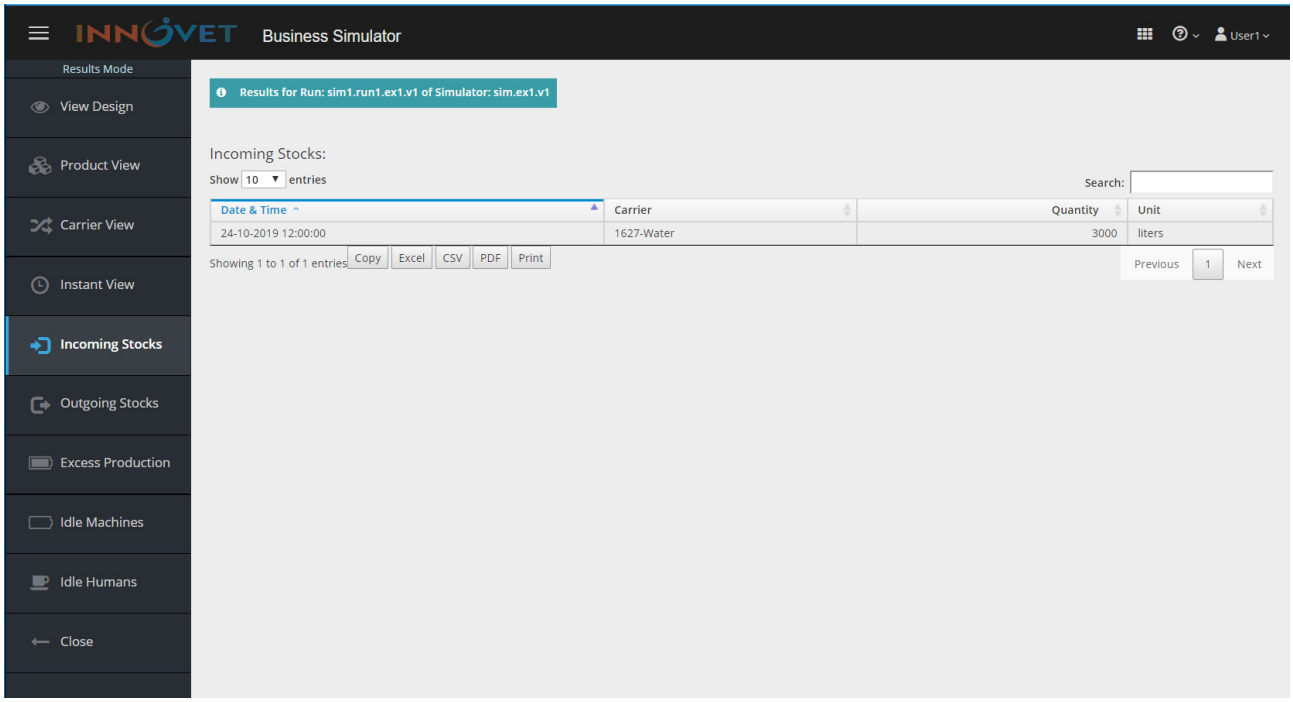
⓪ Click on the **Instant View** button, select the specific point of the simulation time at which you wish to view the quantities of the Products or Carriers.



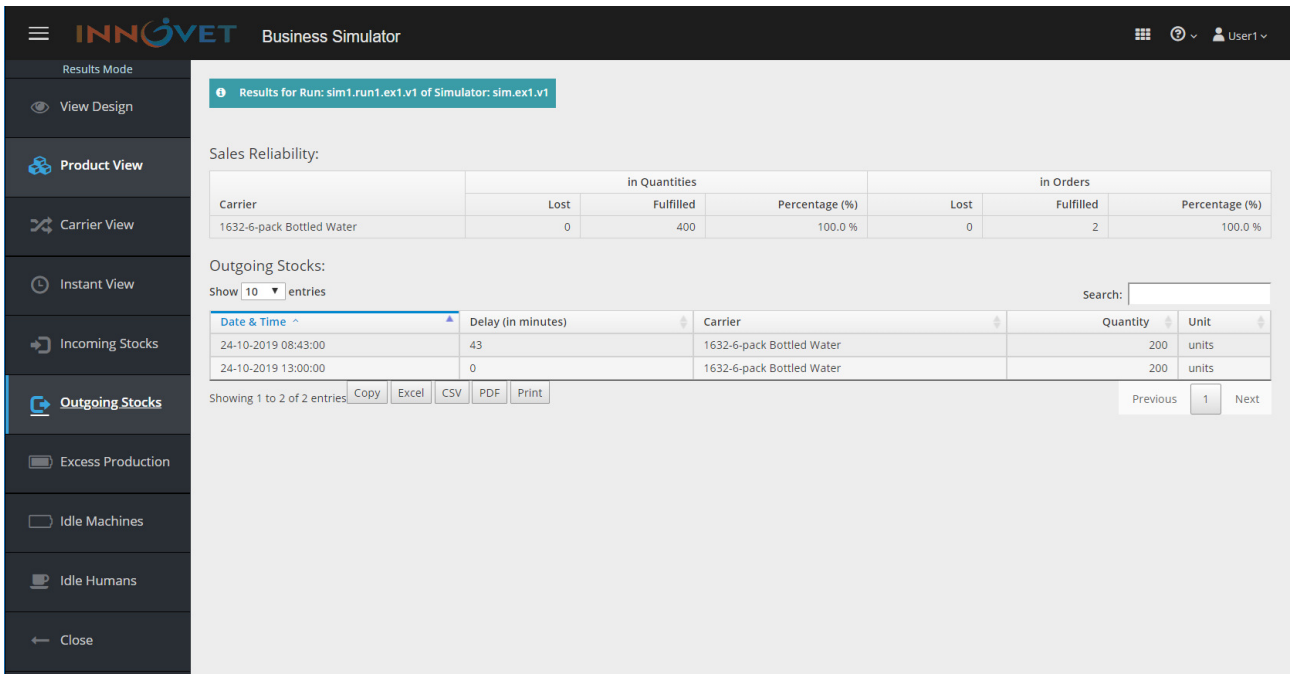
The product quantities in the Carriers for the selected point of time, are presented in the following window.



⓪ Press the **Incoming Stocks** button to display the purchases during the simulation time.

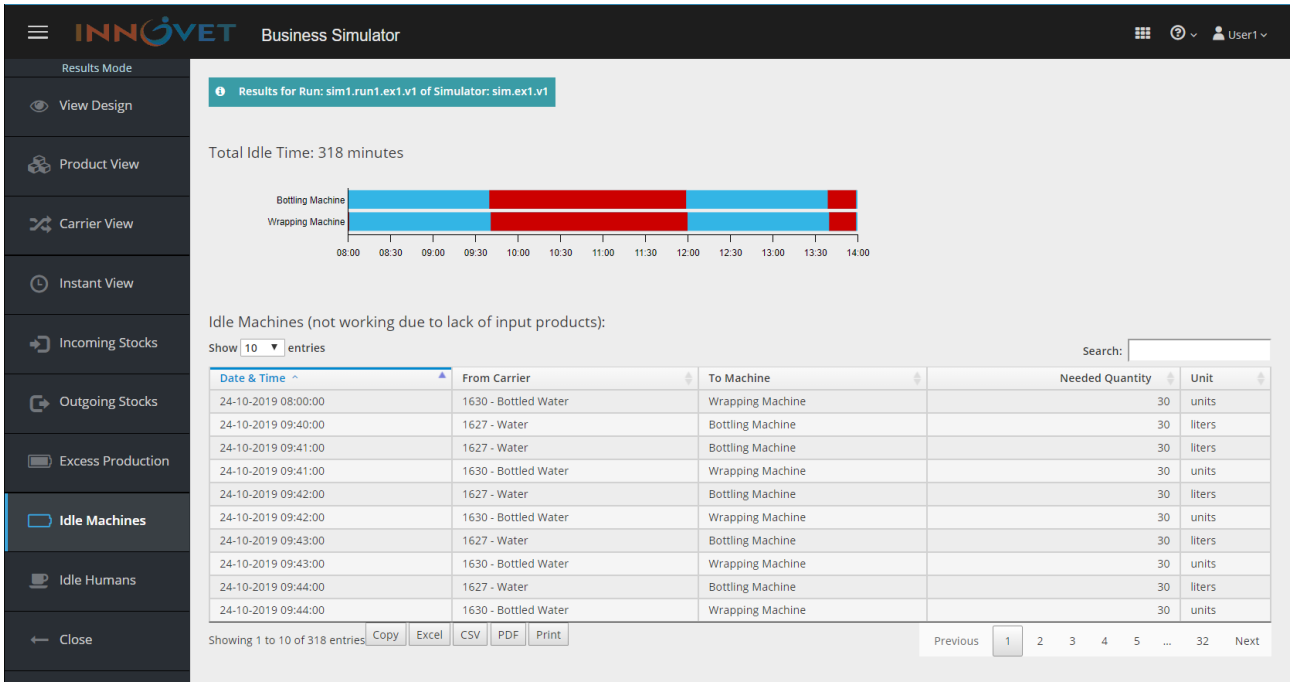


⓪ Press the **Outgoing Stocks** button to display the sales during the simulation time.



⓪ Press the **Excess Production** button to display any excess production during the simulation time. During this particular simulation period, no excess production appears.

⓪ Press the **Idle Machines** button to display the idle time of the Machines during the simulation time.

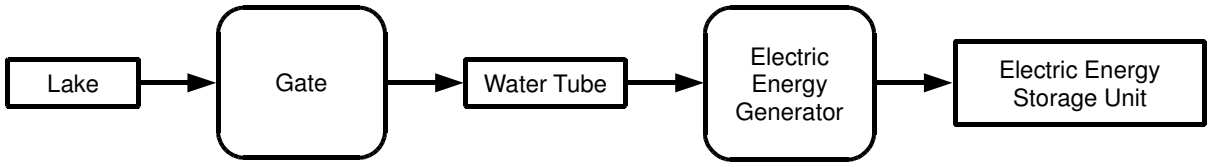


⓪ Press the **Idle Humans** button to display the idle time of labor during the simulation time. During this particular simulation period, there is no idle time of labor.

8.2 Second Educational Paradigm

This example involves a hydroelectric plant production line. The production line includes the high-level lake in which the water used for the waterfall is stored. The water of the lake is holded by a dam. By opening the barrier gate, water is passed through a special duct to the power generator. In the final stage the electric energy is led to a 10,000 kwh electric storage facility. The flow of water when the gate is open is equal to 600 m^3/h. The generator has a nominal power of 60 kw, which means that it produces 60 kwh of energy in one hour and consumes 300 m^3/h of water. If the gate is continuously open, the duct that drives the water from the dam to the generator will overflow due to the greater flow of the gate compared to the one that the generator consumes.

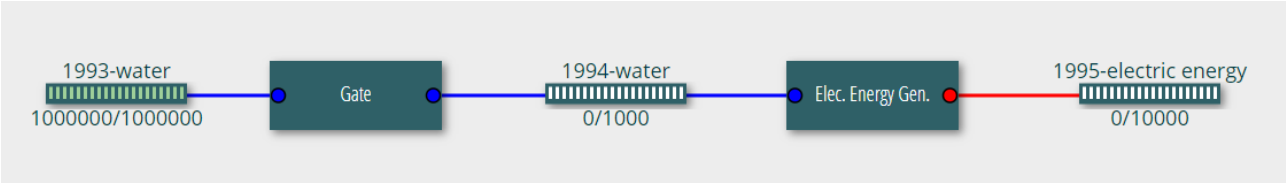
Flow Chart



Specifications

Carriers Max Capacities	**Machines Specifications**
Lake: 1000000 m^3 **Water Tube:** 1000 m^3 **Energy Storage Unit:** 10000 kwh	**Gate**: Inputs: 1 • 10 m^3 of water Outputs: 1 • 10 m^3 of water Next Input Time: 1 minute Production Time: 1 minute Required Human: 1 **Electric Energy Generator:** Inputs: 1 • 5 m^3 of water Outputs: 1 • 1 kwh of electric energy Next Input Time: 1 minute Production Time: 1 minute Required Humans: 1

The following figure shows the Design of the production line as it should be designed in Design Mode.

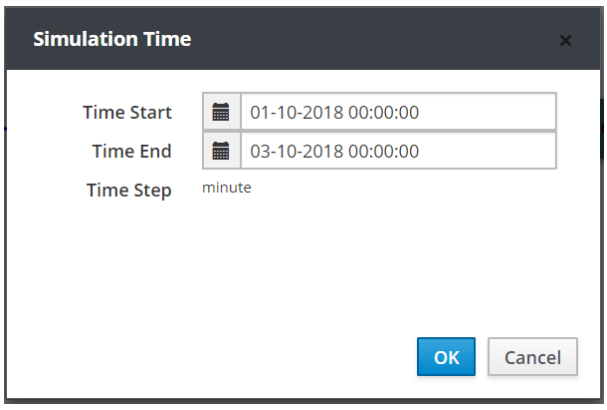


⓪ Create a new Design named *ex2* and draw inside this the above production line.

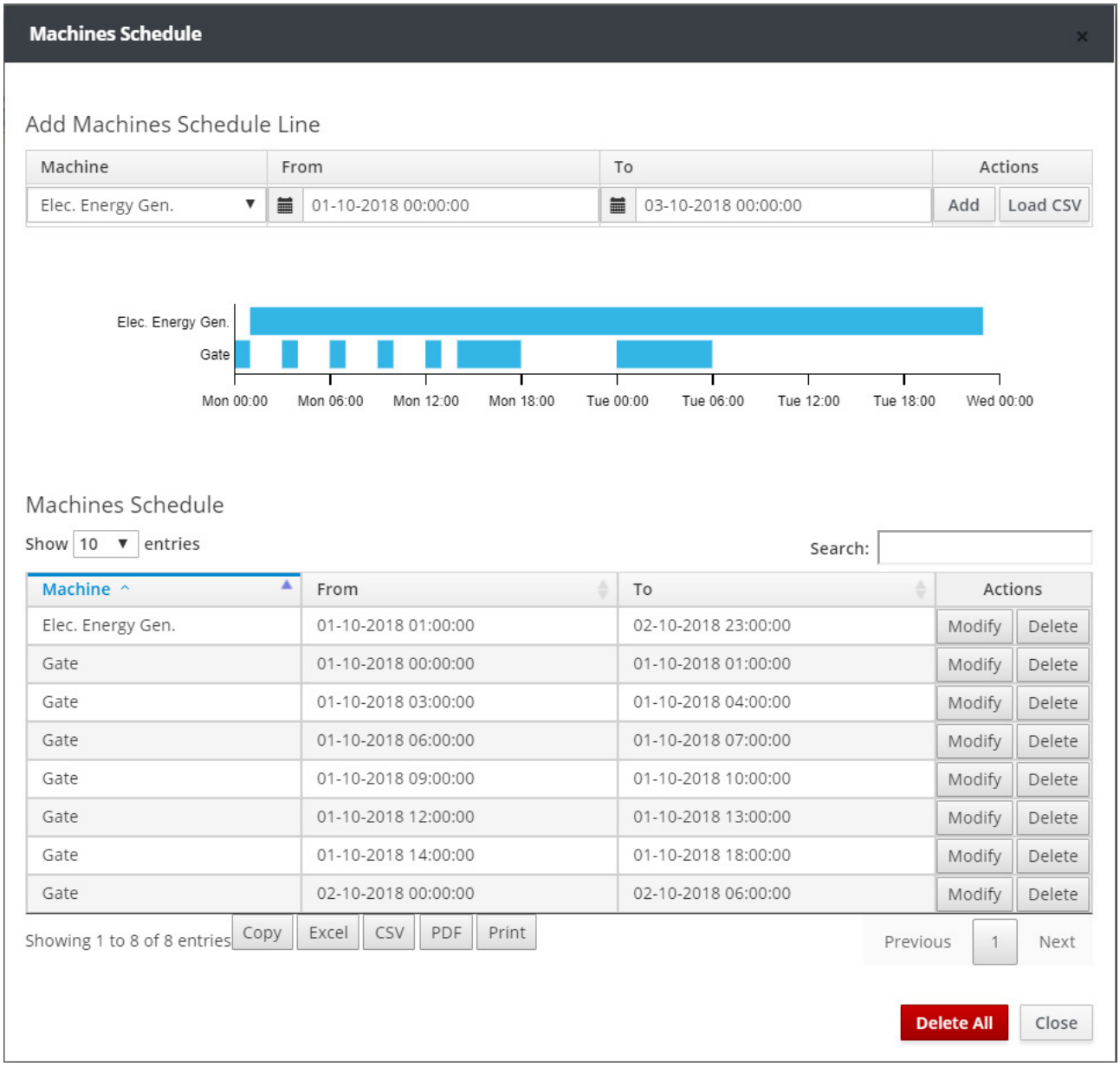
⓪ Then, save the final version of the Design to Version named *ex2.v1*

⓪ Go to Simulation Mode and create a new Simulator named *sim.ex2.v1* based on Version *ex2.v1*

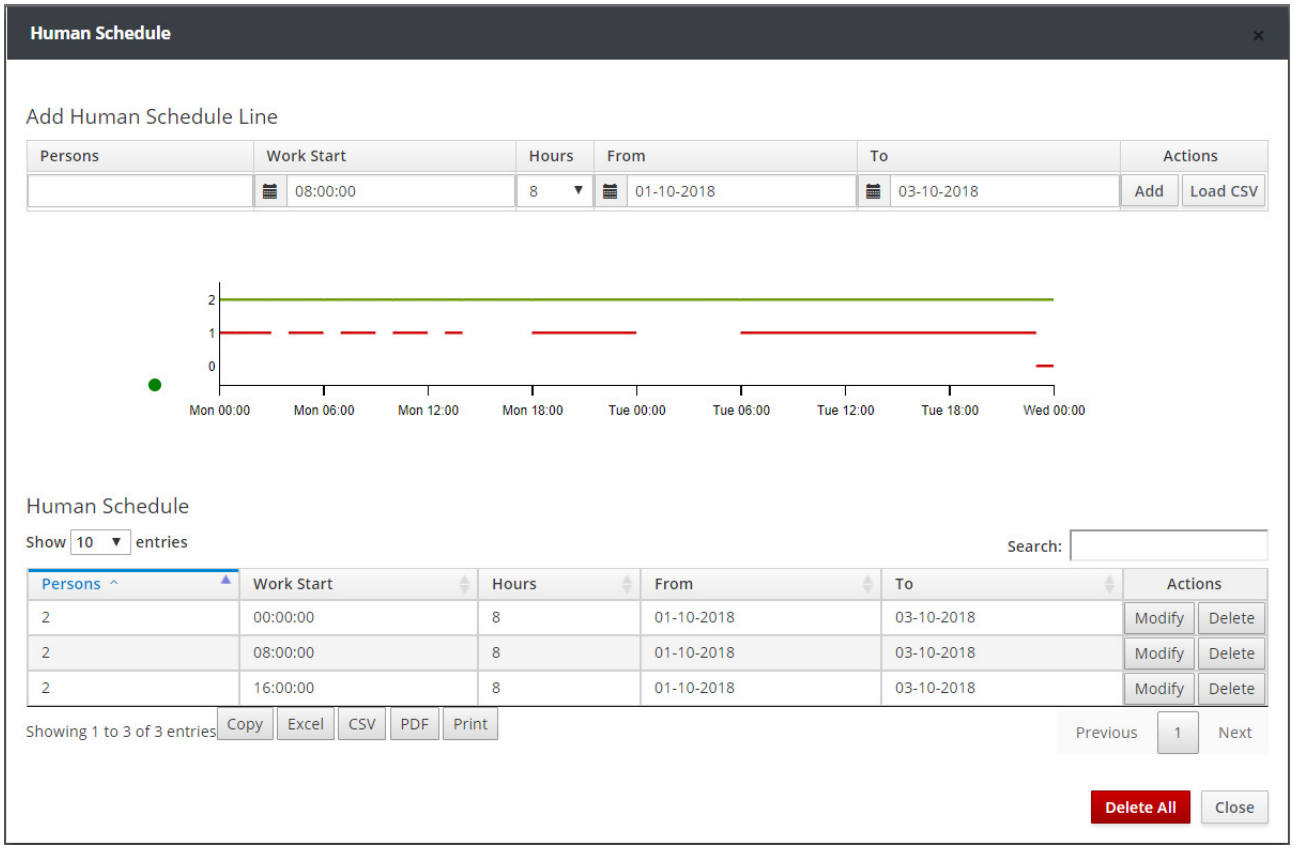
⓪ Set the Time Start and Time End of the simulation as in the following figure..



⓪ Set the Machines Schedule as shown below.

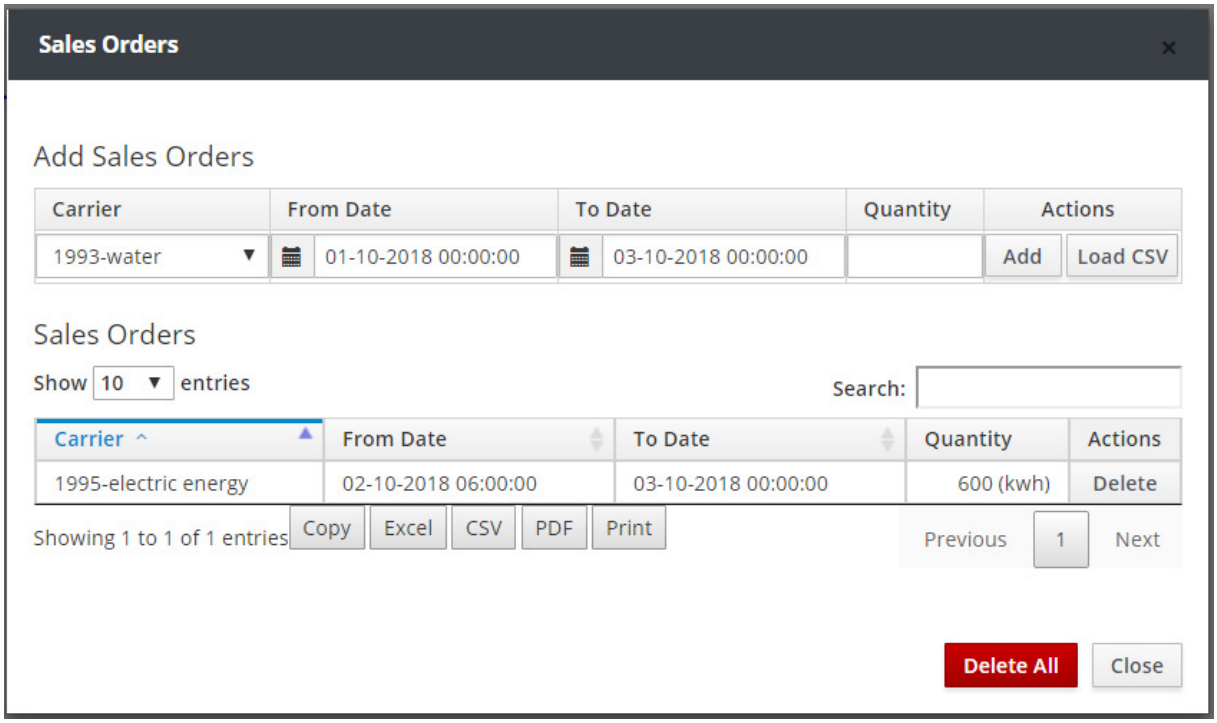


◎ Set the **Human Schedule** as shown in the following figure.

