Integrated factory digital twin designer on RAMP 1.0

User Manual, version 1.0
30-09-2021

César Toscano
ctoscano@inesctec.pt
Rui Dias
rui.c.dias@inesctec.pt
INESC TEC
Campus da FEUP
Rua Dr. Roberto Frias
4200 - 465 Porto
Portugal

TABLE OF CONTENT

EXECUTIVE SUMMARY

This document is the first release of the User Manual of the Advanced Plant Model and its Digital Twin Designer, integrated in the RAMP Marketplace. This information was taken from Better Factory Deliverable D1.2 “Integrated factory digital twin designer on RAMP 1.0”.

The Advanced Plant Model (APM) is a system developed by INESC TEC that aims to provide a real-time digital representation of the ongoing state of a given shop floor, in the form of semantic and geometric information. It includes representations of workers, industrial and mobile robots, work-stations, manufacturing lines, racks, boxes, palettes, kits and parts, consolidated by a production schedule generated by a Manufacturing Execution System (MES). Human operators and robotic manipulators can exploit this information when participating in manufacturing operations on the shop floor.

The Digital Twin Designer, described in this document, is the element inside the APM system that provides the means to enable the User to build a digital representation of manufacturing areas, including their major objects such as logistic racks, robotic manipulators and equipment is general, among others. CAD models representing the objects available in the manufacturing area, may be selected, entered into the system in order to reach a digital model of the three-dimensional environment.

This document provides a User Manual of the Digital twin Designer, describing the main application features of the Tool and a set of training material, oriented to the User and letting him/she experience the main functions implemented by the Tool.

1 Introduction

1.1 Scope and objectives

The document aims the "Integration of the APM in the RAMP Marketplace and a guide how to use it".

The Advanced Plant Model (APM) is a system developed by INESC TEC that aims to provide a real-time digital representation of the ongoing state of a given shop floor, in the form of semantic and geometric information. It includes representations of workers, industrial and mobile robots, work-stations, manufacturing lines, racks, boxes, palettes, kits and parts, consolidated by a production schedule generated by a Manufacturing Execution System (MES). Human operators and robotic manipulators can exploit this information when participating in manufacturing operations on the shop floor.

1.2 Document organization

Besides this introduction, the document is organized in the following chapters:

- Chapter 2 "The Advanced Plant Model and the Digital Twin Designer" – supplies an overall description of the APM and of the Digital Twin Designer, identifying their relationship;
- Chapter 3 "Methodology" – specifies the methodology one should follow to create a digital model on the Digital Twin Designer;
- Chapter 4 "User Manual" – aims to describe all the relevant functional and graphical elements in the Digital Twin Design that enable Users to create digital models;
- Chapter 5 "How to" – provides a series of "how to" cases aiming to provide Users working examples on the usage of the Digital Twin Designer.

1.3 Acronyms

Acronym	Term
APM	Advanced Plant Model, name of the software-based system that includes the Digital Twin Designer
MES	Manufacturing Execution System
OSPS	Open Scalable Production System, architecture framework specifying the relationship of a set of software elements aiming to manage a scalable production system
PLY	Polygon File Format, data format for CAD models
RAMP	Robotics and Automation Market Place
STEP	STandard for the Exchange of Product model data, ISO 10303, data format for CAD models
STL	Standard Triangle Language, data format for CAD models
URDF	Unified Robot Description Format, data format for CAD models

2 The Advanced Plant Model and the Digital Twin Designer

The Advanced Plant Model (APM) is an autonomous software-based system that aims to manage a near real-time digital representation of the ongoing state of a given manufacturing area with the main purpose of controlling and monitoring the operations carried out by a fleet of fixed and/or mobile robotic manipulators that carry on logistic and assembly operations.

The model maintained by the APM comprehends the three-dimensional information about the geometry of major objects present in the shop floor, such as Racks, Boxes, Palettes and Kits in the case of a logistic area and WorkStations, Conveyors, Equipment and Manufacturing Lines in the case of an assembly line. The CAD models of the parts that are manipulated and/or assembled are also included in the Model, together with the corresponding grasping poses.