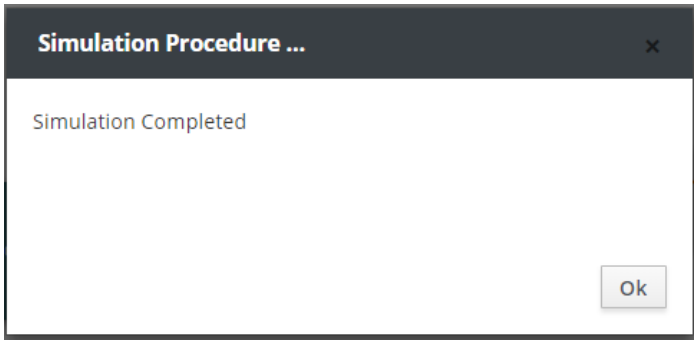


The Purchase Orders for this example correspond to the amount of water entering the lake either from a river or from rainfall. In the example, you may consider that during the simulation time there will be no water inflow into the lake.

◎ Specify the **Sales Orders** program that corresponds to the electric energy distribution from that stored in the electric energy storage unit to the electricity distribution network as shown in the following figure. The sale order shown on the table corresponds to the electric energy requirement of 600 kwh from the network, at any time available between 02-10-2018 06:00:00 to 03-10-2018 00:00:00.



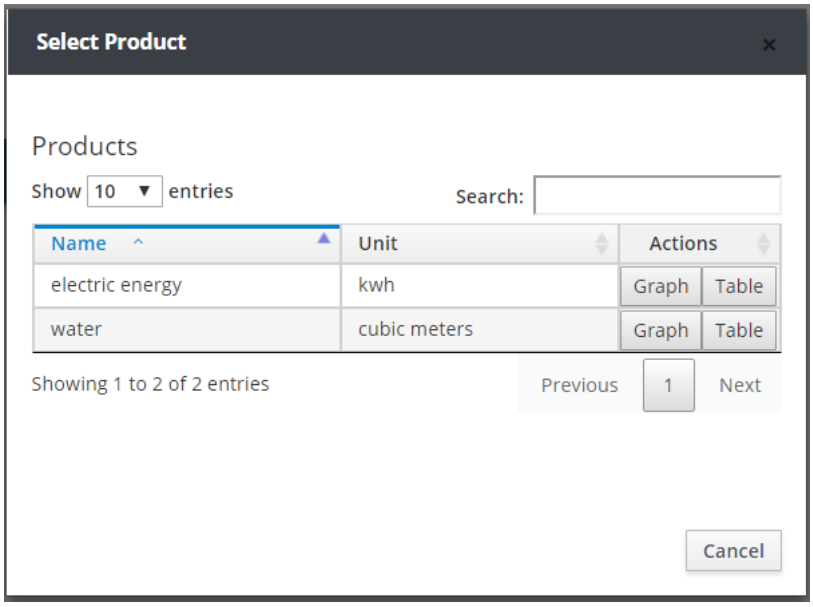
◎ Run the simulation by clicking the **Run** button in the Simulator main menu.



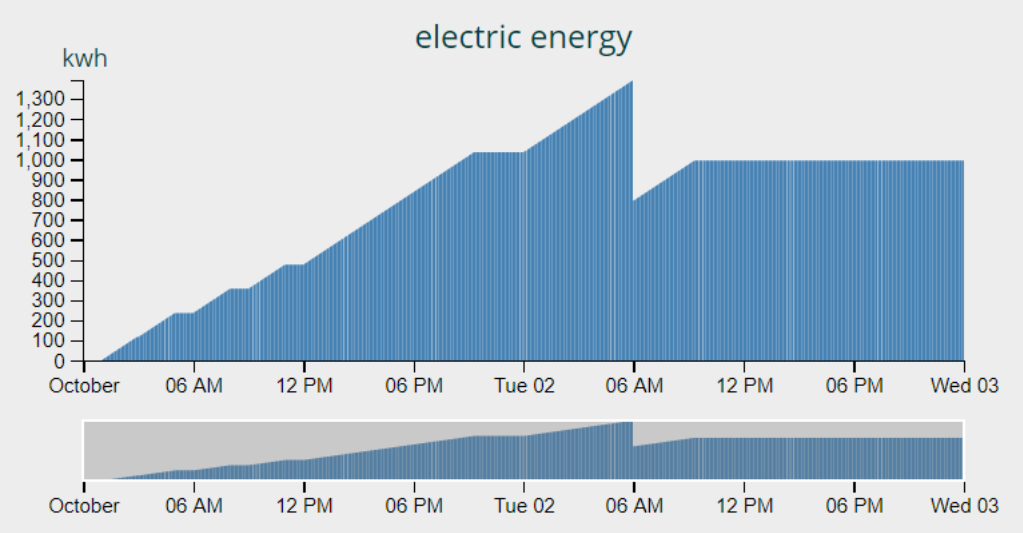
◎ After the simulation is completed, save the simulation results to a Run named *sim1.run1.ex2.v1* by using the **Save Run** button.

◎ Then, go to Results Mode and select the Run named *sim1.run1.ex2.v1*

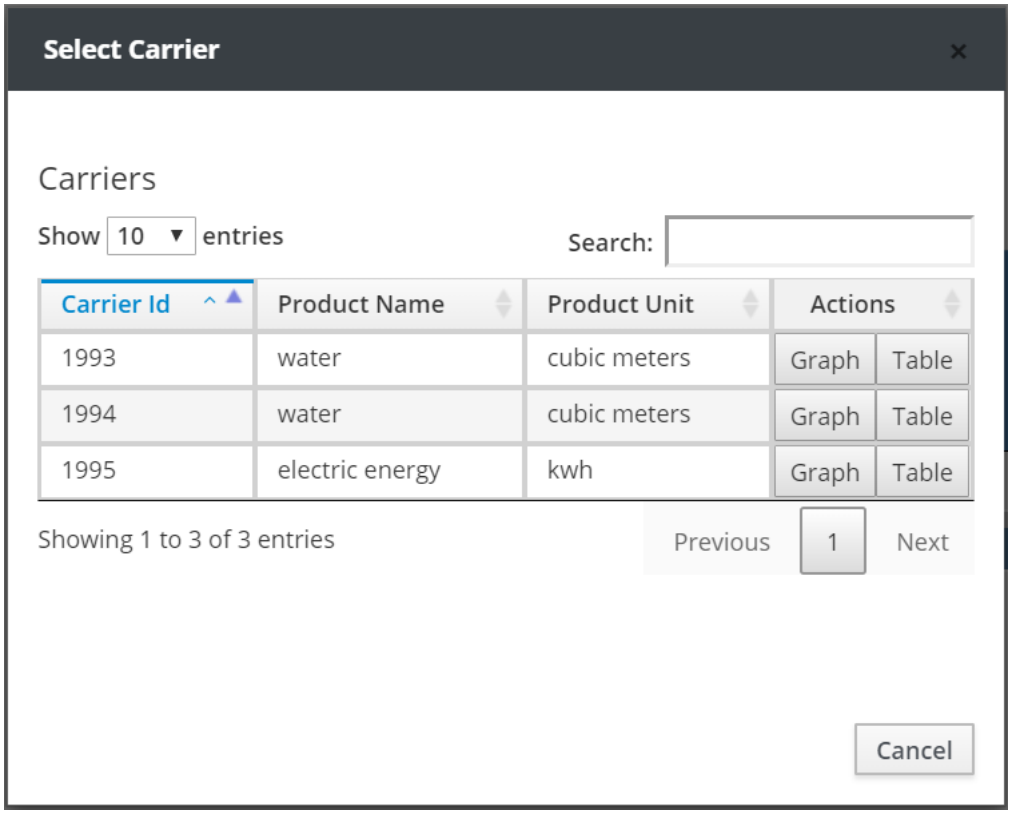
⓪ Press the **Product View** button and then **Graph** or **Table** on the products you want to review the results.



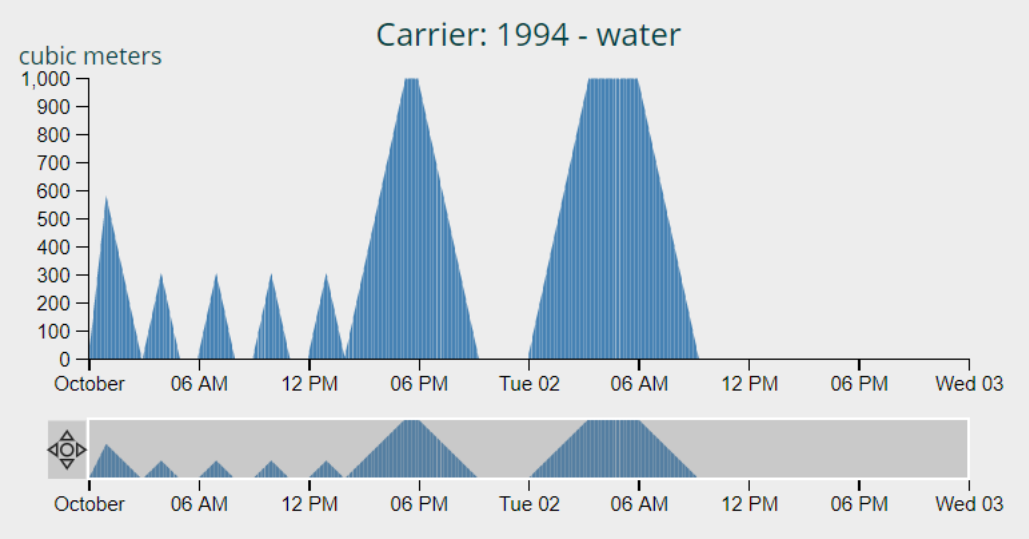
The figure below shows the graph of the amount of electric energy at each moment of simulation time.



⓪ Click the **Carrier View** button and then **Graph** or **Table** on the Carriers you want to review the results.

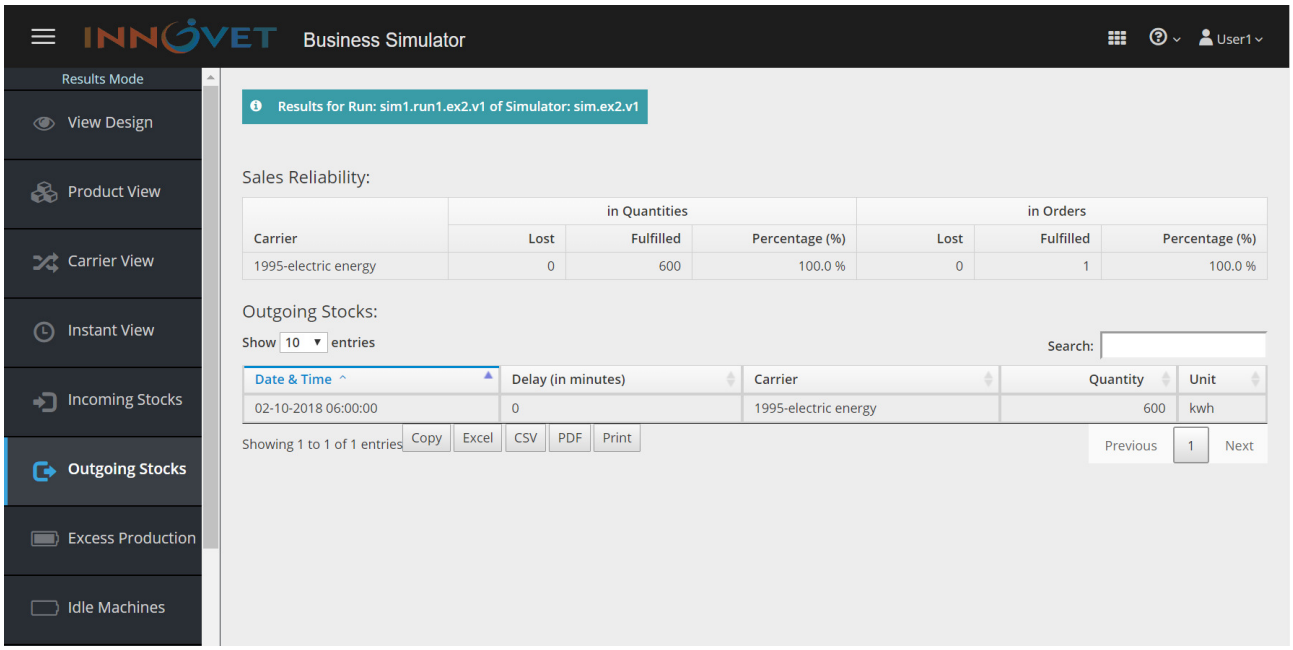


The following figure shows the Graph of the amount of water in the Water Tube at each moment of simulation time.

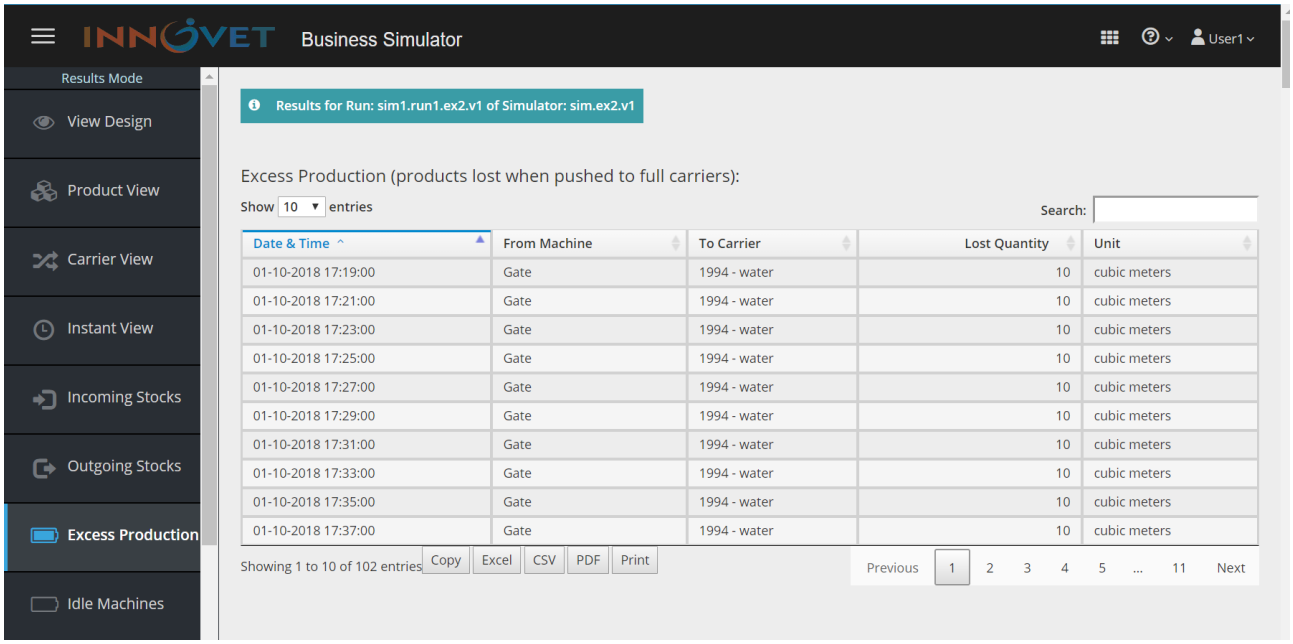


⓪ Press the **Instant View** button and select the specific time of the simulation time in which you want to display the quantities of Products or Carriers.

⓪ Press the **Outgoing Stocks** button to show sales, that is, the amount of electric energy that were fed into the electricity distribution network during simulation time.



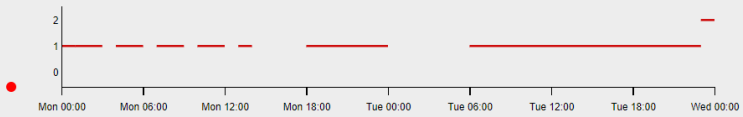
⓪ Press the **Excess Production** button to display any excess of production during simulation time. During this simulation period, notice that from 01-10-2018 17:19:00 to 02-10-2018 05:59:00 there is an overflow of the Water Tube, which means that Machine Gate works unnecessarily during that time and wastes resources.



⓪ Press the **Idle Machines** button to display Machine idle time intervals during simulation time.

⓪ Press the **Idle Humans** button to display employee inactivity time intervals during simulation time.

Total Idle Humans: 35.0 hours



Human Schedule

Show 10 entries Search:

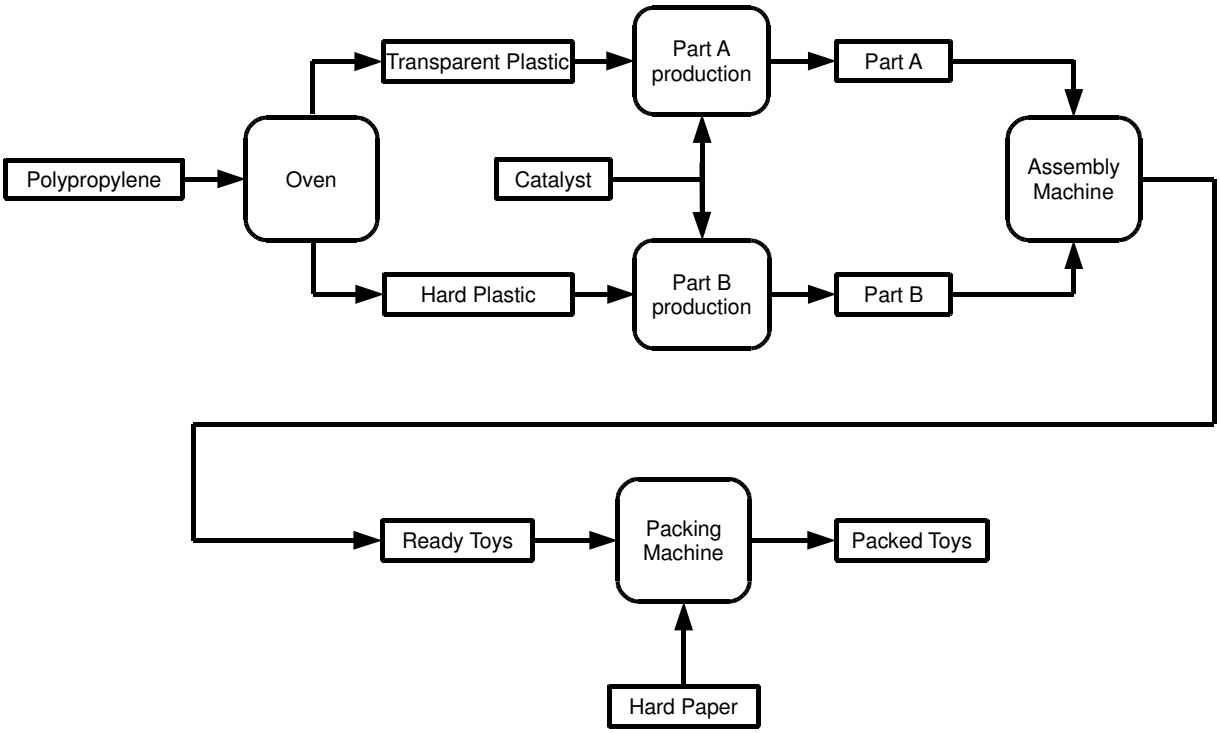
Persons	Work Start	Hours	From	To
2	00:00:00	8	01-10-2018	03-10-2018
2	08:00:00	8	01-10-2018	03-10-2018
2	16:00:00	8	01-10-2018	03-10-2018

Showing 1 to 3 of 3 entries Copy Excel CSV PDF Print Previous 1 Next

8.3 Third Educational Paradigm

This example involves the simulation of a small toy production line. In the production line, polypropylene is used as a raw material in the oven for the production of transparent plastic and hard plastic. Then, the transparent plastic and catalyst used as raw materials produce the component A, while the hard plastic and the catalyst used as raw materials produce the component B. Then with the assembly of the component A with the component B the toy is produced. In the final stage the toy is packed in a box by using cardboard. This example is suggested to be simulated with Time Resolution 1 hour.

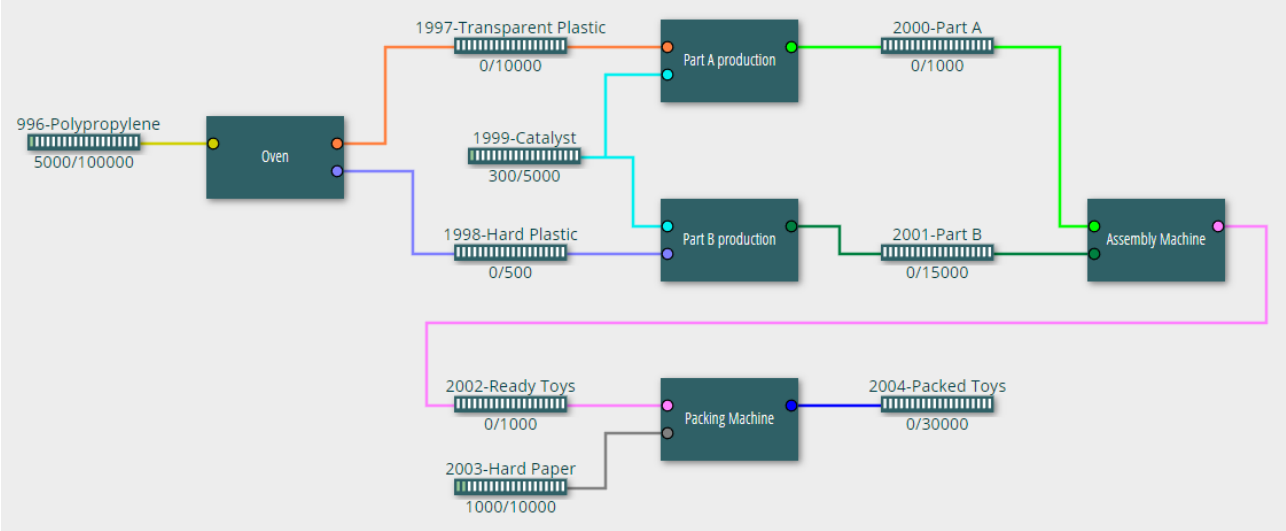
Flow Chart



Specifications

Carriers Max Capacities	Machines Specifications
Polypropylene: 100.000 Kg **Transparent Plastic:** 10.000 Kg **Hard Plastic:** 500 Kg **Catalyst:** 5000 liters **Part A:** 1.000 units **Part B:** 15.000 units **Ready Toys:** 1.000 units **Hard Paper:** 10.000 m **Packed Toys:** 30.000 units	**Oven**: Inputs: 1 • 1.000 Kg of Polypropylene Outputs: 2 • 400 Kg of Transparent Plastic • 400 Kg of Hard Plastic Next Input Time: 1 hour Production Time: 1 hour Required Human: 1 **Part A production:** Inputs: 2 • 400 Kg of Transparent Plastic • 100 liters of Catalyst Outputs: 1 • 250 units of Part A Next Input Time: 1 hour Production Time: 3 hours Required Human: 1 **Part B production:** Inputs: 2 • 400 Kg of Hard Plastic • 100 liters of Catalyst Outputs: 1 • 800 units of Part B Next Input Time: 1 hour Production Time: 1 hour Required Human: 0 **Assembly Machine:** Inputs: 2 • 250 units of Part A • 250 units of Part B Outputs: 1 • 250 units of Ready Toys Next Input Time: 1 hour Production Time: 1 hour Required Human: 0 **Packing Machine:** Inputs: 2 • 100 units of Ready Toys • 30 m of Hard Paper Outputs: 1 • 1 unit of Packed Toys Next Input Time: 1 hour Production Time: 1 hour Required Human: 1

The following figure shows the Design of the above mentioned production line as it should be designed in Design Mode.