Robotic Manipulators are modelled in terms of three-dimensional geometry but also in terms of their capabilities to operate on the shop floor and to execute logistic and assembly tasks. In particular, the robotic programs are also kept in the Advanced Plant Model and downloaded to the robots when needed.

The third aspect that links together the two above ones, is the production schedule. Instances of production schedules may be retrieved from a Manufacturing Execution System, specifying the operations to be achieved, their sequence and the assignment of production resources (human operators, robots, other equipment). The Advanced Plant Model integrates the robotic programs in the production plan and interacts with them in order to instruct them to execute the assigned manufacturing/logistic tasks and to monitor their execution. During the execution of a task by a robot, the Advanced Plant Model provides information to the robot, stating the location and geometry of all the objects that will be used in the context of that task, fulfilling the main purpose of the system which is to provide information about the ‘world’ to the robot fleet.

The communication model between the APM, the robot fleet and the MES is specified by the OSPS framework (Open Scalable Production System). Communication between these elements is achieved through the exchange of messages and via a publish-subscribe mechanism.

The Digital Twin Designer is the identification of the element, inside the APM, that enables Users to build the digital representation of a physical area (logistic, assembly, …) by creating 3D models of objects, such as racks and workstations, and to provide a 3D visualization of the Model for other purposes not initially envisioned by the Advanced Plant Model.

This document addresses the Digital Twin Designer and its integration in the RAMP Platform.

3 Methodology

The Digital Twin Designer assumes that the User knows very well the layout of the physical area that he/she intends to represent in a digital form as well as the functional and geometric characteristics of the physical objects located in the physical area. These objects may be racks, palettes, conveyors, workstations, production lines, robotic manipulators and equipment in general. The very first step for the User to start using the Tool is to get acquainted with the physical reality of the targeted area.

Subsequently, the User should:

1. Build a Catalogue comprehending the geometry of each type of physical objects he/she needs to insert in the final Model. CAD models should be retrieved from external sources (either from public repositories available in the Internet, from the company's own CAD/CAM system or from the equipment manufacturers).
   Section 4.4 addresses this step.

2. Create a Map that specifies the layout of the target physical area. Create the 'physical area' object by specifying its dimension, scale and map.
   Section 4.5.1 addresses this step.

3. Start populating the Map with instances of objects, by selecting objects on the Catalogue and implanting them on the image representing the Map.
   Section 4.5.2 addresses this step.

4. Validate the locations where objects were implanted, by looking at the entire model in a three-dimensional window.
   Section 4.5.3 addresses this step.

Initial training is essential for the user to know concretely what he/she can do with the Tool and how to do it. Section 5 addresses this need.

4 User Manual

This section describes the main features of the Digital Twin Designer (the Tool), taking the perspective of the final User. Thus, the section aims to be the User Manual of the tool. A set of screen shots support this manual so that the User sees always the concrete elements that interact with him/her in the context of each main feature being explained. In the text, the term Interface is used to designate the User Interface of the Tool.

4.1 The Login process

Usage of the tool requires the User to go through an authentication process, through which the User has to supply a username and corresponding password. As the Tool is integrated with the RAMP Platform, but continues to be an autonomous system, running in an independent way, this authentication process is done by the RAMP Platform by following the OAuth2 protocol (https://oauth.net/2/), the industry-standard protocol for authorization. The following steps guide the User:

1. The Tool shows the screen below, User presses the "RAMP…." button.

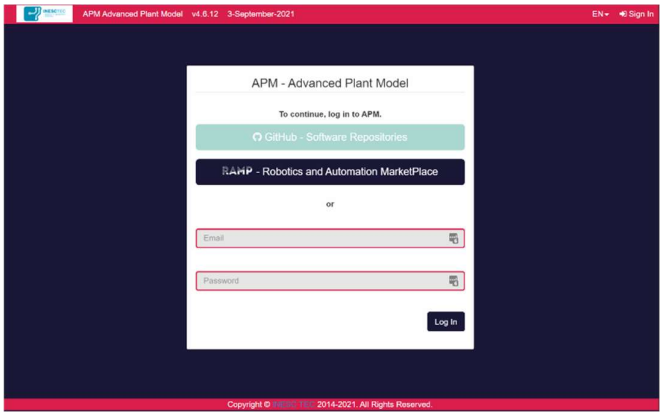


Figure 1 – Login process: 1st step

2. In the first access to the Tool, a screen is presented asking the User to authorize the Tool to access his/her account on the RAMP Platform.
3. Subsequently, the RAMP platform presents the screen below (left), asking the User to enter his/her user name and password.
4. Another window is shown by the RAMP platform (below, on the right), asking the User to authorize the RAMP to access his/her account.

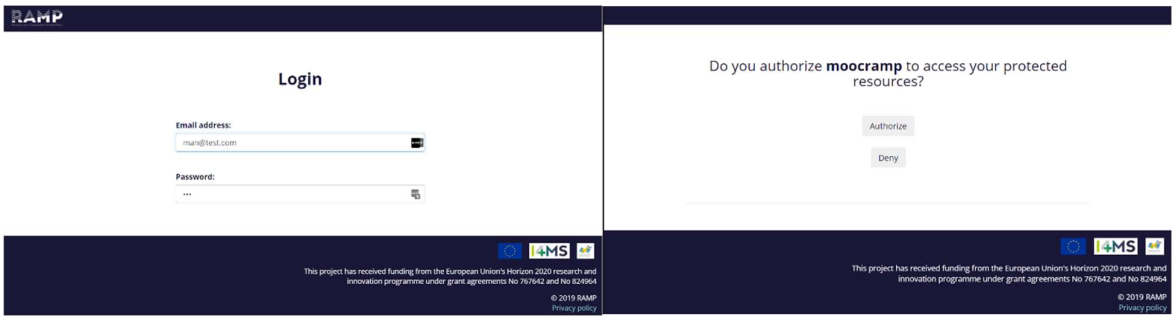


Figure 2 – Login process: 2nd (left) and 3rd (right) steps

In the end (if the User provided all the right information), the login process is completed and control is given to the Tool. The Tool's interface is shown (Figure 3), allowing the User to start using the Digital Twin Designer.

4.2 Organization of the user interface

After a successful login process, the Tool presents its user interface as shown below.