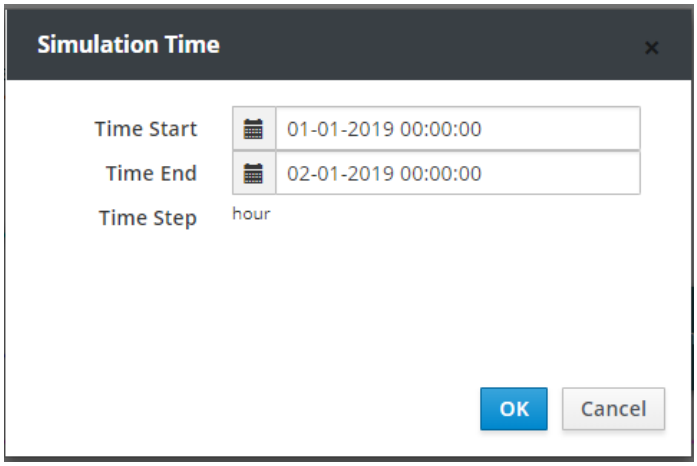


◎ Create a new Design named *ex3* and draw inside the above production line.

◎ Then, save the final version of Design to Version named *ex3.v1*

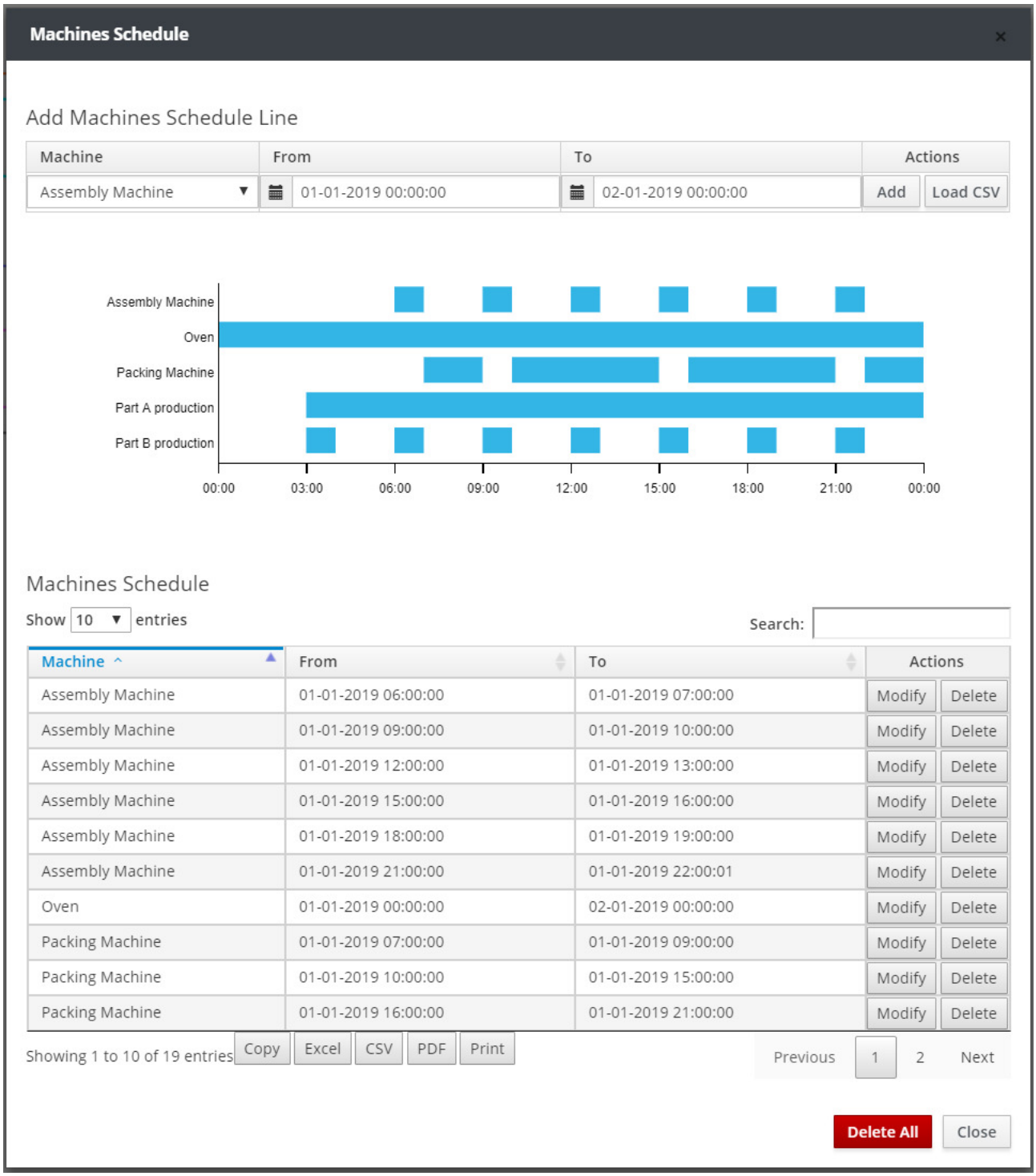
◎ Go to Simulation Mode and create a new Simulator named *sim.ex3.v1* based on Version *ex3.v1*

◎ Set the Time Start and Time End of the simulation as in the following figure.

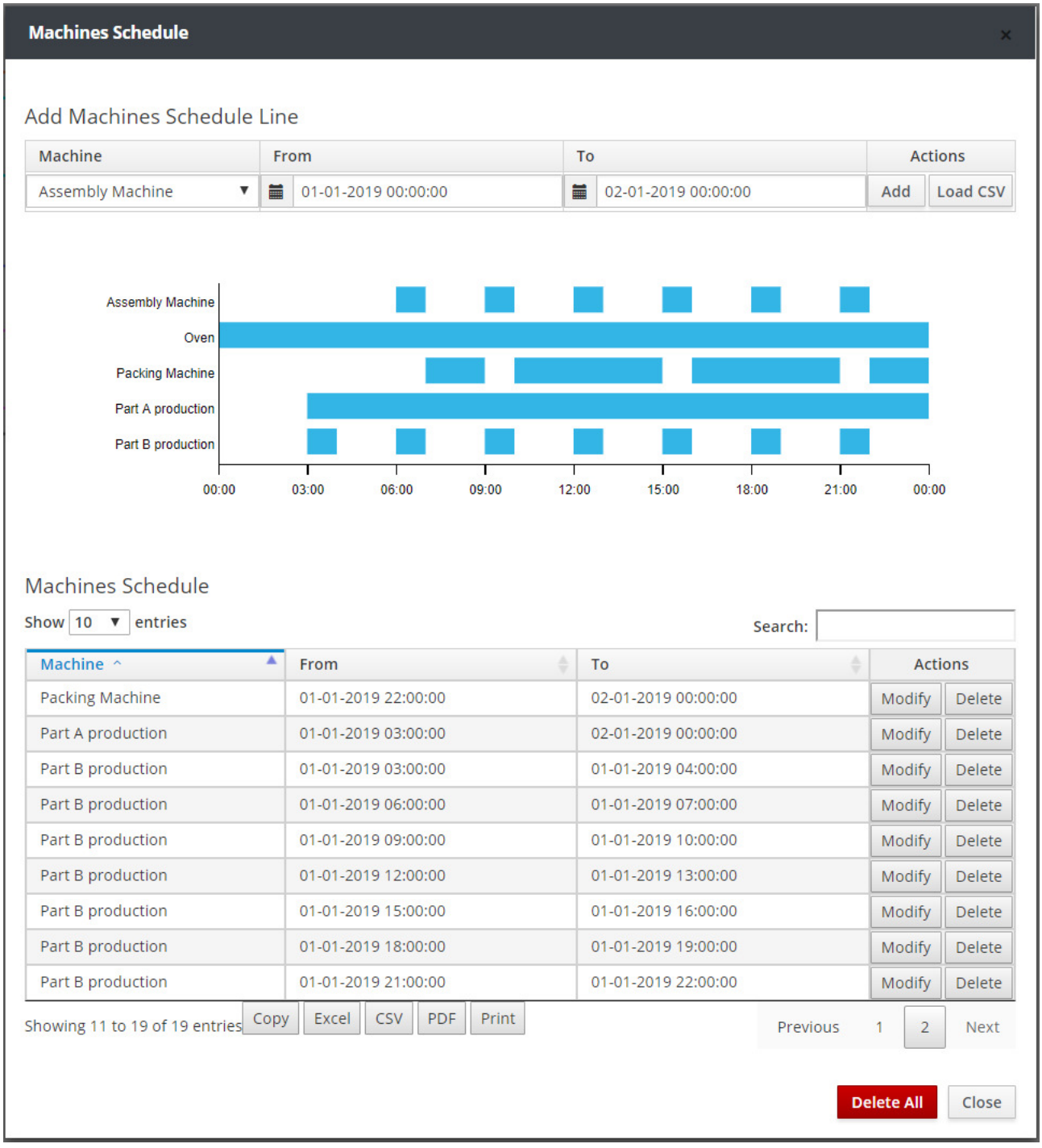


⓪ Set the Machines Schedule as shown below.

1st Page



2nd Page


Machines Schedule
Add Machines Schedule Line
Machine
From
To
Actions
Assembly Machine
01-01-2019 00:00:00
02-01-2019 00:00:00
Add
Load CSV
Assembly Machine
Oven
Packing Machine
Part A production
Part B production
00:00
03:00
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18:00
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Machines Schedule
Show 10 entries
Search:
Machine
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Actions
Packing Machine 01-01-2019 22:00:00 02-01-2019 00:00:00 Modify Delete
Part A production 01-01-2019 03:00:00 02-01-2019 00:00:00 Modify Delete
Part B production 01-01-2019 03:00:00 01-01-2019 04:00:00 Modify Delete
Part B production 01-01-2019 06:00:00 01-01-2019 07:00:00 Modify Delete
Part B production 01-01-2019 09:00:00 01-01-2019 10:00:00 Modify Delete
Part B production 01-01-2019 12:00:00 01-01-2019 13:00:00 Modify Delete
Part B production 01-01-2019 15:00:00 01-01-2019 16:00:00 Modify Delete
Part B production 01-01-2019 18:00:00 01-01-2019 19:00:00 Modify Delete
Part B production 01-01-2019 21:00:00 01-01-2019 22:00:00 Modify Delete
Showing 11 to 19 of 19 entries
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CSV
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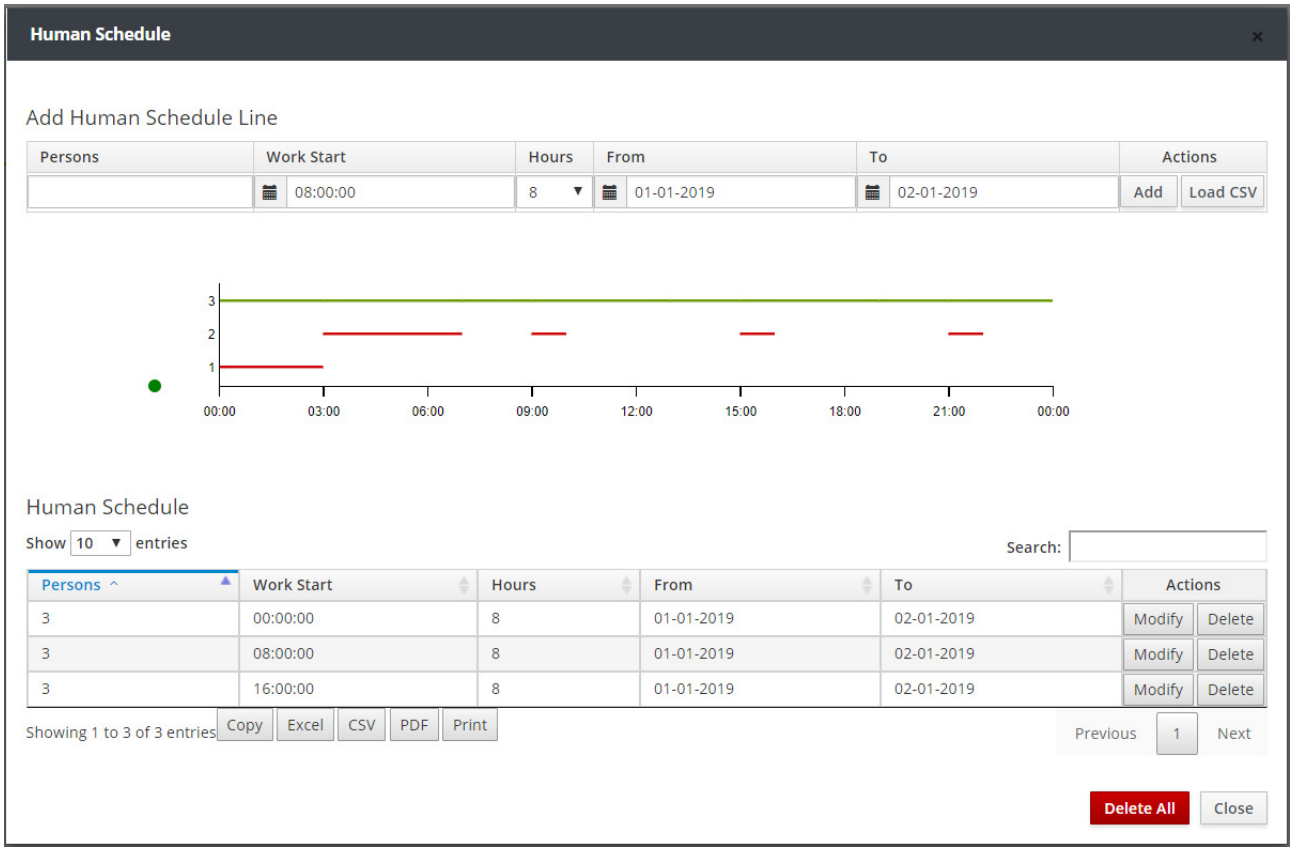
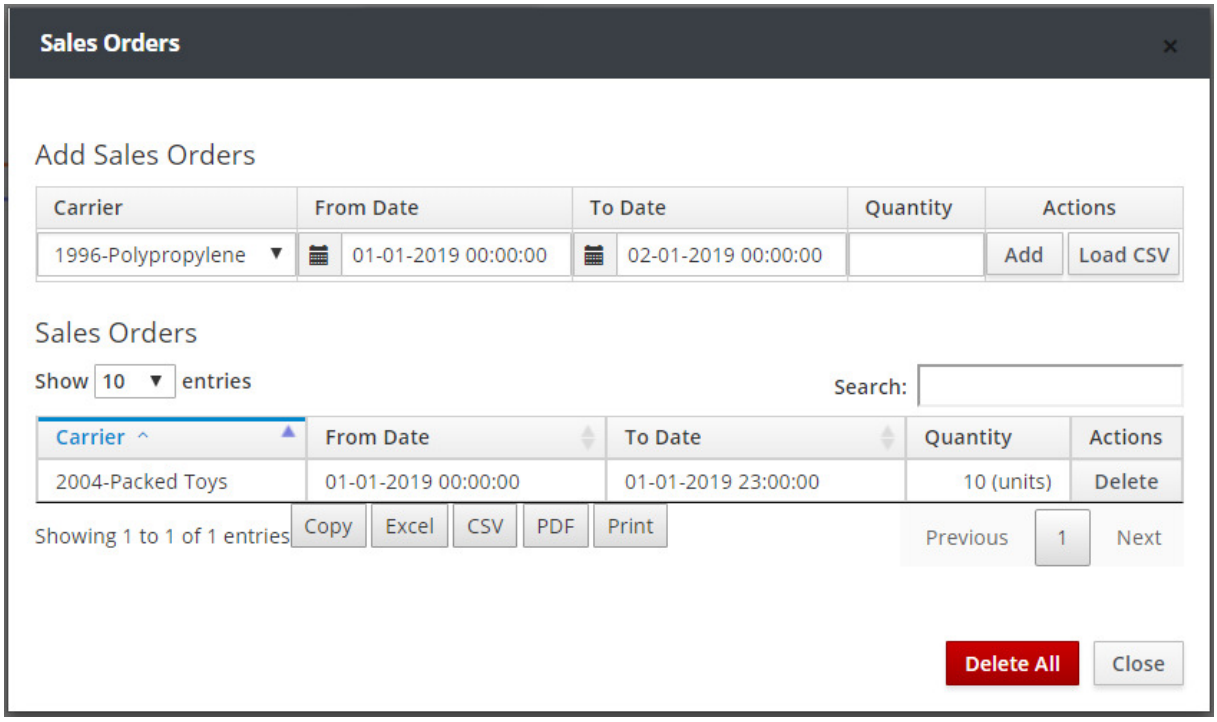
Next
Delete All
Close

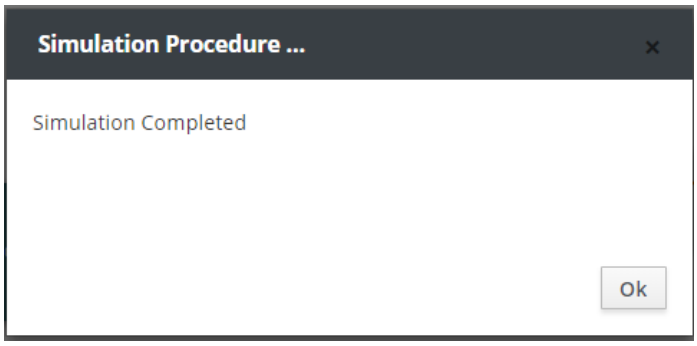
◎ Set the Human Schedule as shown in the following figure.



◎ Set the Sales Order as shown in the following figure.



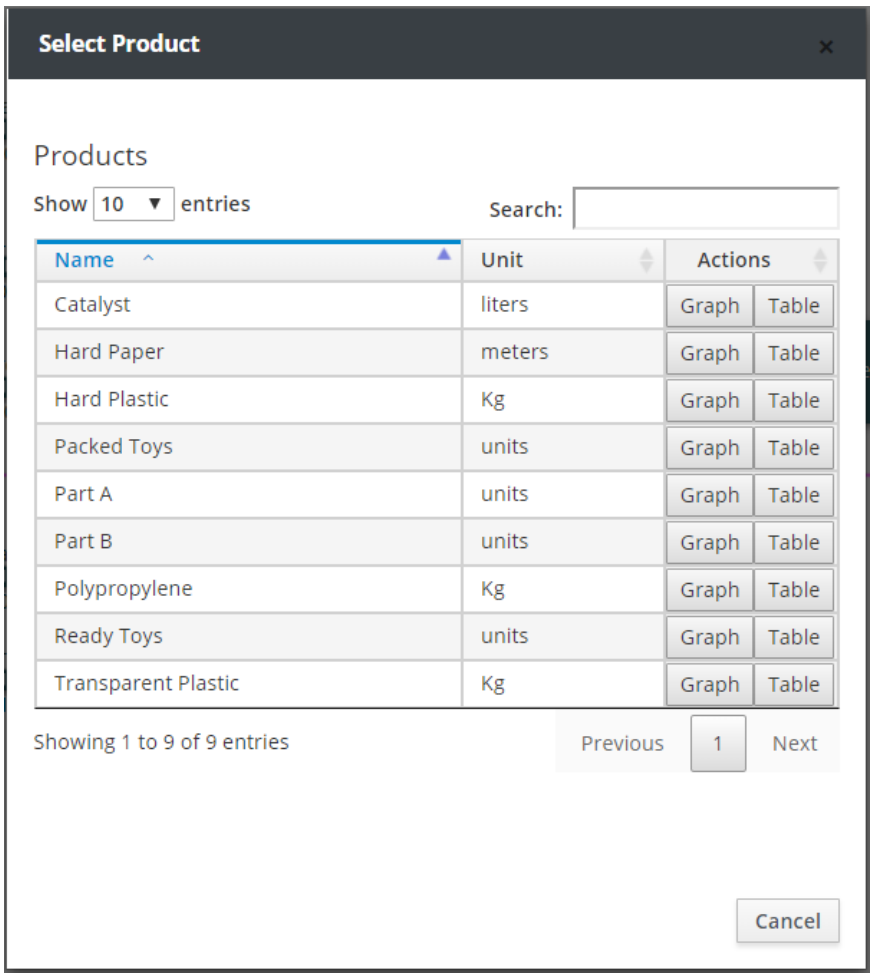
◎ Run the simulation by clicking the **Run** button in the Simulator main menu.



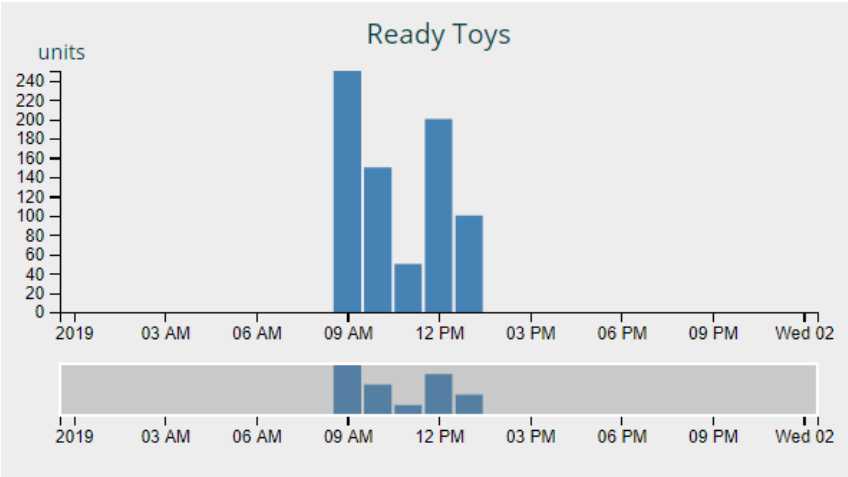
◎ After completing the simulation, save the results to a Run named *sim1.run1.ex3.v1* using the **Save Run** button.