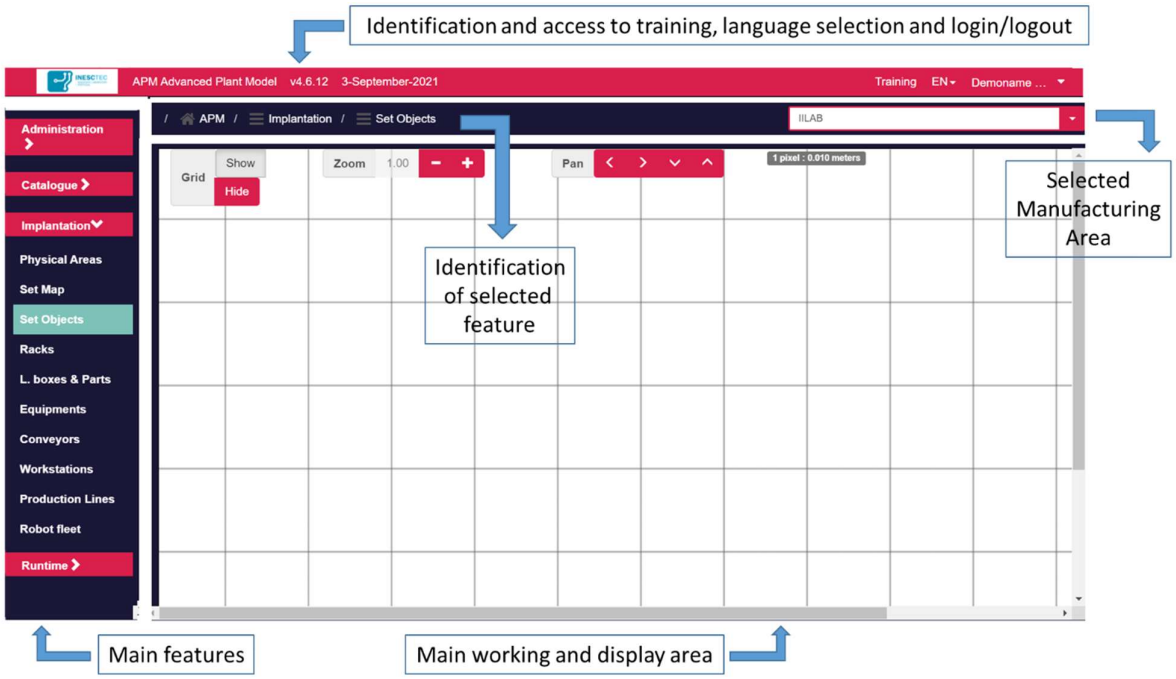


Figure 3 – User Interface: main working areas

The Interface is organized in four areas:

- The top area identifies the Tool (name and version) and allows the User to access a training area (see chapter 5 "How to"), to change the language used by the Tool (at present stage English and Portuguese are the supported languages) and to exit the Tool.
- The left area provides access to the several application features (Administration, Catalogue, Implantation and Runtime) that are then presented in the central area of the Interface.
- The central area is the area where most information is presented and where the value-added interactivity with the User takes place.
- Between the top and central areas, on the left, a "breadcrumb" is displayed identifying the feature of the application that is active and its navigation hierarchy ('APM / Implantation / Set Objects' in the above picture). On the right side, a drop-down list lets the User select the physical area (e.g. a logistic or assembly area) he/she is working on. This is VERY important. By opening this drop-down list, all the known physical areas are shown, letting the User select the one which he/she will start to work with ("IILAB" in the picture above). After this selection, the implantation and Runtime features are dependent on the selected physical area.

4.3 The Administration area

This application feature identifies which Users have already entered into the Tool (successfully concluded the login process). As the Tool is integrated with the RAMP Platform, any User is the RAMP Platform is associated with an organization. By default, all the users associated with a company can use the Too.

As show in the picture below, the Tool knows two users ('Demoname' and 'Providername'), that are associated with the 'test.com' organization. Be selecting one user (e.g. ('Demoname'), the Interface allows one to update the picture that will visually identify the User in the Interface. The remaining options, 'Edit Profile' … have no effect when the Tool is integrated in the RAMP Platform.

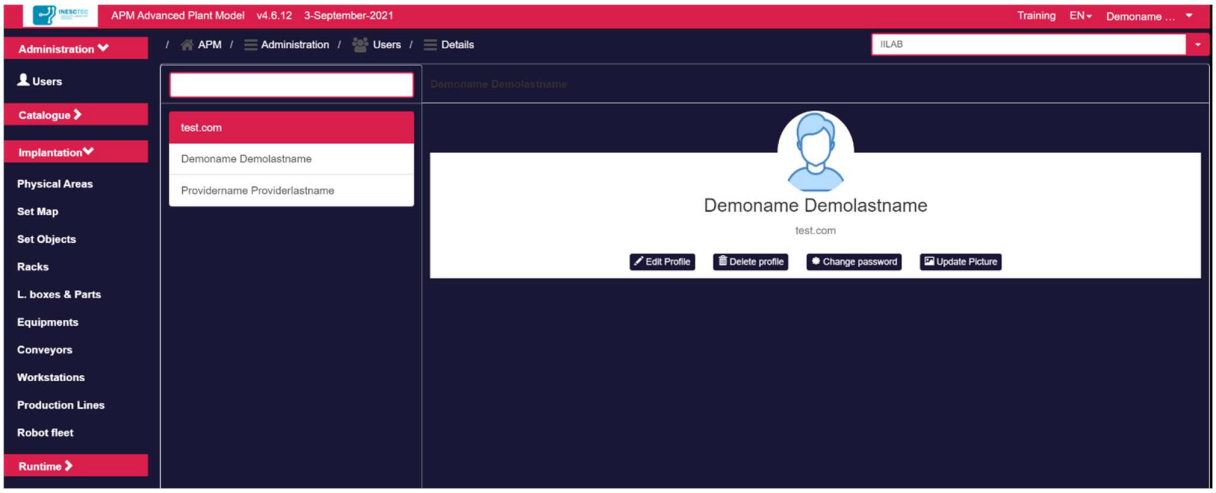


Figure 4 – Administration feature

4.4 The Catalogue

The Catalogue is the application feature responsible for keeping a list of all the known 3D models. Depending on the final aim of the User, each major object present in a physical area (e.g. a workstation) should have a correspondent 3D model. The Catalogue is the feature letting the User create, change or remove the models associated with each type of object. The purpose of the Catalogue is to enable the user to build models of a given physical area by 'instantiating' and implanting the object models on the digital representation of the physical area.

Presently, the application supports the following types of objects: Racks/Large Boxes/Small Boxes/Kits for modelling logistic areas, Workstations/Conveyors/Equipments/Production Lines for modelling assembly areas and Parts/FinalProducts for modelling the elements processed in a physical area. Robots are related with the modelling of robotic equipment.

4.4.1 Listing the objects

By selecting an object type on the left area of the Interface (see picture below where 'Equipments' is selected), a list of all known models is shown, presenting the name and the geometrical dimension of the object's volume.

On top of the list, a button '+ New …" enables the creation of a new object type (described later in this chapter).

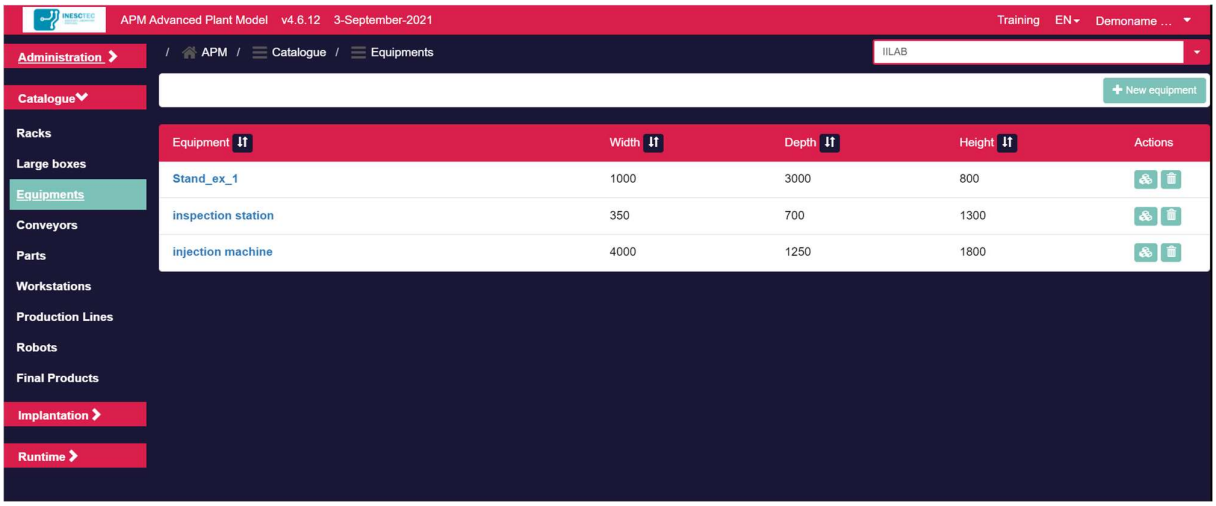


Figure 5 – Catalogue: List of object types

The two buttons on the right (picture above) allows one to remove a model or to visualize and edit its 3D model. Activating this button, causes the Interface to access the 3D model of the selected object (see picture below). User is now able to see the details of the model by using the mouse in the image:

- Pressing the left button and dragging the mouse allows one to orbit around the object's image;
- Rolling the central button allows one to zoom in or zoom out the image;
- Pressing the right button and dragging the mouse allows one to pan the object's image.