◎ Then go to Results Mode and select the Run named *sim1.run1.ex3.v1*

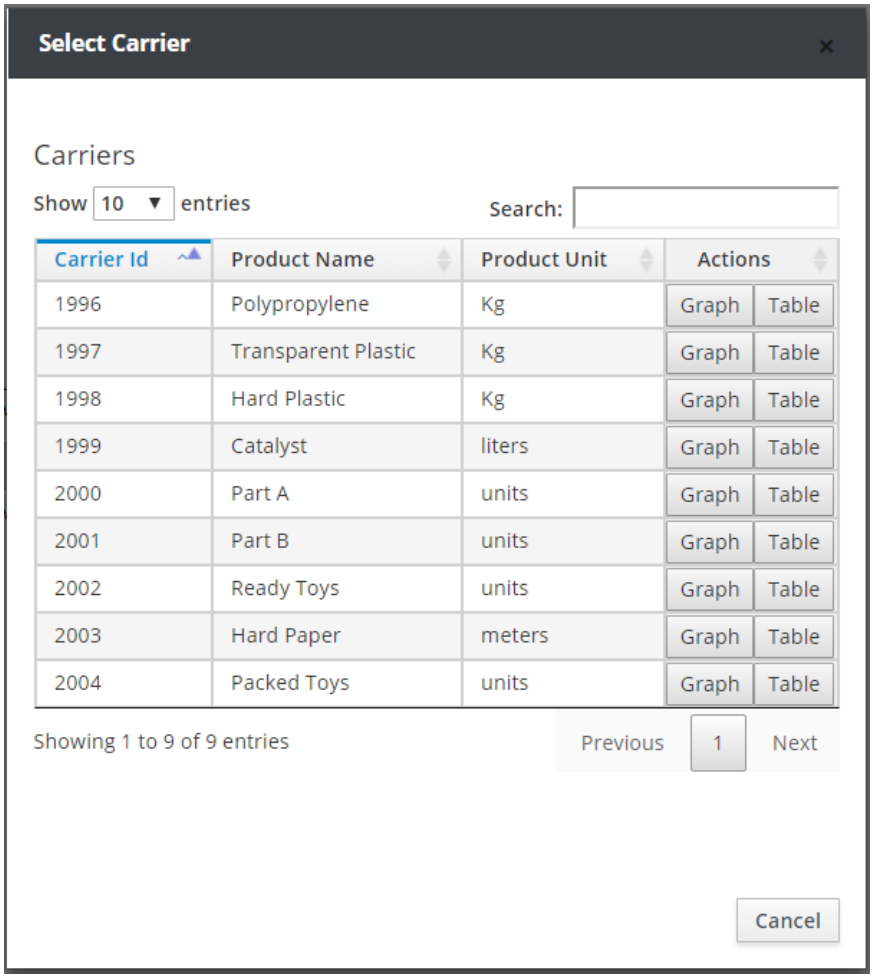
◎ Press the **Product View** button and then **Graph** or **Table** on the products you want to review the results.



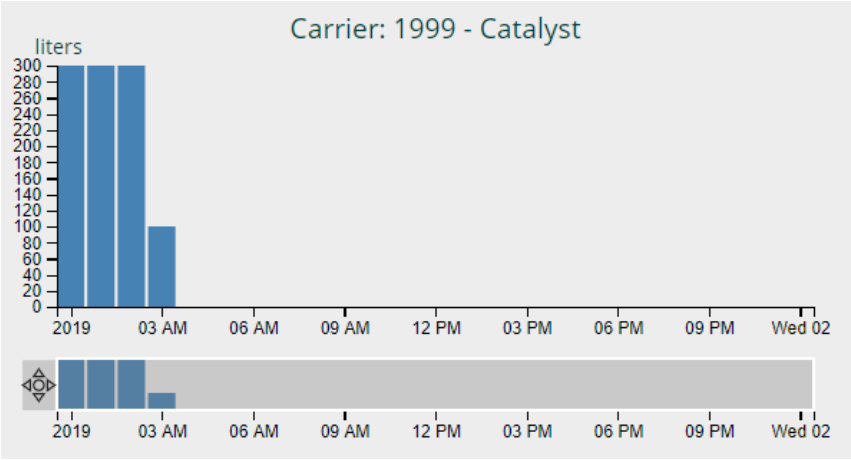
The following figure shows the graph of the finished toys at each moment of the simulation time.



© Press the Carrier View button and then Graph or Table on the Carriers you want to review the results.

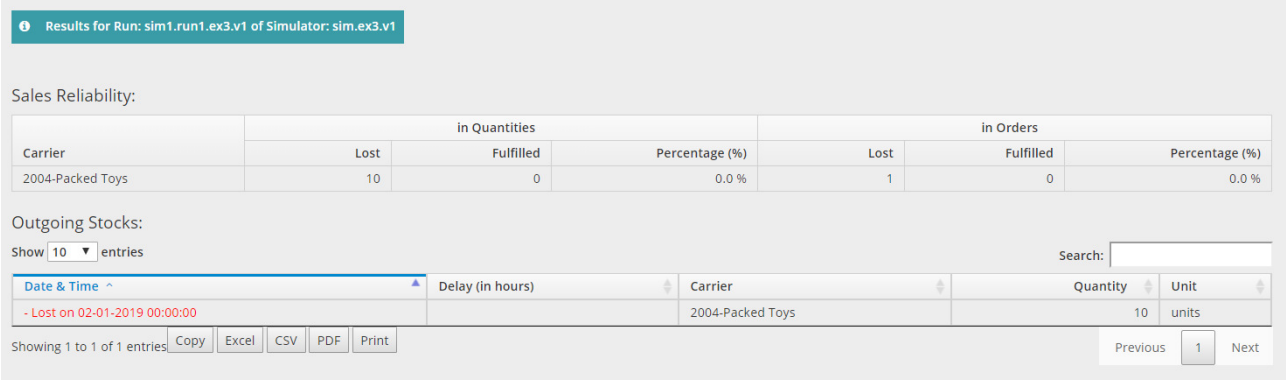


The graph below shows the graph of the amount of available catalyst at Carrier 1999 at each moment of simulation time.



◎ Press the **Instant View** button and select the specific time of the simulation time in which you want to display the quantities of Products or Carriers.

⓪ Press the **Outgoing Stocks** button to show sales that were made or lost during simulation time.



⓪ Press the **Excess Production** button to display any excess production at simulation time. During this simulation period, you notice that at the moments of 01-01-2019 03:00:00, 01-01-2019 05:00:00 and 01-01-2019 06:00:00 there are overflows of the Carrier 1998 that stores Hard Plastic, which means that the Machine Oven runs unnecessarily on this specific time interval and wastes resources.

⓪ Press the **Idle Machines** button to display Machine idle times during simulation time.

⓪ Press the **Idle Humans** button to display employee inactivity times during simulation time.

⓪ Notice that the order for 10 Packed Toys was not fulfilled because no such products were produced. There were also periods of inactivity of employees and unnecessary machine operation. Correct the appropriate schedules in Simulation Mode to eliminate the above problems in the production line.

8.4 Fourth Educational Paradigm

This example concerns a production line of bottling juice and packing them in packs of 12 bottles. At first, the propylene which is the raw material for the manufacture of the bottles and packaging material is fed into the ovens, to create bottles, caps and packaging material. The empty bottles are transferred to the juice filling machine and then to the bottling machine. The caps are advanced to the bottling machine. After the seal has been completed, the finished bottles are pushed into the packing machine where they are packaged in packs of 12. For this example, a 39-hour simulation is proposed.

Flow Chart

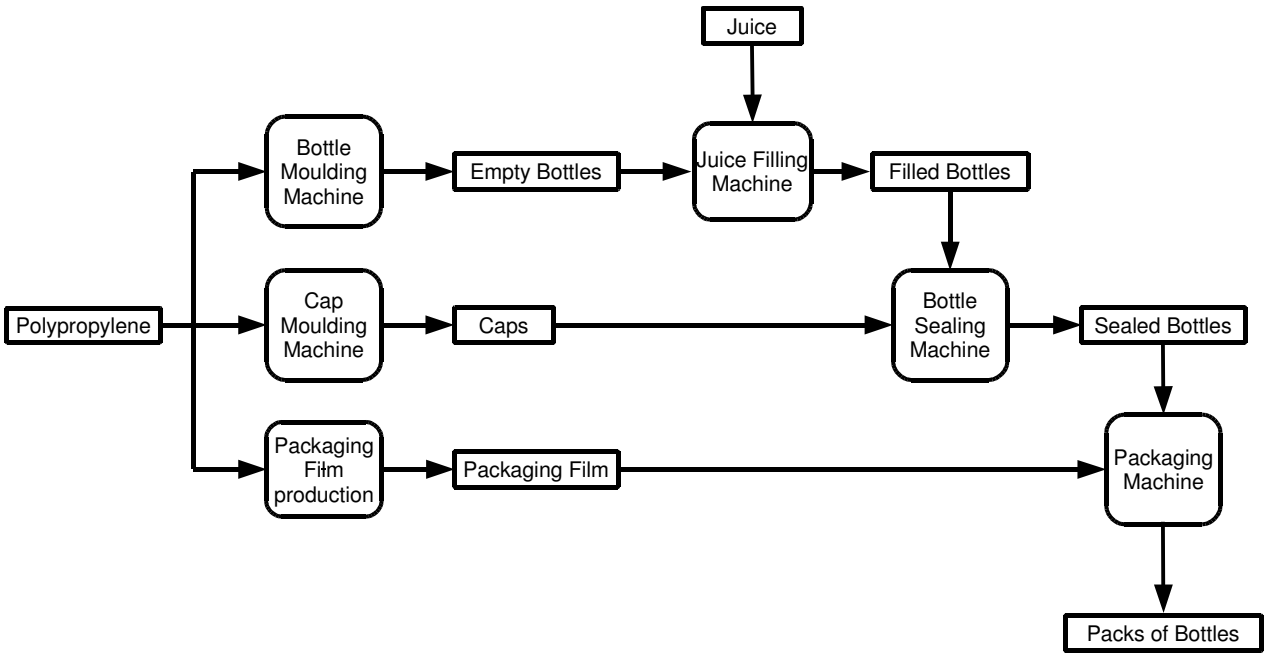
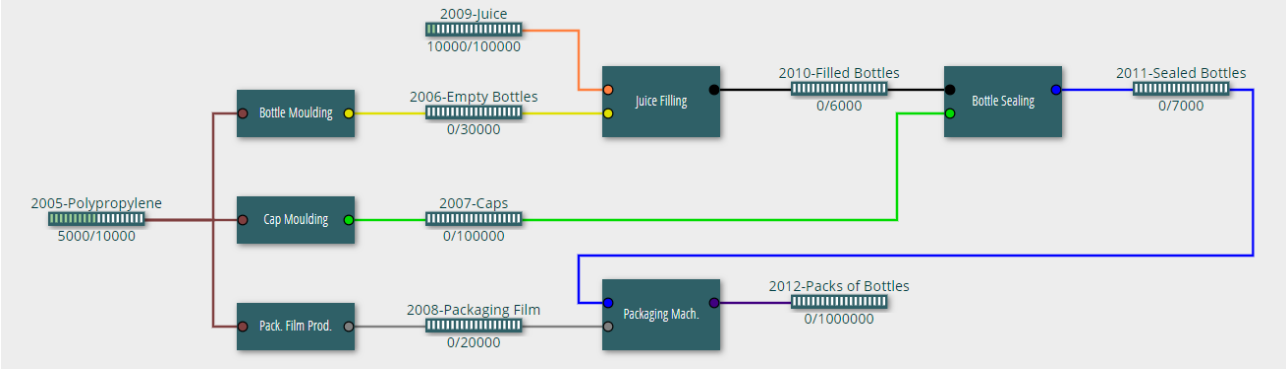


Table of Specifications

Carriers Max Capacities	Machines Specifications
Polypropylene: 10.000 Kg **Empty Bottles:** 30.000 units **Caps:** 100.000 units **Packaging Film:** 20.000 m **Juice:** 100.000 liters **Filled Bottles:** 6.000 units **Sealed Bottles:** 7.000 units **Packs of Bottles:** 1.000.000 units	**Bottle Moulding Machine**: Inputs: 1 • 100 Kg of Polypropylene Outputs: 1 • 9.500 units of Empty Bottles Next Input Time: 1 hour Production Time: 1 hour Required Human: 1 **Cap Moulding Machine:** Inputs: 1 • 100 Kg of Polypropylene Outputs: 1 • 21.250 units of Caps Next Input Time: 1 hour Production Time: 1 hours Required Human: 1 **Packaging Film Production:** Inputs: 1 • 100 Kg of Polypropylene Outputs: 1 • 4.900 m of Packaging Film Next Input Time: 1 hour Production Time: 1 hour Required Human: 1 **Juice Filling Machine:** Inputs: 2 • 5.000 liters of Juice • 5.000 units of Empty Bottles Outputs: 1 • 5.000 units of Filled Bottles Next Input Time: 2 hour Production Time: 2 hour Required Human: 0 **Bottle Sealing Machine:** Inputs: 2 • 5.000 units of Filled Bottles • 5.000 units of Caps Outputs: 1 • 5.000 units of Sealed Bottles Next Input Time: 1 hour Production Time: 1 hour Required Human: 1 **Packaging Machine:** Inputs: 2 • 3.000 units of Sealed Bottles • 250 m of Packaging Film Outputs: 1 • 250 units of Packs of Bottles Next Input Time: 1 hour Production Time: 1 hour Required Human: 1

The following figure shows the Design of the above production line as it should be designed in Design Mode.

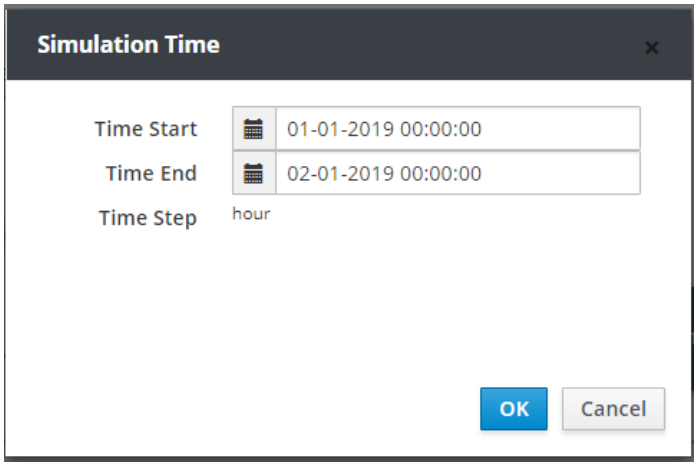


⓪ Create a new Design named *ex4* and draw inside the above production line.

⓪ Then save the final version of Design to Version named *ex4.v1*

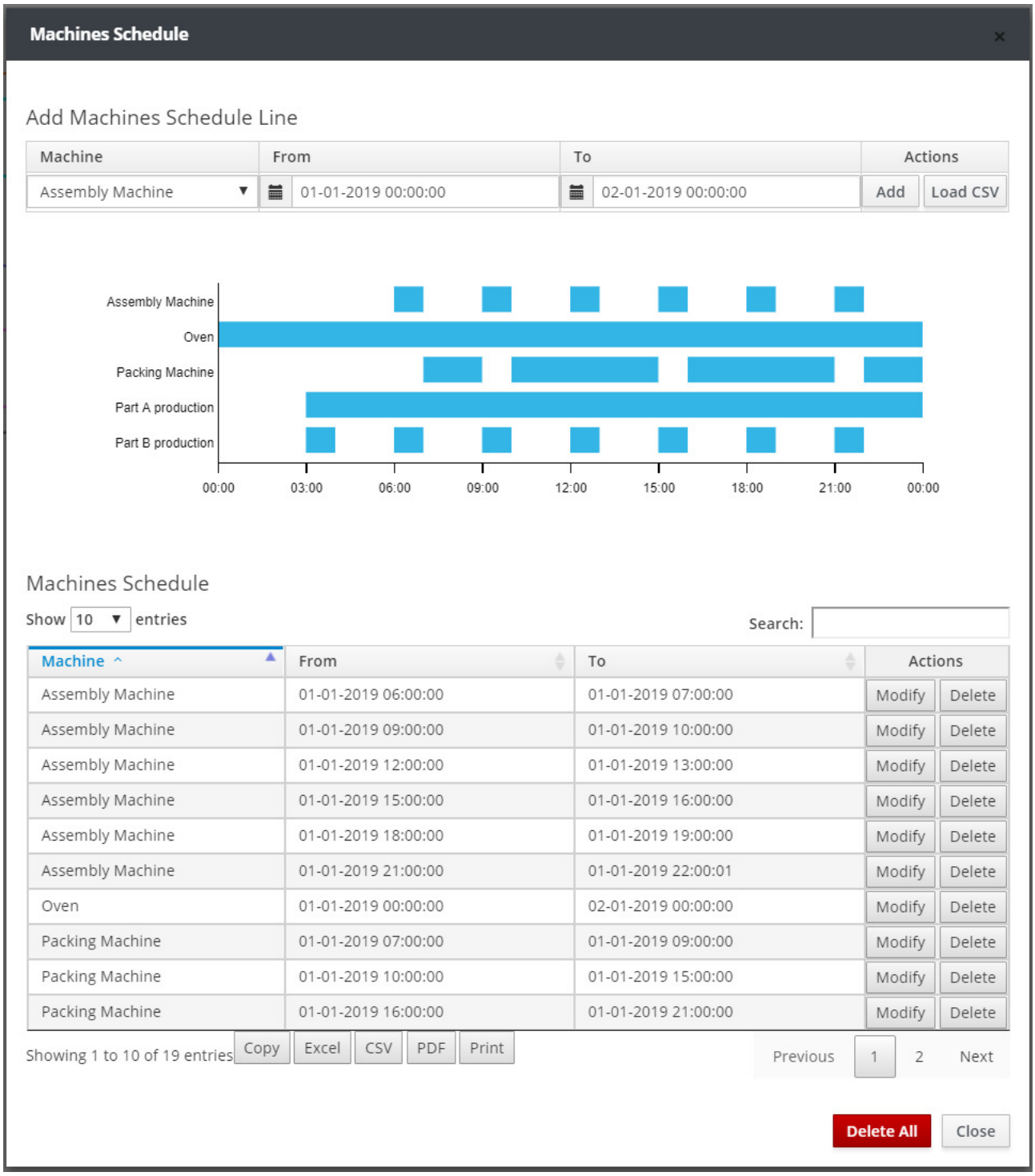
⓪ Go to Simulation Mode and create a new Simulator named *sim.ex4.v1* based on Version *ex4.v1*

⓪ Set the Time Start and Time End of the simulation as in the following figure.



⓪ Set the **Machine Schedule** as shown below.

1st Page


Machines Schedule
Add Machines Schedule Line
Machine
From
To
Actions
Assembly Machine
01-01-2019 00:00:00
02-01-2019 00:00:00
Add
Load CSV
Assembly Machine
Oven
Packing Machine
Part A production
Part B production
00:00
03:00
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12:00
15:00
18:00
21:00
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Machines Schedule
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Actions
Assembly Machine 01-01-2019 06:00:00 01-01-2019 07:00:00 Modify Delete
Assembly Machine 01-01-2019 09:00:00 01-01-2019 10:00:00 Modify Delete
Assembly Machine 01-01-2019 12:00:00 01-01-2019 13:00:00 Modify Delete
Assembly Machine 01-01-2019 15:00:00 01-01-2019 16:00:00 Modify Delete
Assembly Machine 01-01-2019 18:00:00 01-01-2019 19:00:00 Modify Delete
Assembly Machine 01-01-2019 21:00:00 01-01-2019 22:00:01 Modify Delete
Oven 01-01-2019 00:00:00 02-01-2019 00:00:00 Modify Delete
Packing Machine 01-01-2019 07:00:00 01-01-2019 09:00:00 Modify Delete
Packing Machine 01-01-2019 10:00:00 01-01-2019 15:00:00 Modify Delete
Packing Machine 01-01-2019 16:00:00 01-01-2019 21:00:00 Modify Delete
Showing 1 to 10 of 19 entries
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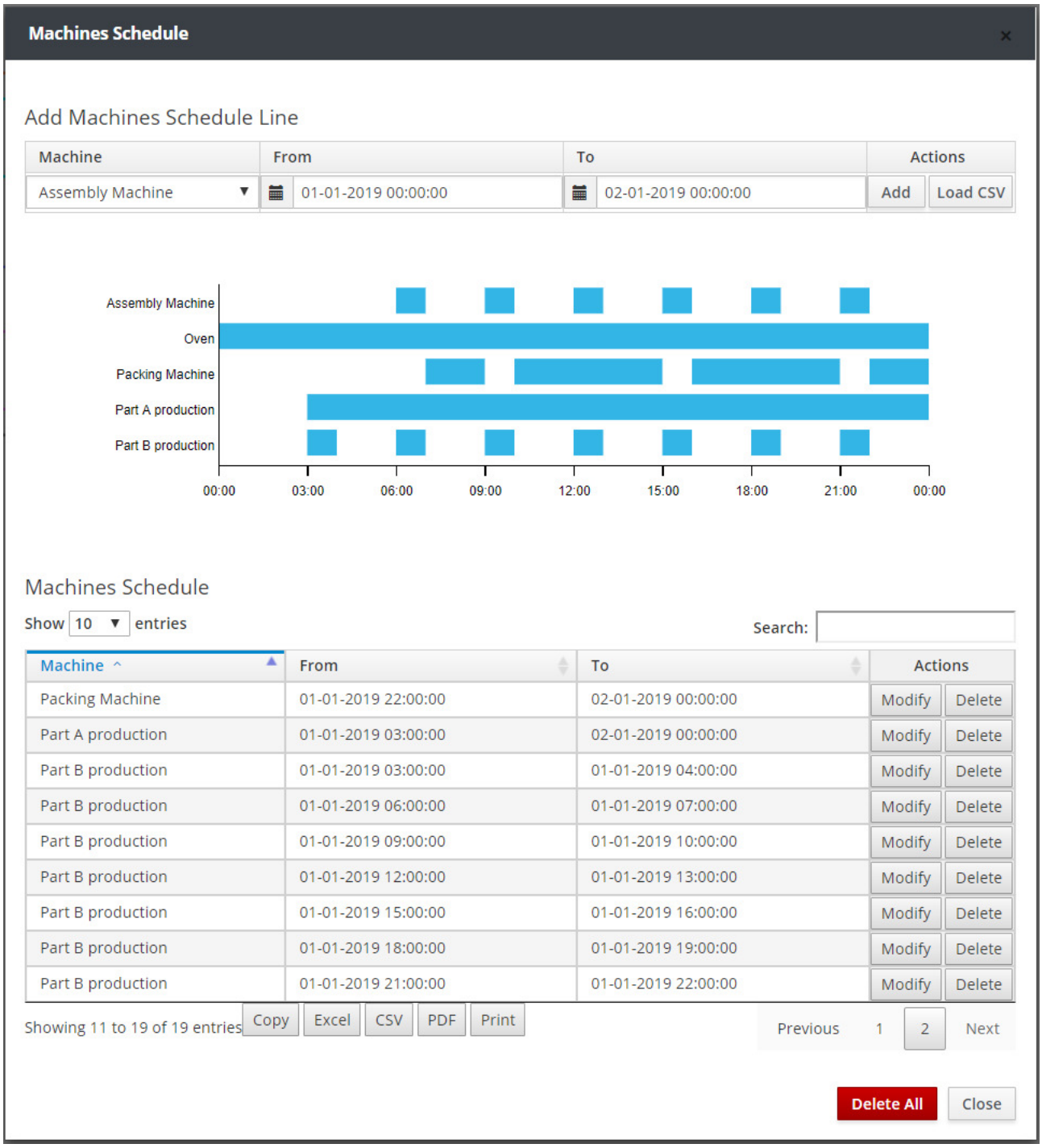
Close

2nd Page


Machines Schedule
Add Machines Schedule Line
Machine
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To
Actions
Assembly Machine
01-01-2019 00:00:00
02-01-2019 00:00:00
Add
Load CSV
Assembly Machine
Oven
Packing Machine
Part A production
Part B production
00:00
03:00
06:00
09:00
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15:00
18:00
21:00
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Machines Schedule
Show 10 entries
Search:
Machine
From
To
Actions
Packing Machine 01-01-2019 22:00:00 02-01-2019 00:00:00 Modify Delete
Part A production 01-01-2019 03:00:00 02-01-2019 00:00:00 Modify Delete
Part B production 01-01-2019 03:00:00 01-01-2019 04:00:00 Modify Delete
Part B production 01-01-2019 06:00:00 01-01-2019 07:00:00 Modify Delete
Part B production 01-01-2019 09:00:00 01-01-2019 10:00:00 Modify Delete
Part B production 01-01-2019 12:00:00 01-01-2019 13:00:00 Modify Delete
Part B production 01-01-2019 15:00:00 01-01-2019 16:00:00 Modify Delete
Part B production 01-01-2019 18:00:00 01-01-2019 19:00:00 Modify Delete
Part B production 01-01-2019 21:00:00 01-01-2019 22:00:00 Modify Delete
Showing 11 to 19 of 19 entries
Copy
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CSV
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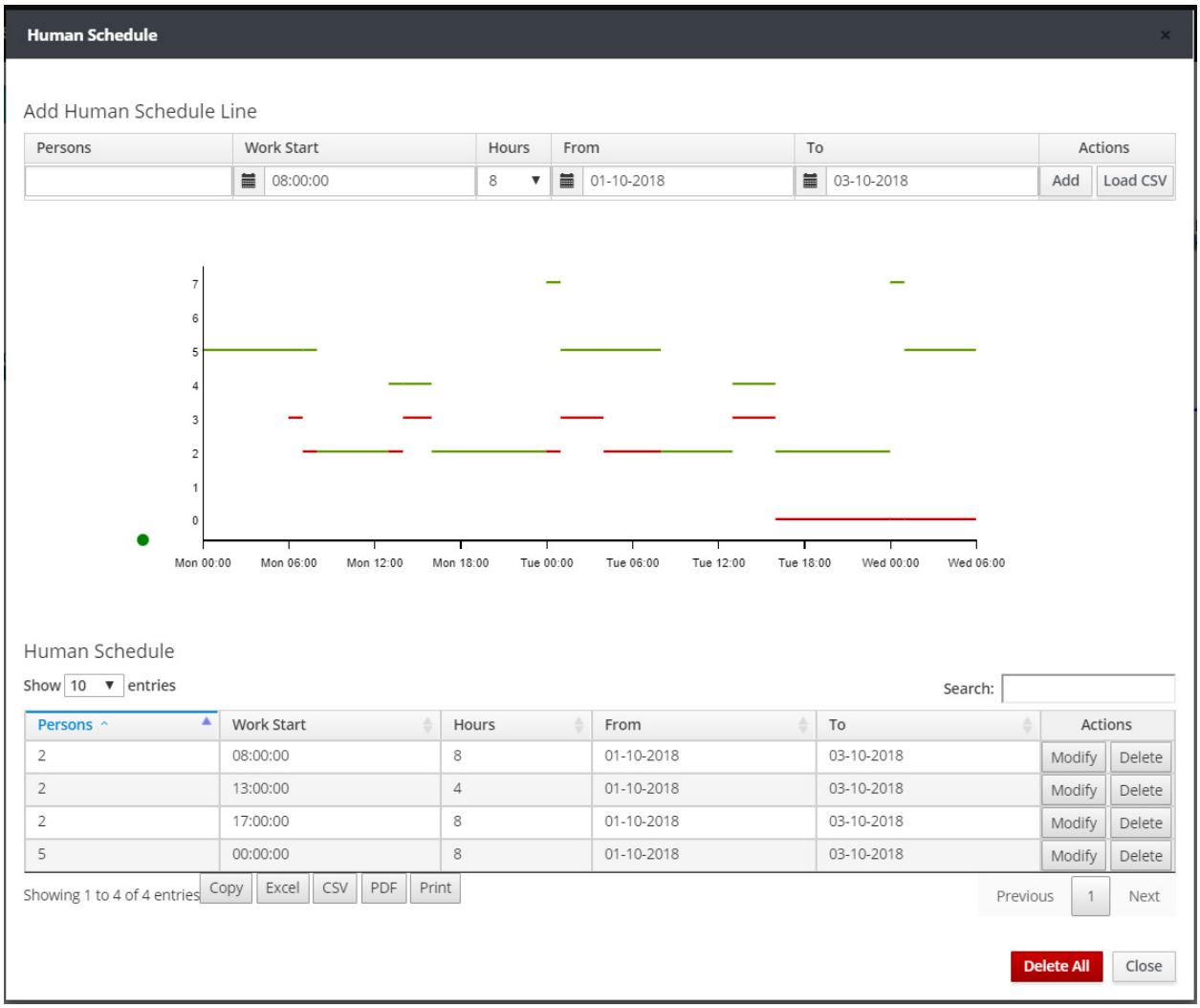
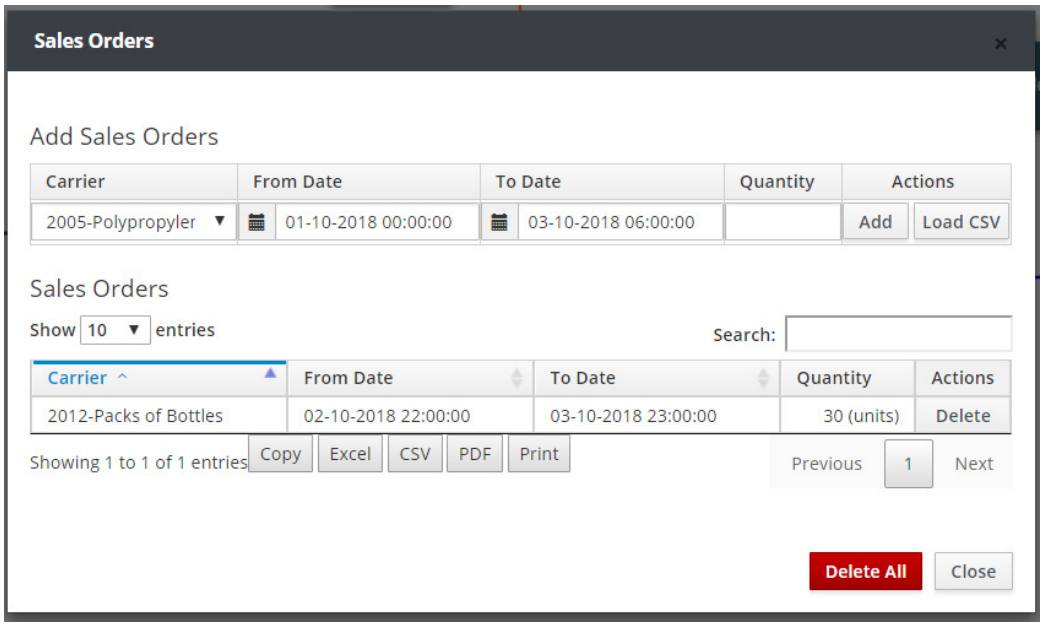
Next
Delete All
Close

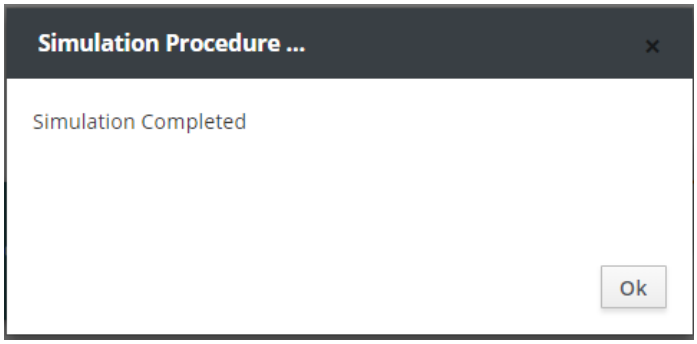
⓪ Set the **Human Schedule** as shown in the following figure.



⓪ Set the **Sales Orders** as shown in the following figure.



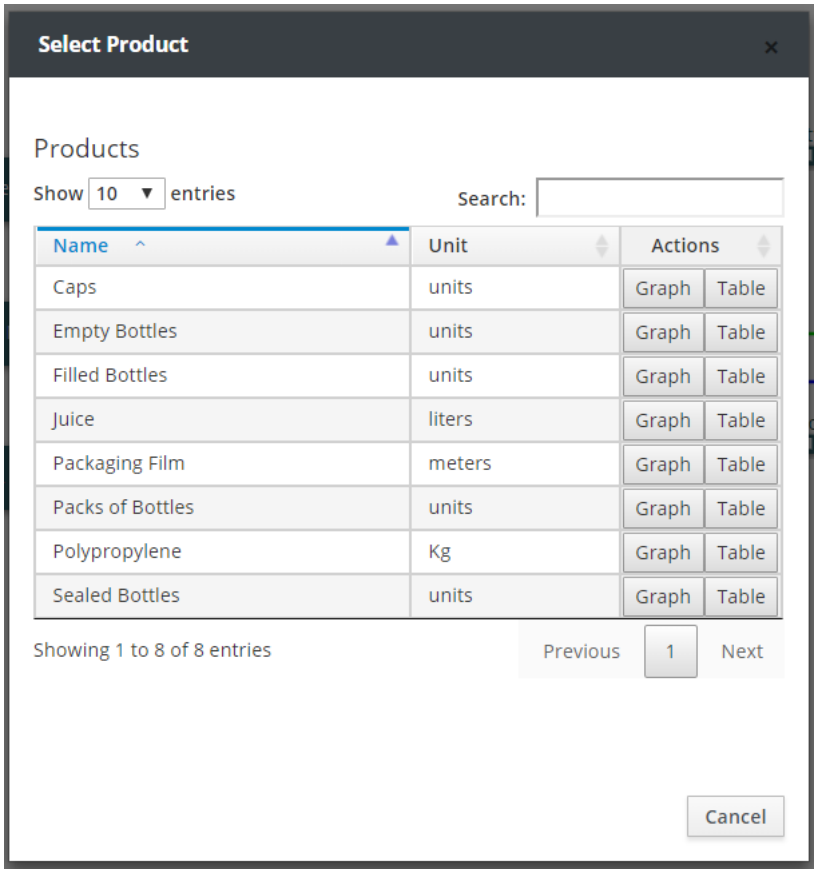
⓪ Run the simulation by clicking the **Run** button in the Simulator main menu.



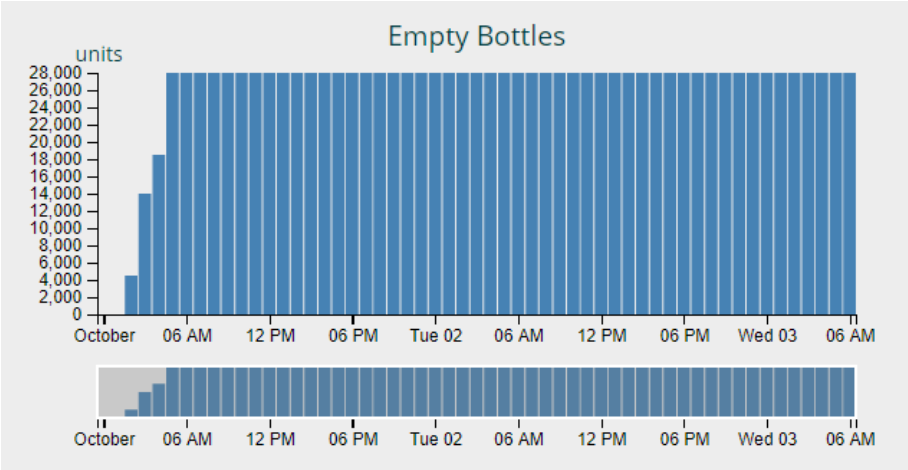
⓪ After completing the simulation, save the simulation results to a Run named *sim1.run1.ex4.v1* using the **Save Run** button.

⓪ Then go to Results Mode and select the Run *sim1.run1.ex4.v1*

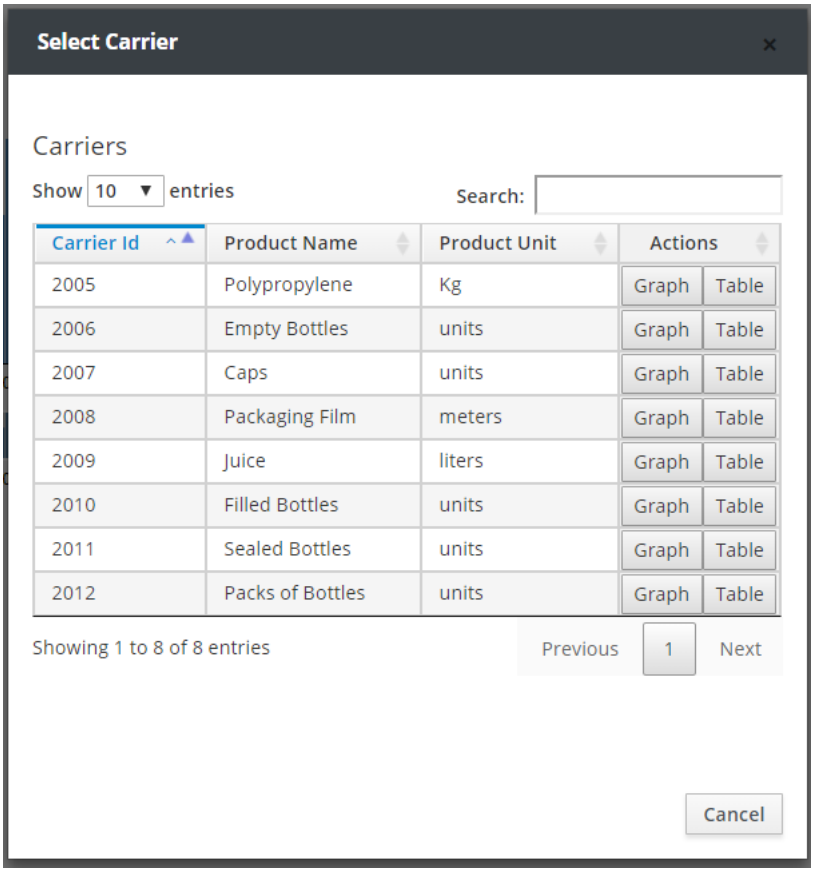
⓪ Press the **Product View** button and then **Graph** or **Table** on the products you want to review the results.



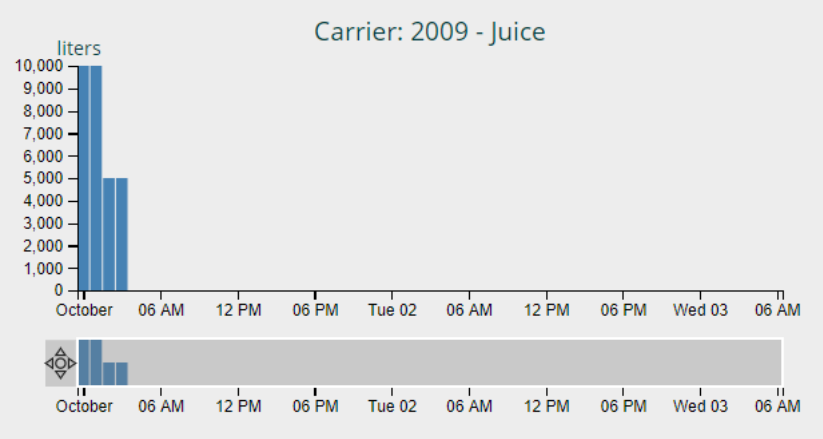
The following figure shows the graph of empty bottles at each moment of simulation time.



Press the **Carrier View** button and then **Graph** or **Table** on the Carriers you want to review the results.

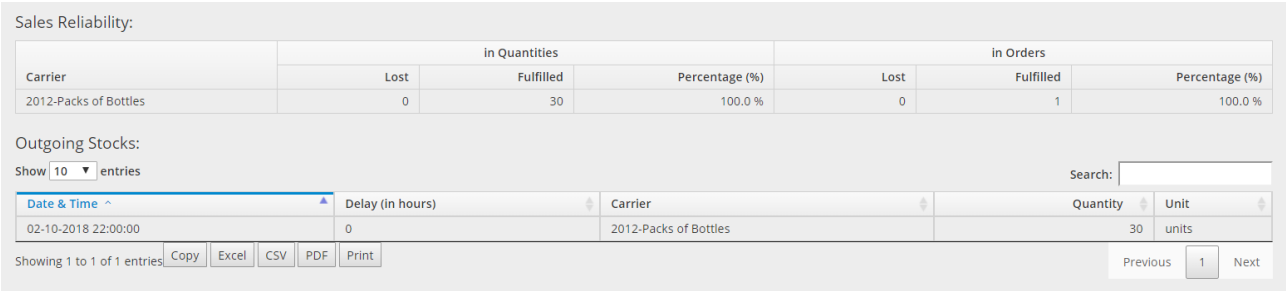


The following figure shows the graph of the amount of juice in Carrier 2009 at each moment of simulation time.



⓪ Press the **Instant View** button, select the specific time of the simulation time in which you want to display the quantities of Products or Carriers.

⓪ Press the **Outgoing Stocks** button to display the sales that were made or lost during the simulation time.



Sales Reliability:

Carrier	in Quantities			in Orders		
	Lost	Fulfilled	Percentage (%)	Lost	Fulfilled	Percentage (%)
2012-Packs of Bottles	0	30	100.0 %	0	1	100.0 %

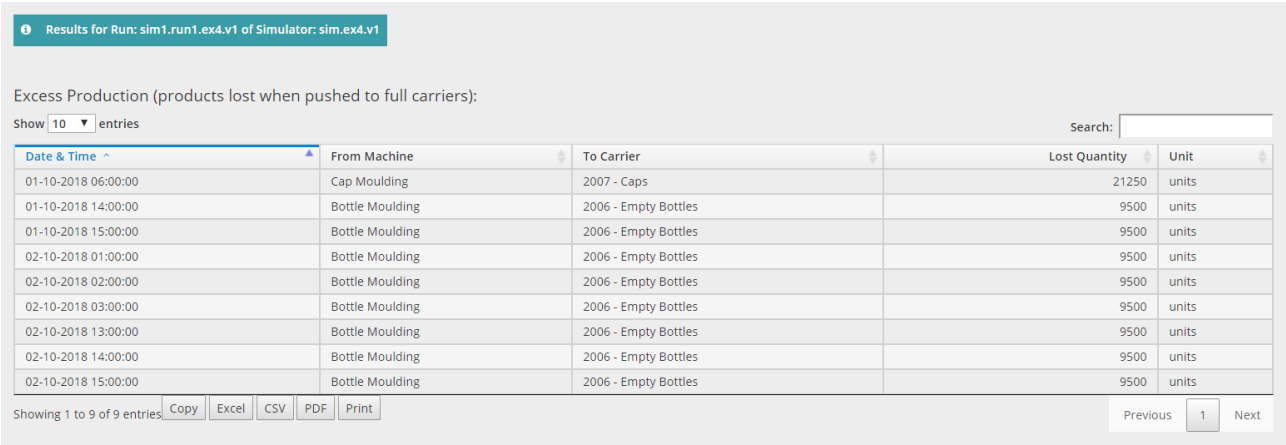
Outgoing Stocks:

Show 10 entries Search:

Date & Time	Delay (in hours)	Carrier	Quantity	Unit
02-10-2018 22:00:00	0	2012-Packs of Bottles	30	units

Showing 1 to 1 of 1 entries Copy Excel CSV PDF Print Previous 1 Next

Ⓞ Press the **Excess Production** button to display any excess production during simulation time. During this simulation period, you notice that there is excess production of caps and empty bottles, which means that the Cap Molding Machine and the Bottle Molding Machine work unnecessarily and waste resources.



Results for Run: sim1.run1.ex4.v1 of Simulator: sim.ex4.v1

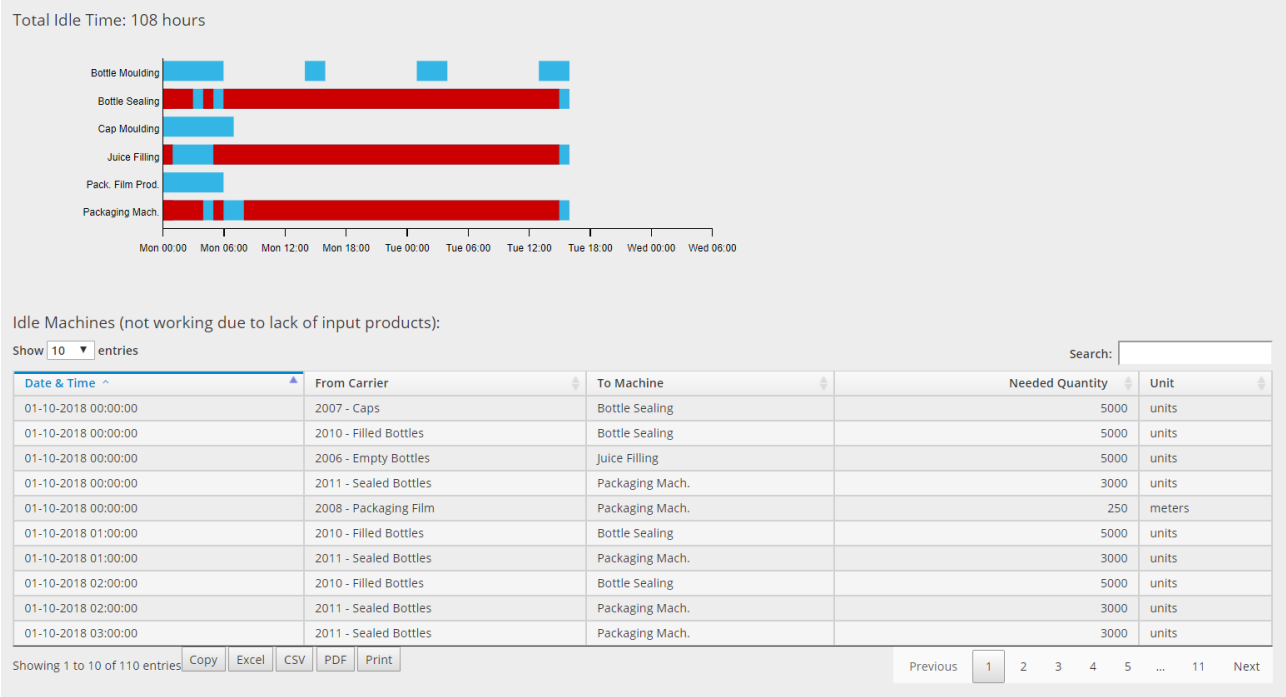
Excess Production (products lost when pushed to full carriers):

Show 10 entries Search:

Date & Time	From Machine	To Carrier	Lost Quantity	Unit
01-10-2018 06:00:00	Cap Moulding	2007 - Caps	21250	units
01-10-2018 14:00:00	Bottle Moulding	2006 - Empty Bottles	9500	units
01-10-2018 15:00:00	Bottle Moulding	2006 - Empty Bottles	9500	units
02-10-2018 01:00:00	Bottle Moulding	2006 - Empty Bottles	9500	units
02-10-2018 02:00:00	Bottle Moulding	2006 - Empty Bottles	9500	units
02-10-2018 03:00:00	Bottle Moulding	2006 - Empty Bottles	9500	units
02-10-2018 13:00:00	Bottle Moulding	2006 - Empty Bottles	9500	units
02-10-2018 14:00:00	Bottle Moulding	2006 - Empty Bottles	9500	units
02-10-2018 15:00:00	Bottle Moulding	2006 - Empty Bottles	9500	units

Showing 1 to 9 of 9 entries Copy Excel CSV PDF Print Previous 1 Next

Ⓞ Press the **Idle Machines** button to display Machine idle times during the simulation time.