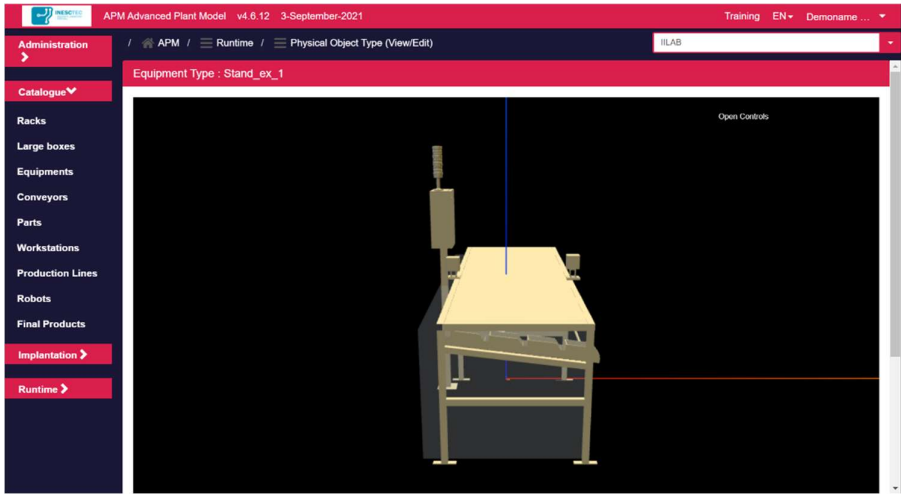


Figure 6 - Catalogue: Access to the 3D Model of an object type

4.4.2 Adjusting the CAD model to the object's bounding volume

By clicking on the top right button 'Open Controls', an interface is opened (see picture below), letting the User change the position of the 3D CAD model on the object's bounding volume. Please note the following:

- Each and every object created in the Catalogue has a bounding volume with the external dimensions provided by the User during model creation (with, depth and height).
- Optionally, a CAD model may be associated with an object. The following formats are supported: STEP, STL, PLY, URDF. After assigning a CAD model to an object, its position within the bounding box can be adjusted if needed.

The adjustment of the CAD model is accomplished by moving its geometry within the bounding volume:

- The 'red axis', 'green axis' and 'blue axis' slider widgets on the 'large displacement' zone, causes the geometry to move in the three X, Y, Z dimensions;
- The widgets below with the very same names but under the 'fine-tune displacement' zone, also allows one to adjust the position of the 3D geometry within its bounding volume but with greater precision.
- The 'Rotation' widgets allow the CAD image to rotate around its X, Y, Z axis.