◎ Press the **Idle Humans** button to display employees inactivity time intervals during simulation time.

◎ Notice that there are long idle time intervals for both machines and staff. Nevertheless, there is also over-production of products. Correct the appropriate programs in Simulation Mode to eliminate the above problems in the production line.

8.5 Fifth Educational Paradigm

This example concerns a production line that produces packed bread slices for toasts. The raw materials are flour, yeast, salt and water. Raw materials are imported into the dough mixer machine to create the dough. Then the dough is provided to the rolling machine. The rolled dough is passed to the dough divider machine. The dough pieces are molded in the moulder machine which produces the unbaked breads. The unbaked breads are baked in the oven and then sliced. At the final stage, slices of toast are packed into two types of package containing either 20 or 36 slices. For this example a simulation of 32 hours is proposed.

Flow Chart

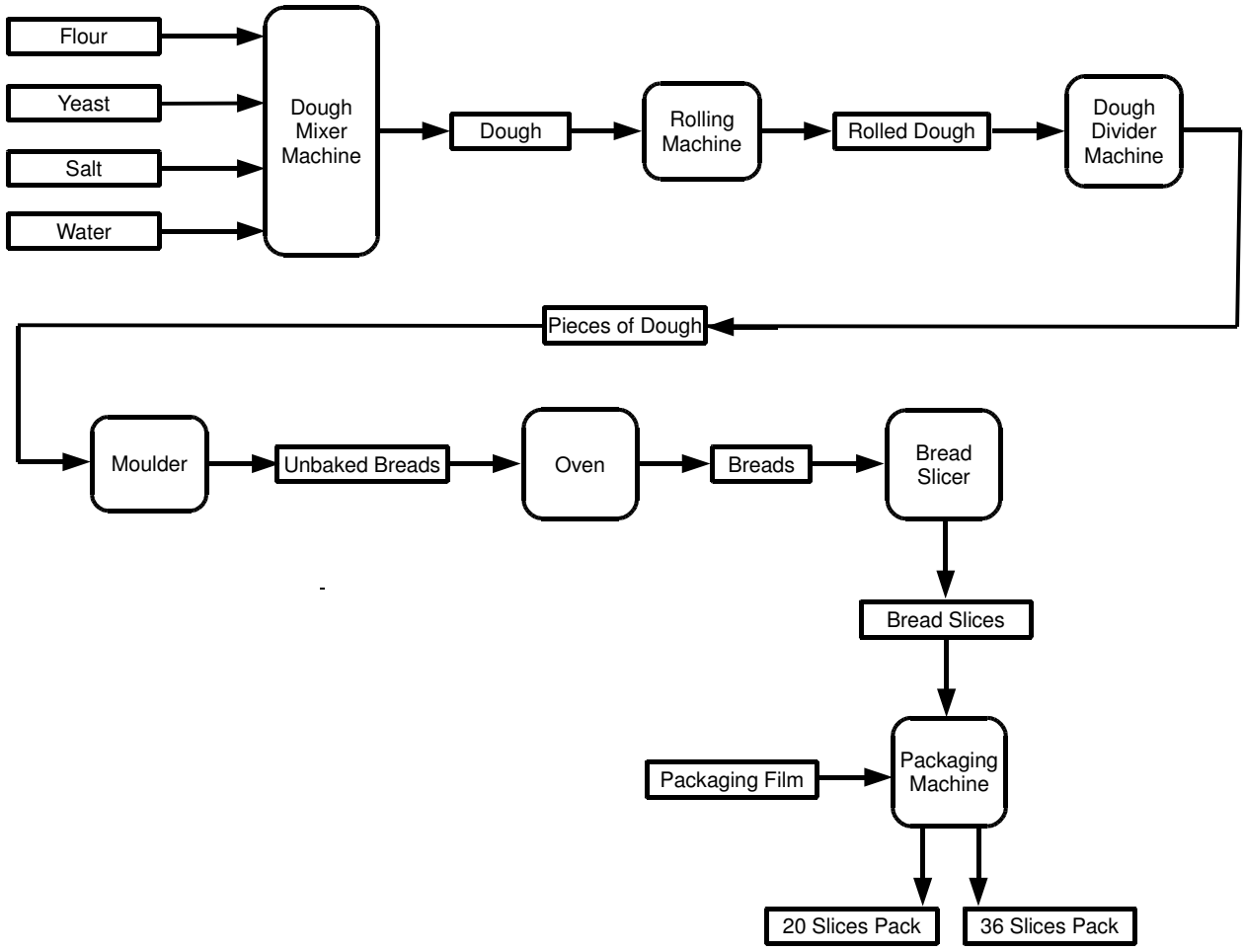
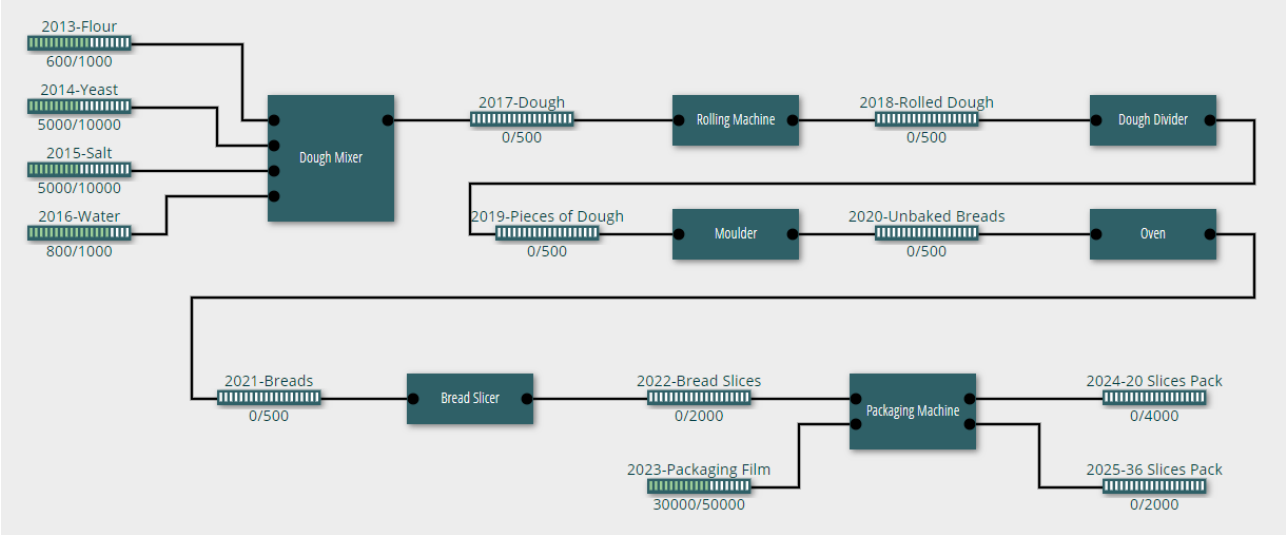


Table of Specifications

Carriers Max Capacities	Machines Specifications
Flour: 1.000 Kg **Yeast:** 10.000 g **Salt:** 10.000 g **Water:** 1.000 liters **Dough:** 500 Kg **Rolled Dough:** 500 Kg **Pieces of Dough:** 500 units **Unbaked Breads:** 500 units **Breads:** 500 units **Bread Slices:** 2.000 units **Packaging Film:** 50.000 cm **20 Slices Pack:** 4.000 units **36 Slices Pack:** 2.000 units	**Dough Mixer Machine**: Inputs: 4 • 60 Kg of Flour • 500 g of Yeast • 200 g of Salt • 25 liters of Water Outputs: 1 • 85 Kg of Dough Next Input Time: 15 min Production Time: 15 min Required Human: 1 **Rolling Machine:** Inputs: 1 • 20 Kg of Dough Outputs: 1 • 20 Kg of Rolled Dough Next Input Time: 5 min Production Time: 5 min Required Human: 1 **Dough Divider Machine:** Inputs: 1 • 20 Kg of Rolled Dough Outputs: 1 • 20 Pieces of Dough Next Input Time: 5 min Production Time: 5 min Required Human: 1 **Moulder:** Inputs: 1 • 1 Piece of Dough Outputs: 1 • 1 unit of Unbaked Bread Next Input Time: 1 min Production Time: 1 min Required Human: 1 **Oven:** Inputs: 1 • 85 units of Unbaked Bread Outputs: 1 • 85 units of Bread Next Input Time: 30 min Production Time: 30 min Required Human: 1 **Bread Slicer:** Inputs: 1 • 1 unit of Bread Outputs: 1 • 40 units of Bread Slices Next Input Time: 1 min Production Time: 1 min Required Human: 1 **Packaging Machine:** Inputs: 2 • 56 unit of Bread Slices • 50 cm of Packaging Film Outputs: 2 • 1 unit of 20 Slices Pack • 1 unit of 36 Slices Pack Next Input Time: 1 min Production Time: 1 min Required Human: 1

The following figure shows the Design of the above production line as it should be designed in Design Mode.

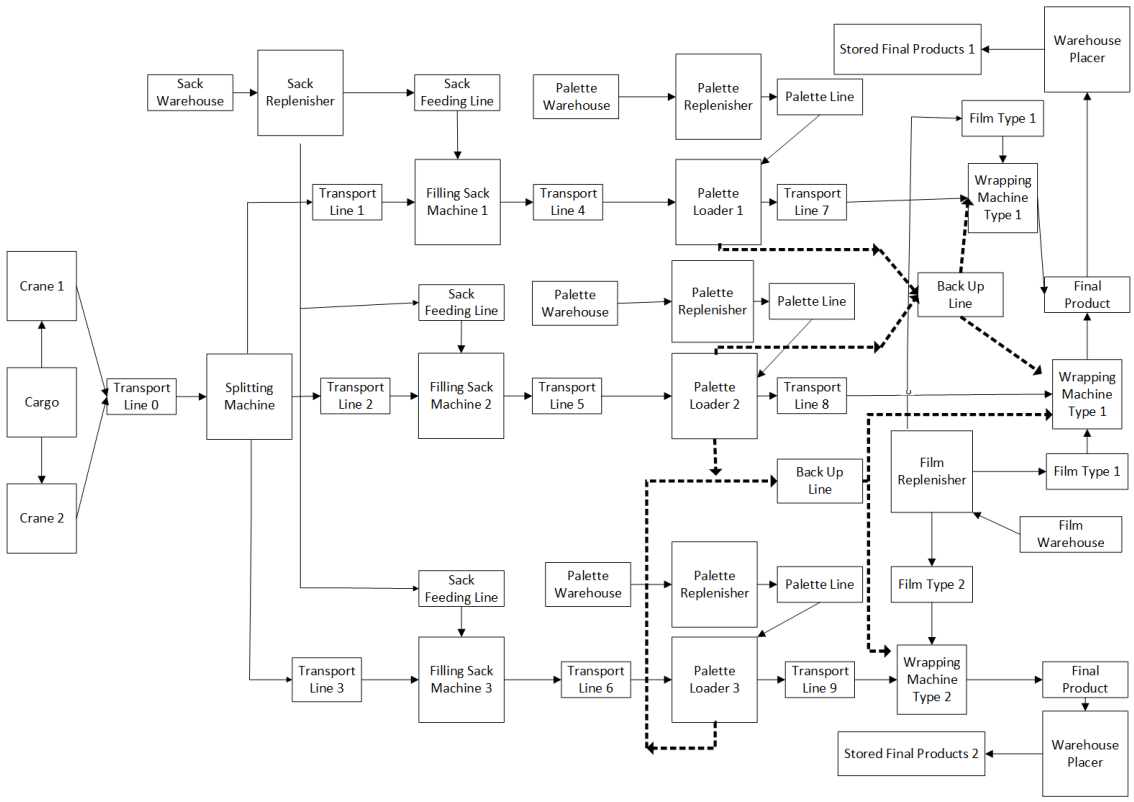


◎ Create a Design named *ex5* that depicts the above production line. Then create a Simulator and simulate the production line to produce 40 "20 Slices Packs" and 40 "36 Slices Packs" using as few resources as possible in both raw materials and human resources.

8.6 Sixth Educational Paradigm

In this example a quite large model is presented. It concerns the unload process of a cargo ship, that may contain wheat, corn, rice or rye. The flow chart of the process has as follows:

Flow Chart



The model will be implemented by creating one Design containing 4 different production lines one for each product. The Machines and Carriers specifications for the production line of each product are presented in the following 4 tables.

Wheat Production Line Specifications

Carriers Initial / Max Capacities	Machines Specifications
Cargo : 50000 / 50000 Kg **Transport Line 0 :** 0 / 10000 Kg **Transport Line 1 :** 0 / 12000 Kg **Transport Line 2 :** 0 / 12000 Kg **Transport Line 3 :** 0 / 12000 Kg	**Cranes**: Inputs: 1, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 1. Inputs: 3000 Kg Outputs: 3000 Kg **Splitting Machine**: Inputs: 1, Outputs: 3, Next Input Time: 1 min, Process Time 1 min / 1 min / 1 min, Required Humans: 0. Inputs: 6000 Kg

Transport Line 4 : 0 / 80 Units **Transport Line 5 :** 0 / 80 Units **Transport Line 6 :** 0 / 80 Units **Transport Line 7 :** 0 / 3 Units **Transport Line 8 :** 0 / 3 Units **Transport Line 9 :** 0 / 3 Units **Sack Warehouse :** 10000 / 80000 Units **Palette Warehouse (1,2,3) :** 1000 / 1000 Units **Sack Feeding Line :** 500 / 500 Units **Final Product :** 0 / 8 Units **Stored Final Products 1 :** 0 / 400 Units **Stored Final Products 2 :** 0 / 350 Units **Film Type 1 :** 2000 / 2000 m **Film Type 2 :** 840 / 840 m **Film Warehouse:** 20000 / 20000 m **Back Up Line :** 0 / 4 Units	Outputs: 2000 Kg / 2000 Kg / 2000 Kg **Filling Sack Machine (1,2,3)**: Inputs: 2, Outputs: 1, Next Input Time: 2 min, Process Time 2 min, Required Humans: 1. Inputs: 40 Units, 1600 Kg Outputs: 40 Units **Palette Loader (1,2,3)**: Inputs: 2, Outputs: 1, Next Input Time: 2 min, Process Time 2 min, Required Humans: 0. Inputs: 1 Unit, 40 Units Outputs: 1 Unit **Wrapping Machine Type 1**: Inputs: 2, Outputs: 1, Next Input Time: 2 min, Process Time 2 min, Required Humans: 0. Inputs: 17 m, 1 Unit Outputs: 1 Unit **Wrapping Machine Type 2**: Inputs: 2, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 0. Inputs: 6 m, 1 Unit Outputs: 1 Unit **Warehouse Placer**: Inputs: 1, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 1. Inputs: 1 Unit Outputs: 1 Unit **Sack Replenisher**: Inputs: 1, Outputs: 3, Next Input Time: 1 min, Process Time 1 min / 1 min / 1 min, Required Humans: 0. Inputs: 450 Units Outputs: 150 Units / 150 Units / 150 Units **Palette Replenisher**: Inputs: 1, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 0. Inputs: 15 Units Outputs: 15 Units **Film Replenisher**: Inputs: 1, Outputs: 3, Next Input Time: 10 min, Process Time 10 min / 10 min / 10 min, Required Humans: 1. Inputs: 4840 m Outputs: 2000 m / 2000 m / 840 m

Corn Production Line Specifications

Carriers Initial / Max Capacities	Machines Specifications
Cargo : 80000 / 80000 Kg **Transport Line 0 :** 0 / 10000 Kg **Transport Line 1 :** 0 / 12000 Kg **Transport Line 2 :** 0 / 12000 Kg **Transport Line 3 :** 0 / 12000 Kg **Transport Line 4 :** 0 / 80 Units **Transport Line 5 :** 0 / 80 Units	**Cranes**: Inputs: 1, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 1. Inputs: 3000 Kg Outputs: 3000 Kg **Splitting Machine**: Inputs: 1, Outputs: 3, Next Input Time: 1 min, Process Time 1 min / 1 min / 1 min, Required Humans: 0. Inputs: 6000 Kg Outputs: 2000 Kg / 2000 Kg / 2000 Kg **Filling Sack Machine (1,2,3)**: Inputs: 2, Outputs: 1, Next Input Time: 2 min, Process Time 2 min,

Transport Line 6 : 0 / 80 Units **Transport Line 7 :** 0 / 3 Units **Transport Line 8 :** 0 / 3 Units **Transport Line 9 :** 0 / 3 Units **Sack Warehouse :** 10000 / 80000 Units **Palette Warehouse (1,2,3) :** 1000 / 1000 Units **Sack Feeding Line :** 500 / 500 Units **Final Product :** 0 / 8 Units **Stored Final Products 1 :** 0 / 400 Units **Stored Final Products 2 :** 0 / 350 Units **Film Type 1 :** 2000 / 2000 m **Film Type 2 :** 840 / 840 m **Film Warehouse:** 20000 / 20000 m **Back Up Line :** 0 / 3 Units	Required Humans: 1. Inputs: 40 Units, 1600 Kg Outputs: 40 Units **Palette Loader (1,2,3)**: Inputs: 2, Outputs: 1, Next Input Time: 2 min, Process Time 2 min, Required Humans: 0. Inputs: 1 Unit, 40 Units Outputs: 1 Unit **Wrapping Machine Type 1**: Inputs: 2, Outputs: 1, Next Input Time: 3 min, Process Time 3 min, Required Humans: 0. Inputs: 17 m, 1 Unit Outputs: 1 Unit **Wrapping Machine Type 2**: Inputs: 2, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 0. Inputs: 6 m, 1 Unit Outputs: 1 Unit **Warehouse Placer**: Inputs: 1, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 1. Inputs: 1 Unit Outputs: 1 Unit **Sack Replenisher**: Inputs: 1, Outputs: 3, Next Input Time: 1 min, Process Time 1 min / 1 min / 1 min, Required Humans: 0. Inputs: 450 Units Outputs: 150 m / 150 m / 150 m **Palette Replenisher**: Inputs: 1, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 0. Inputs: 15 Units Outputs: 15 Units **Film Replenisher**: Inputs: 1, Outputs: 3, Next Input Time: 10 min, Process Time 10 min / 10 min / 10 min, Required Humans: 1. Inputs: 4840 m Outputs: 2000 m / 2000 m / 840 m

Rice Production Line Specifications

Carriers Initial / Max Capacities	Machines Specifications
Cargo : 75000 / 75000 Kg **Transport Line 0 :** 0 / 10000 Kg **Transport Line 1 :** 0 / 12000 Kg **Transport Line 2 :** 0 / 12000 Kg **Transport Line 3 :** 0 / 12000 Kg **Transport Line 4 :** 0 / 80 Units **Transport Line 5 :** 0 / 80 Units **Transport Line 6 :** 0 / 80 Units **Transport Line 7 :** 0 / 3 Units	**Cranes**: Inputs: 1, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 1. Inputs: 3000 Kg Outputs: 3000 Kg **Splitting Machine**: Inputs: 1, Outputs: 3, Next Input Time: 1 min, Process Time 1 min / 1 min / 1 min, Required Humans: 0. Inputs: 6000 Kg Outputs: 2000 Kg / 2000 Kg / 2000 Kg **Filling Sack Machine (1,2,3)**: Inputs: 2, Outputs: 1, Next Input Time: 2 min, Process Time 2 min, Required Humans: 1. Inputs: 64 Units, 1600 Kg Outputs: 64 Units

Transport Line 8 : 0 / 3 Units **Transport Line 9 :** 0 / 3 Units **Sack Warehouse :** 25000 / 80000 Units **Palette Warehouse (1,2,3) :** 1000 / 1000 Units **Sack Feeding Line :** 500 / 500 Units **Final Product :** 0 / 8 Units **Stored Final Products 1 :** 0 / 400 Units **Stored Final Products 2 :** 0 / 350 Units **Film Type 1 :** 2000 / 2000 m **Film Type 2 :** 840 / 840 m **Film Warehouse:** 20000 / 20000 m **Back Up Line :** 0 / 3 Units	**Palette Loader (1,2,3)**: Inputs: 2, Outputs: 1, Next Input Time: 3 min, Process Time 3 min, Required Humans: 0. Inputs: 1 Unit, 64 Units Outputs: 1 Unit **Wrapping Machine Type 1**: Inputs: 2, Outputs: 1, Next Input Time: 3 min, Process Time 3 min, Required Humans: 0. Inputs: 17 m, 1 Unit Outputs: 1 Unit **Wrapping Machine Type 2**: Inputs: 2, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 0. Inputs: 6 m, 1 Unit Outputs: 1 Unit **Warehouse Placer**: Inputs: 1, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 1. Inputs: 1 Unit Outputs: 1 Unit **Sack Replenisher**: Inputs: 1, Outputs: 3, Next Input Time: 1 min, Process Time 1 min / 1 min / 1 min, Required Humans: 0. Inputs: 450 Units Outputs: 150 Units / 150 Units / 150 Units **Palette Replenisher**: Inputs: 1, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 0. Inputs: 15 Units Outputs: 15 Units **Film Replenisher**: Inputs: 1, Outputs: 3, Next Input Time: 10 min, Process Time 10 min / 10 min / 10 min, Required Humans: 1. Inputs: 4840 m Outputs: 2000 m / 2000 m / 840 m

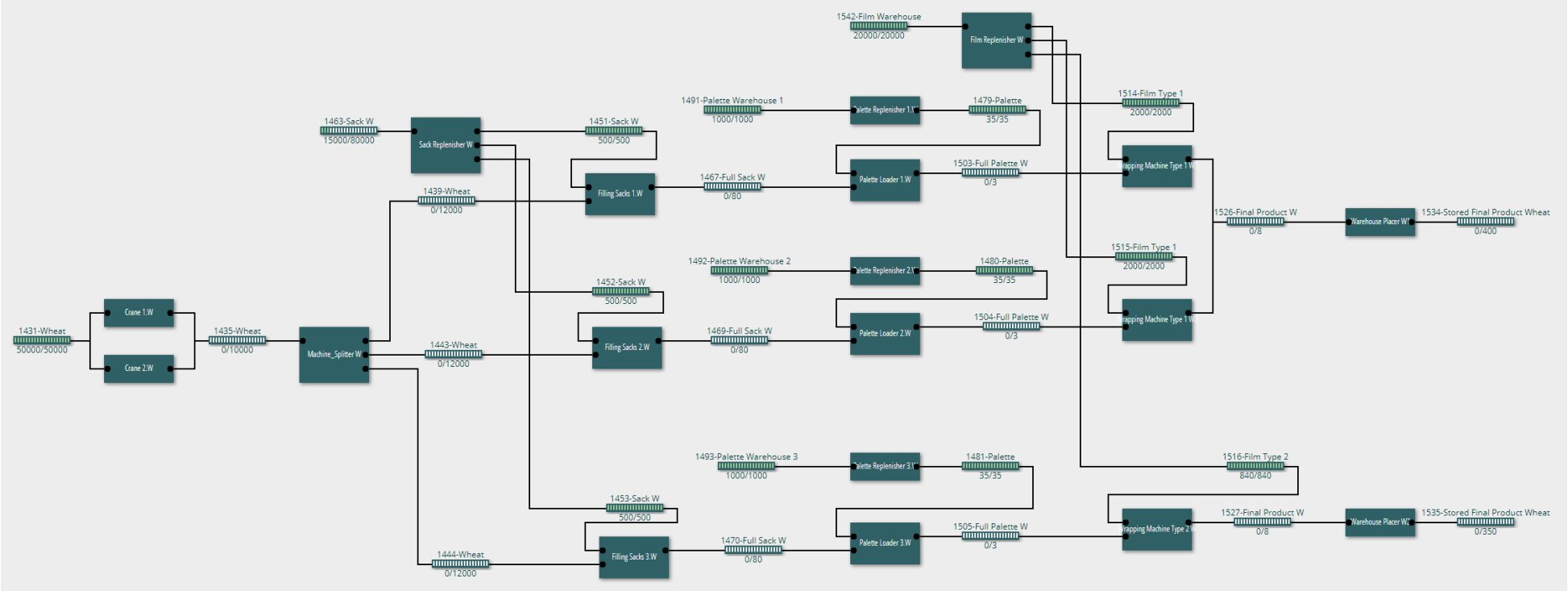
Rye Production Line Specifications

Carriers Initial / Max Capacities	Machines Specifications
Cargo : 195000 / 195000 Kg **Transport Line 0 :** 0 / 10000 Kg **Transport Line 1 :** 0 / 12000 Kg **Transport Line 2 :** 0 / 12000 Kg **Transport Line 3 :** 0 / 12000 Kg **Transport Line 4 :** 0 / 80 Units **Transport Line 5 :** 0 / 80 Units **Transport Line 6 :** 0 / 80 Units **Transport Line 7 :** 0 / 3 Units **Transport Line 8 :** 0 / 3 Units **Transport Line 9 :** 0 / 3 Units	**Cranes**: Inputs: 1, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 1. Inputs: 3000 Kg Outputs: 3000 Kg **Splitting Machine**: Inputs: 1, Outputs: 3, Next Input Time: 1 min, Process Time 1 min / 1 min / 1 min, Required Humans: 0. Inputs: 6000 Kg Outputs: 2000 Kg / 2000 Kg / 2000 Kg **Filling Sack Machine (1,2,3)**: Inputs: 2, Outputs: 1, Next Input Time: 3 min, Process Time 3 min, Required Humans: 1. Inputs: 64 Units, 1600 Kg Outputs: 64 Units **Palette Loader (1,2,3)**: Inputs: 2, Outputs: 1, Next Input Time: 3 min, Process Time 3 min, Required Humans: 0. Inputs: 1 Unit, 64 Units

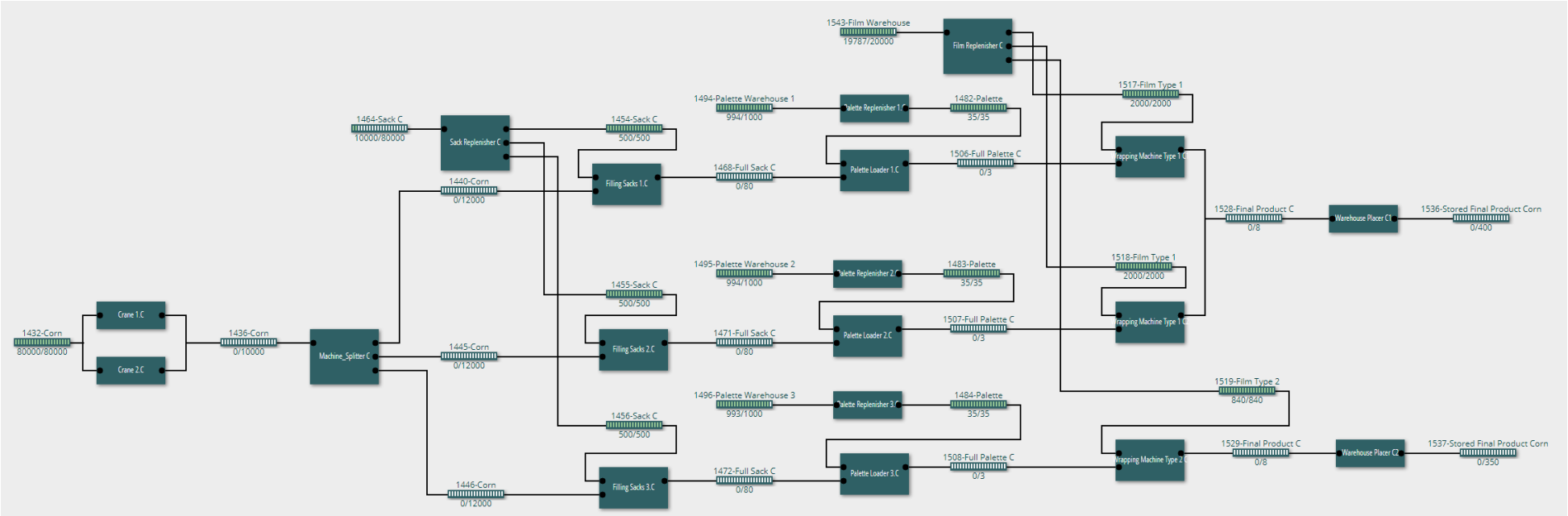
Sack Warehouse : 25000 / 80000 Units **Palette Warehouse (1,2,3) :** 1000 / 1000 Units **Sack Feeding Line :** 500 / 500 Units **Final Product :** 0 / 8 Units **Stored Final Products 1 :** 0 / 400 Units **Stored Final Products 2 :** 0 / 350 Units **Film Type 1 :** 2000 / 2000 m **Film Type 2 :** 840 / 840 m **Film Warehouse:** 20000 / 20000 m **Back Up Line :** 0 / 3 Units	Outputs: 1 Unit **Wrapping Machine Type 1**: Inputs: 2, Outputs: 1, Next Input Time: 3 min, Process Time 3 min, Required Humans: 0. Inputs: 17 m, 1 Unit Outputs: 1 Unit **Wrapping Machine Type 2**: Inputs: 2, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 0. Inputs: 6 m, 1 Unit Outputs: 1 Unit **Warehouse Placer**: Inputs: 1, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 1. Inputs: 1 Unit Outputs: 1 Unit **Sack Replenisher**: Inputs: 1, Outputs: 3, Next Input Time: 1 min, Process Time 1 min / 1 min / 1 min, Required Humans: 0. Inputs: 450 Units Outputs: 150 Units / 150 Units / 150 Units **Palette Replenisher**: Inputs: 1, Outputs: 1, Next Input Time: 1 min, Process Time 1 min, Required Humans: 0. Inputs: 15 Units Outputs: 15 Units **Film Replenisher**: Inputs: 1, Outputs: 2, Next Input Time: 10 min, Process Time 10 min / 10 min, Required Humans: 1. Inputs: 2840 m Outputs: 2000 m / 840 m

The Design that should be implemented consists of 4 independent designs one for each unloading process. They are presented in the following 4 figures,.

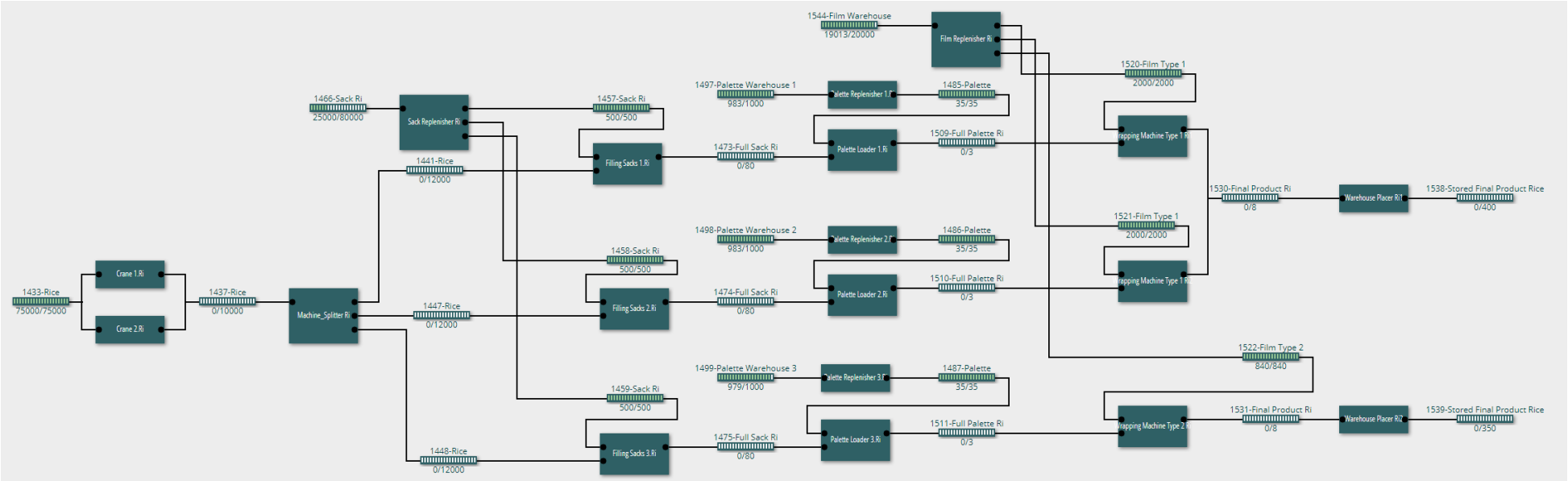
Design of wheat unloading process



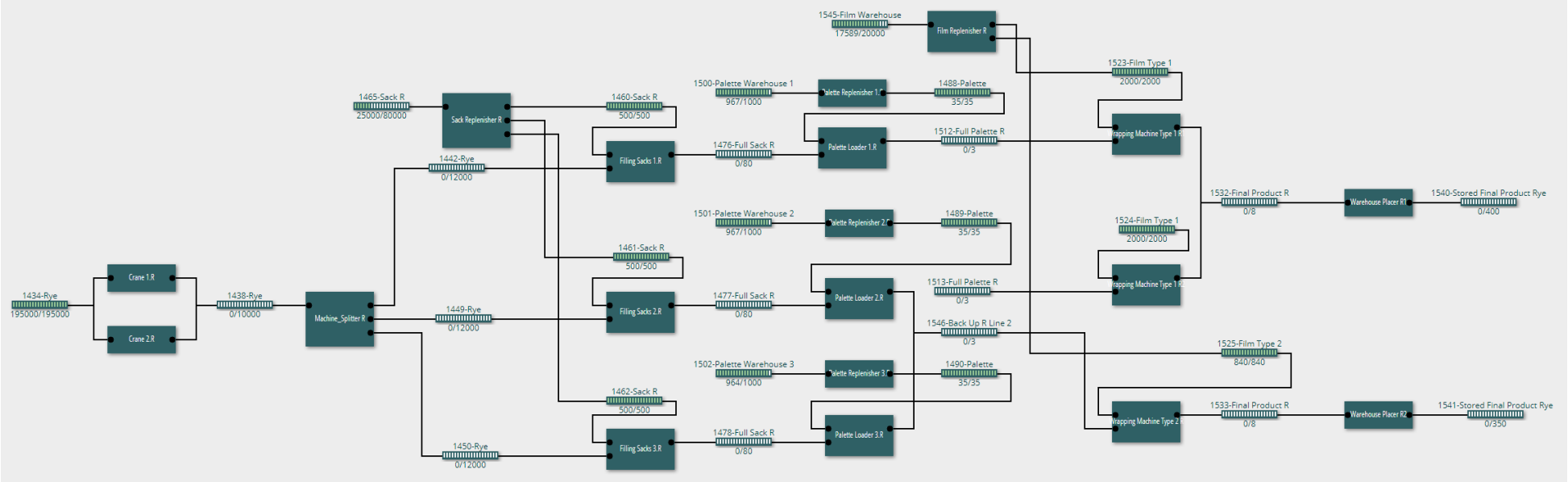
Design of corn unloading process



Design of rice unloading process



Design of rye unloading process



After saving the above Design in a Version go to Simulation Mode, create a new Simulator and implement tha Machine Schedule that is presented in the following Table:

Machines Schedule

Show 100 entries Search:

Machine	From	To	Actions	
Crane 1.C	01-11-2018 08:45:00	01-11-2018 08:55:00	Modify	Delete
Crane 1.C	01-11-2018 09:02:00	01-11-2018 09:04:00	Modify	Delete
Crane 1.R	01-11-2018 10:45:00	01-11-2018 10:53:00	Modify	Delete
Crane 1.R	01-11-2018 11:12:00	01-11-2018 11:17:00	Modify	Delete
Crane 1.R	01-11-2018 11:43:00	01-11-2018 11:49:00	Modify	Delete
Crane 1.R	01-11-2018 12:13:00	01-11-2018 12:19:00	Modify	Delete
Crane 1.R	01-11-2018 12:37:00	01-11-2018 12:44:00	Modify	Delete
Crane 1.Ri	01-11-2018 09:30:00	01-11-2018 09:37:00	Modify	Delete
Crane 1.Ri	01-11-2018 09:51:00	01-11-2018 09:56:00	Modify	Delete
Crane 1.W	01-11-2018 08:00:00	01-11-2018 08:09:00	Modify	Delete
Crane 2.C	01-11-2018 08:45:00	01-11-2018 08:55:00	Modify	Delete
Crane 2.C	01-11-2018 09:02:00	01-11-2018 09:04:00	Modify	Delete
Crane 2.R	01-11-2018 10:45:00	01-11-2018 10:53:00	Modify	Delete
Crane 2.R	01-11-2018 11:12:00	01-11-2018 11:17:00	Modify	Delete
Crane 2.R	01-11-2018 11:43:00	01-11-2018 11:49:00	Modify	Delete
Crane 2.R	01-11-2018 12:13:00	01-11-2018 12:19:00	Modify	Delete
Crane 2.R	01-11-2018 12:37:00	01-11-2018 12:44:00	Modify	Delete
Crane 2.Ri	01-11-2018 09:30:00	01-11-2018 09:37:00	Modify	Delete
Crane 2.Ri	01-11-2018 09:51:00	01-11-2018 09:56:00	Modify	Delete
Crane 2.W	01-11-2018 08:00:00	01-11-2018 08:09:00	Modify	Delete
Filling Sacks 1.C	01-11-2018 08:48:00	01-11-2018 08:52:00	Modify	Delete
Filling Sacks 1.C	01-11-2018 08:56:00	01-11-2018 09:01:00	Modify	Delete
Filling Sacks 1.C	01-11-2018 09:06:00	01-11-2018 09:08:00	Modify	Delete
Filling Sacks 1.C	01-11-2018 09:10:00	01-11-2018 09:13:00	Modify	Delete
Filling Sacks 1.R	01-11-2018 10:47:00	01-11-2018 13:01:00	Modify	Delete
Filling Sacks 1.Ri	01-11-2018 09:32:00	01-11-2018 09:38:00	Modify	Delete
Filling Sacks 1.Ri	01-11-2018 09:40:00	01-11-2018 09:45:00	Modify	Delete
Filling Sacks 1.Ri	01-11-2018 09:47:00	01-11-2018 09:54:00	Modify	Delete
Filling Sacks 1.Ri	01-11-2018 09:57:00	01-11-2018 10:03:00	Modify	Delete
Filling Sacks 1.Ri	01-11-2018 10:05:00	01-11-2018 10:12:00	Modify	Delete

Filling Sacks 1.W	01-11-2018 08:03:00	01-11-2018 08:21:00	Modify	Delete
Filling Sacks 2.C	01-11-2018 08:48:00	01-11-2018 08:52:00	Modify	Delete
Filling Sacks 2.C	01-11-2018 08:56:00	01-11-2018 09:01:00	Modify	Delete
Filling Sacks 2.C	01-11-2018 09:06:00	01-11-2018 09:08:00	Modify	Delete
Filling Sacks 2.C	01-11-2018 09:10:00	01-11-2018 09:13:00	Modify	Delete
Filling Sacks 2.R	01-11-2018 10:47:00	01-11-2018 13:01:00	Modify	Delete
Filling Sacks 2.Ri	01-11-2018 09:32:00	01-11-2018 09:38:00	Modify	Delete
Filling Sacks 2.Ri	01-11-2018 09:40:00	01-11-2018 09:45:00	Modify	Delete
Filling Sacks 2.Ri	01-11-2018 09:47:00	01-11-2018 09:54:00	Modify	Delete
Filling Sacks 2.Ri	01-11-2018 09:57:00	01-11-2018 10:03:00	Modify	Delete
Filling Sacks 2.Ri	01-11-2018 10:05:00	01-11-2018 10:12:00	Modify	Delete
Filling Sacks 2.W	01-11-2018 08:03:00	01-11-2018 08:21:00	Modify	Delete
Filling Sacks 3.C	01-11-2018 08:48:00	01-11-2018 08:52:00	Modify	Delete
Filling Sacks 3.C	01-11-2018 08:56:00	01-11-2018 09:01:00	Modify	Delete
Filling Sacks 3.C	01-11-2018 09:06:00	01-11-2018 09:09:00	Modify	Delete
Filling Sacks 3.C	01-11-2018 09:10:00	01-11-2018 09:12:00	Modify	Delete
Filling Sacks 3.R	01-11-2018 10:47:00	01-11-2018 13:01:00	Modify	Delete
Filling Sacks 3.Ri	01-11-2018 09:32:00	01-11-2018 09:38:00	Modify	Delete
Filling Sacks 3.Ri	01-11-2018 09:40:00	01-11-2018 09:45:00	Modify	Delete
Filling Sacks 3.Ri	01-11-2018 09:47:00	01-11-2018 09:54:00	Modify	Delete
Filling Sacks 3.Ri	01-11-2018 09:57:00	01-11-2018 10:03:00	Modify	Delete
Filling Sacks 3.Ri	01-11-2018 10:05:00	01-11-2018 10:12:00	Modify	Delete
Filling Sacks 3.W	01-11-2018 08:03:00	01-11-2018 08:21:00	Modify	Delete
Machine_Splitter C	01-11-2018 08:46:00	01-11-2018 08:57:00	Modify	Delete
Machine_Splitter C	01-11-2018 09:02:00	01-11-2018 09:04:00	Modify	Delete
Machine_Splitter R	01-11-2018 10:46:00	01-11-2018 10:53:00	Modify	Delete
Machine_Splitter R	01-11-2018 11:12:00	01-11-2018 11:19:00	Modify	Delete
Machine_Splitter R	01-11-2018 11:43:00	01-11-2018 11:49:00	Modify	Delete
Machine_Splitter R	01-11-2018 12:13:00	01-11-2018 12:20:00	Modify	Delete
Machine_Splitter R	01-11-2018 12:38:00	01-11-2018 12:45:00	Modify	Delete
Machine_Splitter Ri	01-11-2018 09:31:00	01-11-2018 09:56:00	Modify	Delete
Machine_Splitter W	01-11-2018 08:01:00	01-11-2018 08:10:00	Modify	Delete

Palette Loader 1.C	01-11-2018 08:45:00	01-11-2018 09:02:00	Modify	Delete
Palette Loader 1.C	01-11-2018 09:04:00	01-11-2018 09:06:00	Modify	Delete
Palette Loader 1.C	01-11-2018 09:08:00	01-11-2018 09:16:00	Modify	Delete
Palette Loader 1.R	01-11-2018 10:50:00	01-11-2018 13:04:00	Modify	Delete
Palette Loader 1.Ri	01-11-2018 09:34:00	01-11-2018 10:18:00	Modify	Delete
Palette Loader 1.W	01-11-2018 08:04:00	01-11-2018 08:23:00	Modify	Delete
Palette Loader 2.C	01-11-2018 08:48:00	01-11-2018 09:02:00	Modify	Delete
Palette Loader 2.C	01-11-2018 09:04:00	01-11-2018 09:06:00	Modify	Delete
Palette Loader 2.C	01-11-2018 09:08:00	01-11-2018 09:16:00	Modify	Delete
Palette Loader 2.R	01-11-2018 10:50:00	01-11-2018 13:04:00	Modify	Delete
Palette Loader 2.Ri	01-11-2018 09:34:00	01-11-2018 10:18:00	Modify	Delete
Palette Loader 2.W	01-11-2018 08:04:00	01-11-2018 08:23:00	Modify	Delete
Palette Loader 3.C	01-11-2018 08:48:00	01-11-2018 09:15:00	Modify	Delete
Palette Loader 3.R	01-11-2018 10:50:00	01-11-2018 13:04:00	Modify	Delete
Palette Loader 3.Ri	01-11-2018 09:34:00	01-11-2018 10:18:00	Modify	Delete
Palette Loader 3.W	01-11-2018 08:04:00	01-11-2018 08:23:00	Modify	Delete
Palette Replenisher 1.R	01-11-2018 12:28:00	01-11-2018 12:29:00	Modify	Delete
Palette Replenisher 2.R	01-11-2018 12:28:00	01-11-2018 12:29:00	Modify	Delete
Palette Replenisher 3.R	01-11-2018 12:28:00	01-11-2018 12:29:00	Modify	Delete
Sack Replenisher R	01-11-2018 09:00:00	01-11-2018 09:03:00	Modify	Delete
Sack Replenisher R	01-11-2018 11:08:00	01-11-2018 11:11:00	Modify	Delete
Sack Replenisher R	01-11-2018 11:33:00	01-11-2018 11:37:00	Modify	Delete
Sack Replenisher R	01-11-2018 12:00:00	01-11-2018 12:03:00	Modify	Delete
Sack Replenisher R	01-11-2018 12:21:00	01-11-2018 12:24:00	Modify	Delete
Sack Replenisher R	01-11-2018 12:38:00	01-11-2018 12:41:00	Modify	Delete
Sack Replenisher Ri	01-11-2018 09:44:00	01-11-2018 09:46:00	Modify	Delete
Sack Replenisher Ri	01-11-2018 10:00:00	01-11-2018 10:02:00	Modify	Delete
Warehouse Placer C1	01-11-2018 08:51:00	01-11-2018 09:30:00	Modify	Delete
Warehouse Placer C2	01-11-2018 08:51:00	01-11-2018 09:20:00	Modify	Delete
Warehouse Placer R1	01-11-2018 10:56:00	01-11-2018 13:08:00	Modify	Delete
Warehouse Placer R2	01-11-2018 10:54:00	01-11-2018 13:07:00	Modify	Delete
Warehouse Placer Ri1	01-11-2018 09:38:00	01-11-2018 10:23:00	Modify	Delete
Warehouse Placer Ri2	01-11-2018 09:38:00	01-11-2018 10:23:00	Modify	Delete
Warehouse Placer W1	01-11-2018 08:00:00	01-11-2018 08:25:00	Modify	Delete
Warehouse Placer W2	01-11-2018 08:00:00	01-11-2018 08:25:00	Modify	Delete
Wrapping Machine Type 1 C1	01-11-2018 08:45:00	01-11-2018 09:30:00	Modify	Delete
Wrapping Machine Type 1 C2	01-11-2018 08:45:00	01-11-2018 09:30:00	Modify	Delete
Wrapping Machine Type 1 R1	01-11-2018 10:53:00	01-11-2018 13:07:00	Modify	Delete