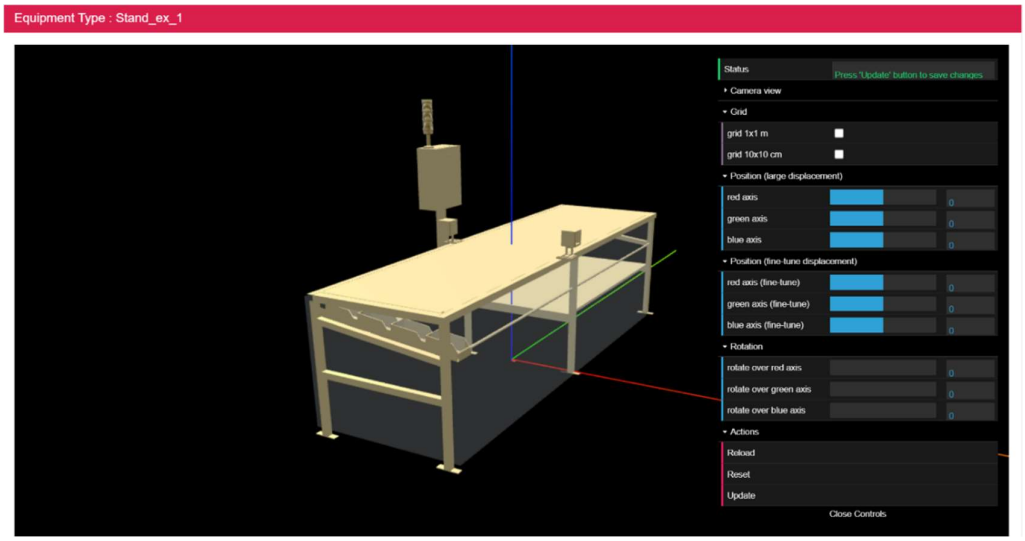


Figure 7 – Catalogue: Access to the 3D model of an object

The following picture shows the same object but the CAD model is completely separated from the bounding volume of the object. This situation must be avoided because the bounding volume is the concept that will enable the User to locate an instance of the object in the proper place within the model of a physical area.

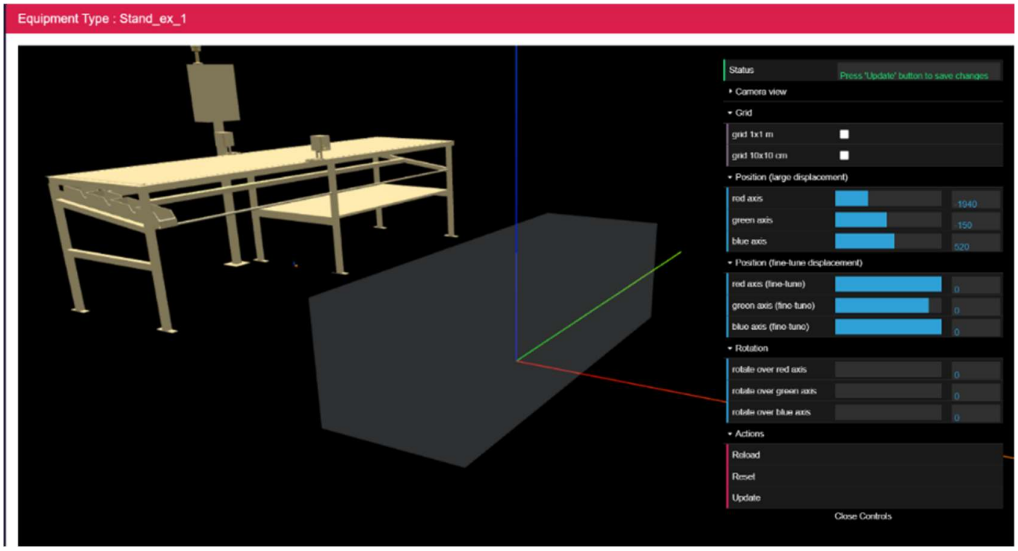


Figure 8 - Catalogue: separation between the CAD model and the bounding volume of an object

4.4.3 Creating a new object type

As shown on Figure 5, on top of the list identifying the different models of a selected object category, a button '+ New …" is present, enabling the User to create a new object type.

For all the object categories, the creation of a new object model, comprises the following steps:

1. Identification of the new object model, by supplying an identifier and the dimensions of the object's bounding volume, that is, the dimensions of the volume that encompasses the physical elements of the object.