Showing 1 to 100 of 109 entries

Previous 1 2 Next

Machines Schedule

Show 100 entries Search:

Machine	From	To	Actions
Wrapping Machine Type 1 Ri1	01-11-2018 09:34:00	01-11-2018 10:23:00	Modify Delete
Wrapping Machine Type 1 Ri2	01-11-2018 09:34:00	01-11-2018 09:34:00	Modify Delete
Wrapping Machine Type 1 W1	01-11-2018 08:05:00	01-11-2018 08:25:00	Modify Delete
Wrapping Machine Type 1 W2	01-11-2018 08:05:00	01-11-2018 08:25:00	Modify Delete
Wrapping Machine Type 1 W2	01-11-2018 08:05:00	01-11-2018 08:25:00	Modify Delete
Wrapping Machine Type 2 C	01-11-2018 08:45:00	01-11-2018 09:20:00	Modify Delete
Wrapping Machine Type 2 R	01-11-2018 10:53:00	01-11-2018 13:07:00	Modify Delete
Wrapping Machine Type 2 Ri	01-11-2018 09:34:00	01-11-2018 10:20:00	Modify Delete
Wrapping Machine Type 2 W	01-11-2018 08:05:00	01-11-2018 08:25:00	Modify Delete

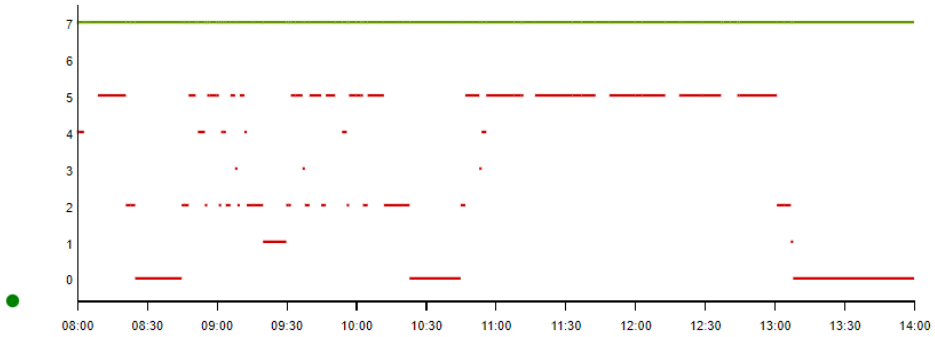
Showing 101 to 109 of 109 entries Previous 1 2 Next

OK

Create also the Human Schedule that is shown in the following figure

Add Human Schedule Line

Persons	Work Start	Hours	Date From	Date To	Actions
	08:00:00	8	01-11-2018	01-11-2018	Add



Human Schedule

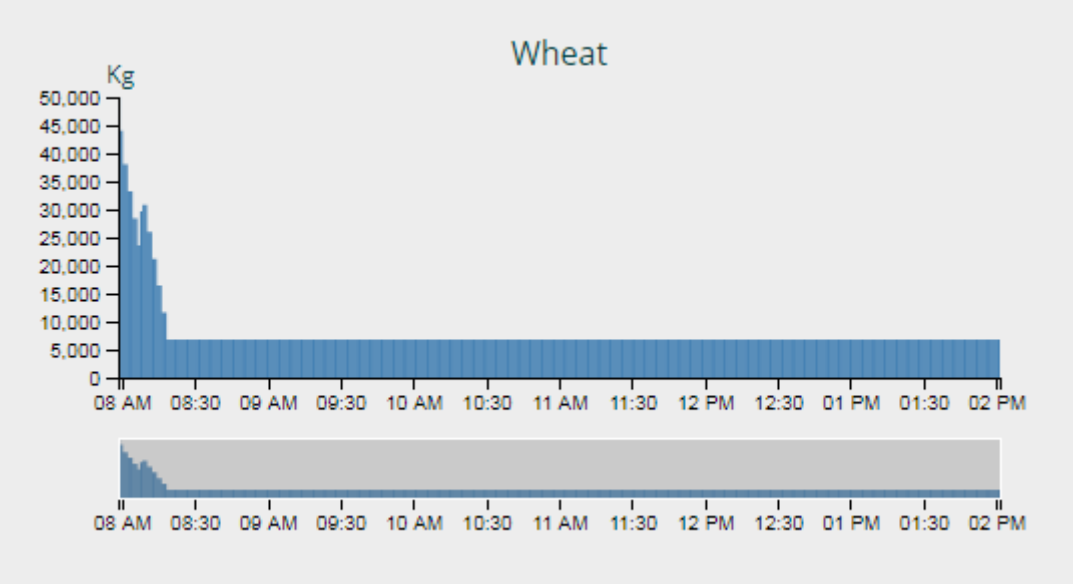
Show 10 entries Search:

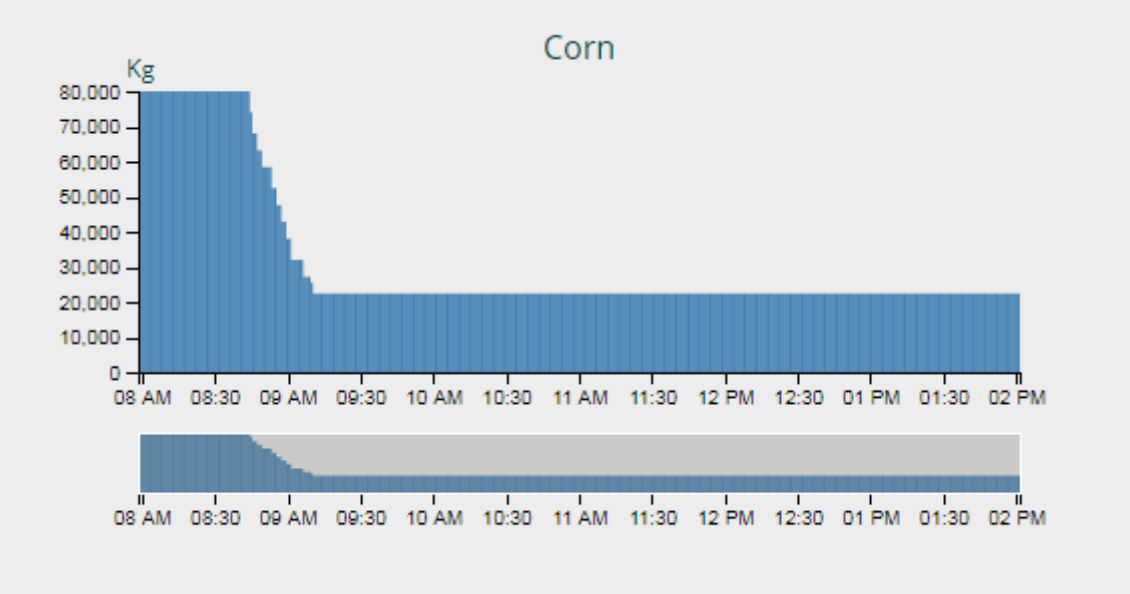
Persons	Work Start	Hours	From	To	Actions
7	08:00:00	8	01-11-2018	01-11-2018	Modify Delete

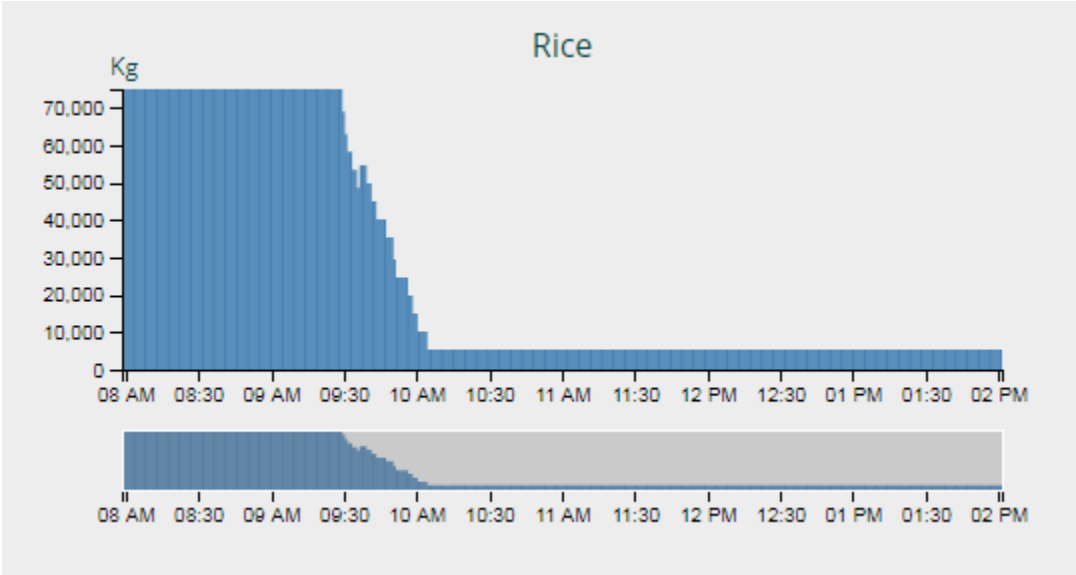
Showing 1 to 1 of 1 entries Previous 1 Next

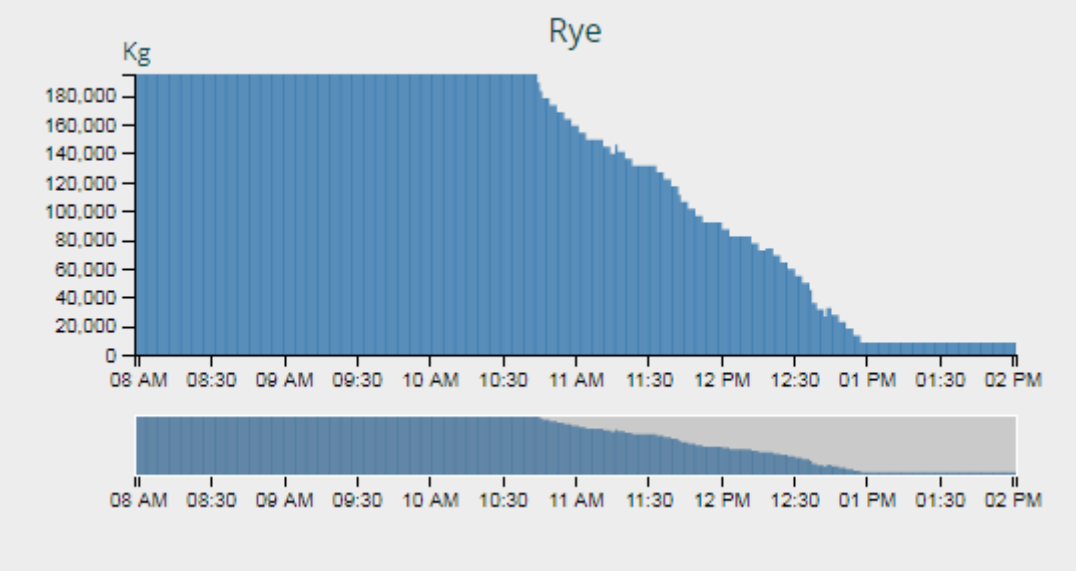
OK

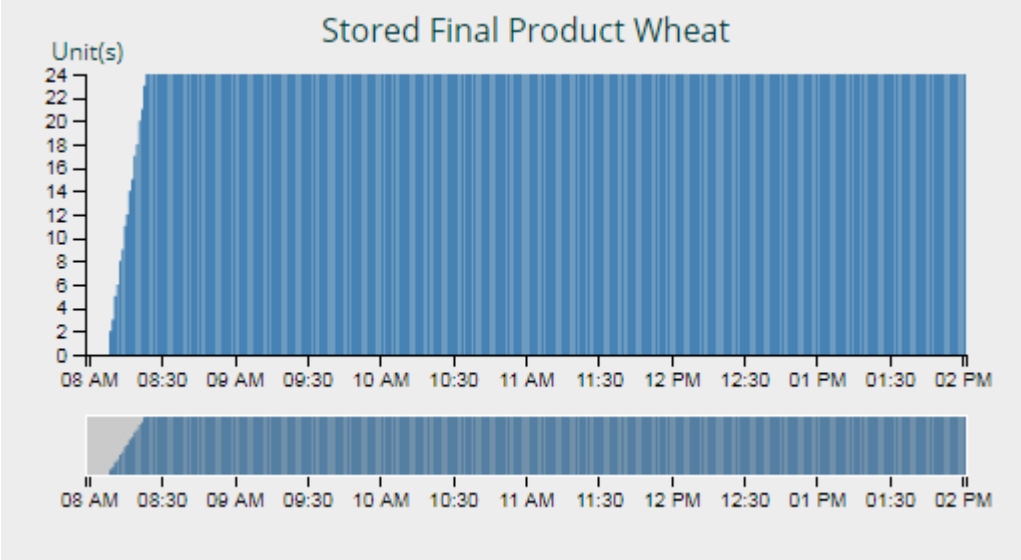
Run the Simulator and save the results by pressing the Save Run button. Then go to Results Mode and review some of the available results presenting functions:

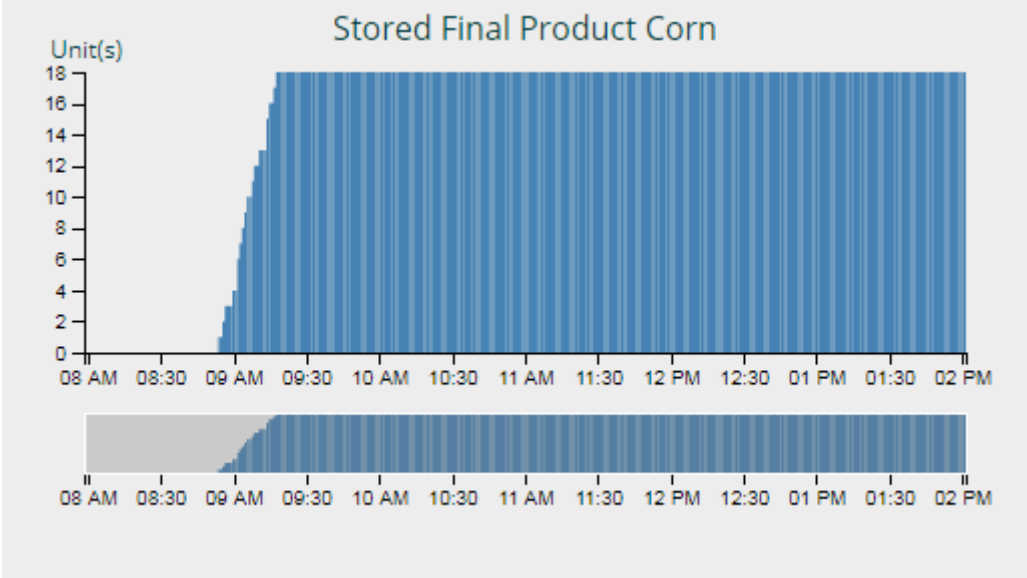


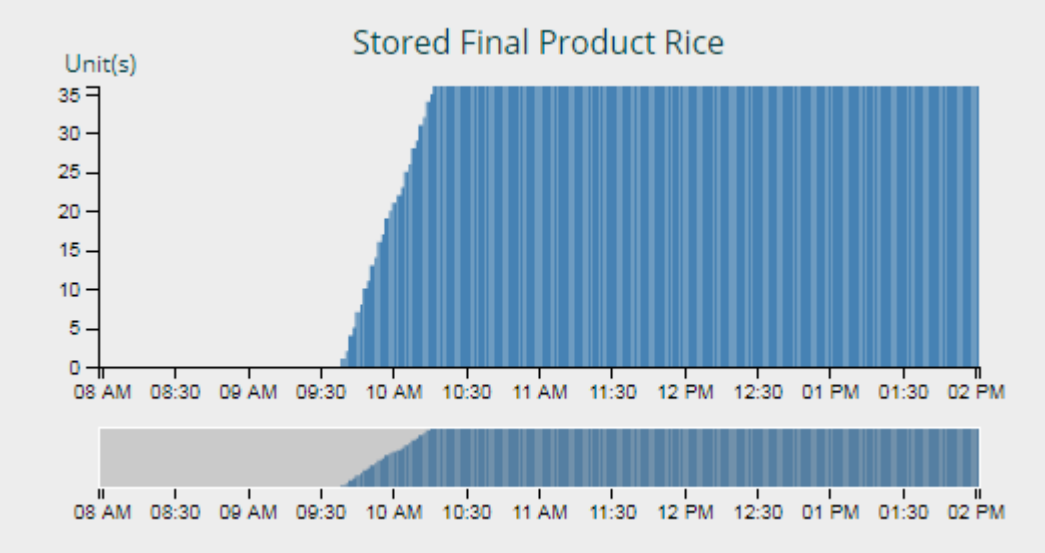


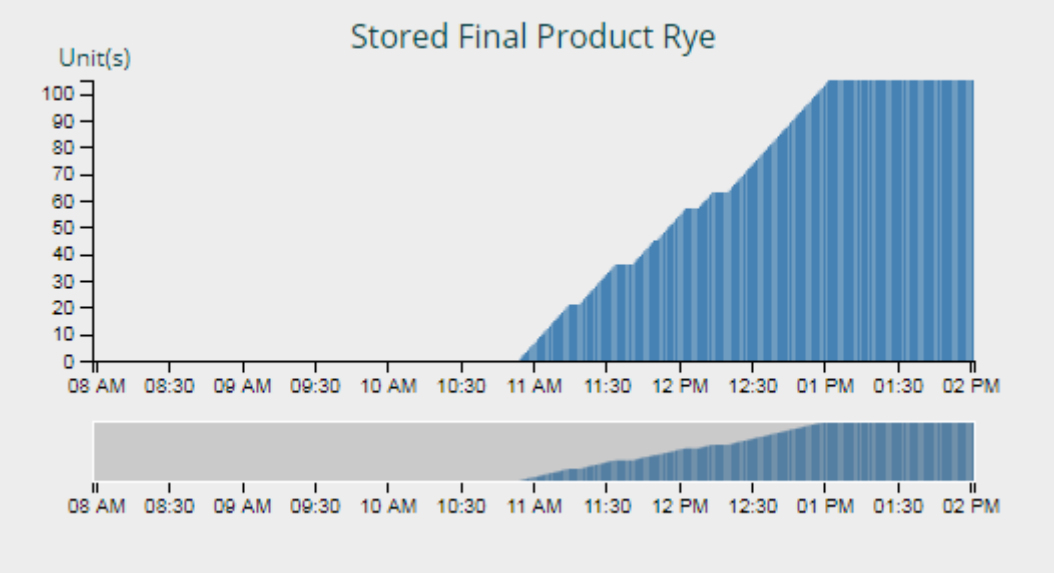

Rice
Kg
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
08 AM
08:30
09 AM
09:30
10 AM
10:30
11 AM
11:30
12 PM
12:30
01 PM
01:30
02 PM


Rye
Kg
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
08 AM
08:30
09 AM
09:30
10 AM
10:30
11 AM
11:30
12 PM
12:30
01 PM
01:30
02 PM


Stored Final Product Wheat
Unit(s)
24
22
20
18
16
14
12
10
8
6
4
2
0
08 AM
08:30
09 AM
09:30
10 AM
10:30
11 AM
11:30
12 PM
12:30
01 PM
01:30
02 PM


Stored Final Product Corn
Unit(s)
18
16
14
12
10
8
6
4
2
0
08 AM
08:30
09 AM
09:30
10 AM
10:30
11 AM
11:30
12 PM
12:30
01 PM
01:30
02 PM


Stored Final Product Rice
Unit(s)
35
30
25
20
15
10
5
0
08 AM
08:30
09 AM
09:30
10 AM
10:30
11 AM
11:30
12 PM
12:30
01 PM
01:30
02 PM


Stored Final Product Rye
Unit(s)
100
90
80
70
60
50
40
30
20
10
0
08 AM
08:30
09 AM
09:30
10 AM
10:30
11 AM
11:30
12 PM
12:30
01 PM
01:30
02 PM

The amounts of products at the simulation time starting point:

Date & Time: 01-11-2018 08:00:00

Show 50 entries Search:

Product	Amount	Unit
Back Up R Line 2	0	Unit(s)
Corn	80000	Kg
Film Type 1	16000	m
Film Type 2	3360	m
Film Warehouse	76389	m
Final Product C	0	Unit(s)
Final Product R	0	Unit(s)
Final Product Ri	0	Unit(s)
Final Product W	0	Unit(s)
Full Palette C	0	Unit(s)
Full Palette R	0	Unit(s)
Full Palette Ri	0	Unit(s)
Full Palette W	0	Unit(s)
Full Sack C	0	Unit(s)
Full Sack R	0	unit(s)
Full Sack Ri	0	unit(s)
Full Sack W	0	Unit(s)
Palette	420	Unit(s)
Palette Warehouse 1	3944	Unit(s)
Palette Warehouse 2	3944	Unit(s)
Palette Warehouse 3	3936	Unit(s)
Rice	75000	Kg
Rye	195000	Kg
Sack C	11500	unit(s)
Sack R	26500	unit(s)
Sack Ri	26500	unit(s)
Sack W	16500	unit(s)
Stored Final Product Corn	0	Unit(s)
Stored Final Product Rice	0	Unit(s)
Stored Final Product Rye	0	Unit(s)
Stored Final Product Wheat	0	Unit(s)
Wheat	44000	Kg

Showing 1 to 32 of 32 entries Copy Excel CSV PDF Print Previous 1 Next

The amounts of products at the simulation time ending point:

Date & Time: 01-11-2018 14:01:00

Show 50 entries Search:

Product	Amount	Unit
Back Up R Line 2	0	Unit(s)
Corn	22400	Kg
Film Type 1	14521	m
Film Type 2	2784	m
Film Warehouse	76389	m
Final Product C	0	Unit(s)
Final Product R	0	Unit(s)
Final Product Ri	0	Unit(s)
Final Product W	0	Unit(s)
Full Palette C	0	Unit(s)
Full Palette R	0	Unit(s)
Full Palette Ri	0	Unit(s)
Full Palette W	0	Unit(s)
Full Sack C	0	Unit(s)
Full Sack R	192	unit(s)
Full Sack Ri	0	unit(s)
Full Sack W	0	Unit(s)
Palette	237	Unit(s)
Palette Warehouse 1	3929	Unit(s)
Palette Warehouse 2	3929	Unit(s)
Palette Warehouse 3	3921	Unit(s)
Rice	5400	Kg
Rye	8400	Kg
Sack C	9760	unit(s)
Sack R	18046	unit(s)
Sack Ri	23746	unit(s)
Sack W	15420	unit(s)
Stored Final Product Corn	18	Unit(s)
Stored Final Product Rice	36	Unit(s)
Stored Final Product Rye	105	Unit(s)
Stored Final Product Wheat	24	Unit(s)
Wheat	6800	Kg

Showing 1 to 32 of 32 entries Copy Excel CSV PDF Print Previous 1 Next