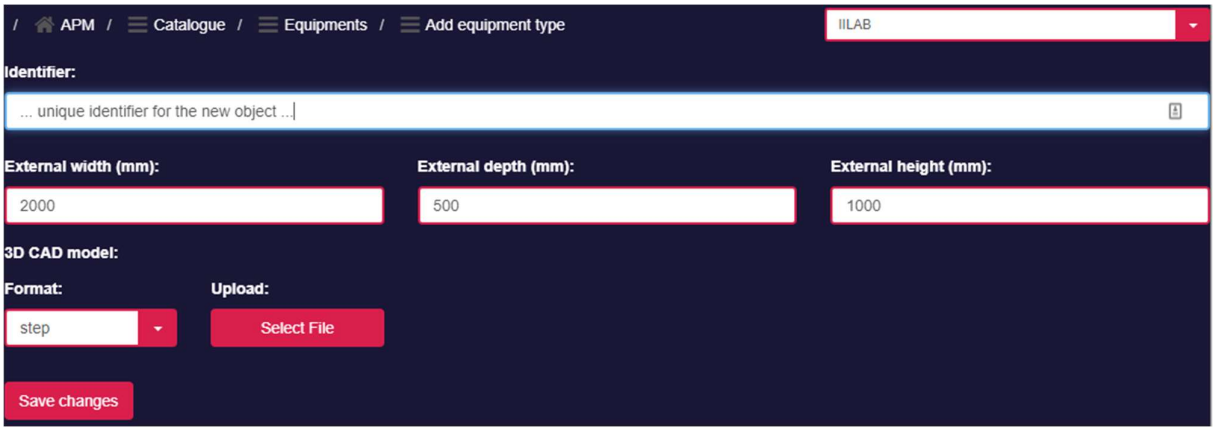


Figure 9 - Catalogue: Identification of new object

2. The upload of the CAD model that corresponds to the new object. The CAD model is retrieved from the User's computer and may be a STEP, STL, PLY or URDF file or set of files. This step is optional but recommended. As show below, the button 'Select File' triggers the selection of the files. A new field is then presented, to enable the user to specify the scale conversion (from meters to millimetres).

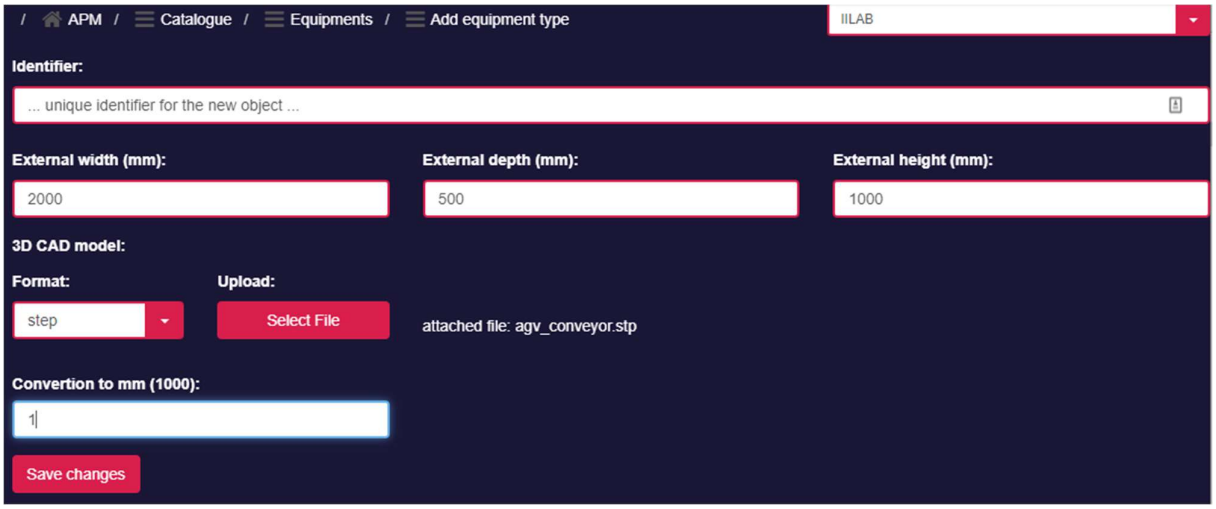


Figure 10 - Catalogue: Upload of CAD model

3. The identification of the internal geometry of the new object. This step is mandatory for logistic racks and Large boxes (logistic pallets). In both cases, the Tool requests the Users to specify the number of levels (rack) or layers (pallet) in the object and their physical dimensions. Additionally, information about the following characteristics are requested to the User:

   - In a logistic rack - The physical dimensions and positioning of each level. Levels may be horizontally and/or vertical displaced and each level can also be subdivided into cells. Once instantiated (see chapter 4.5) logistic racks can support on each compartment small boxes containing physical elements (parts).
   - In a logistic pallet - The physical dimension of each layer and the number of cells planned to hold one physical element (part).

   The following pictures shows the interfaces used to capture this information from the User.

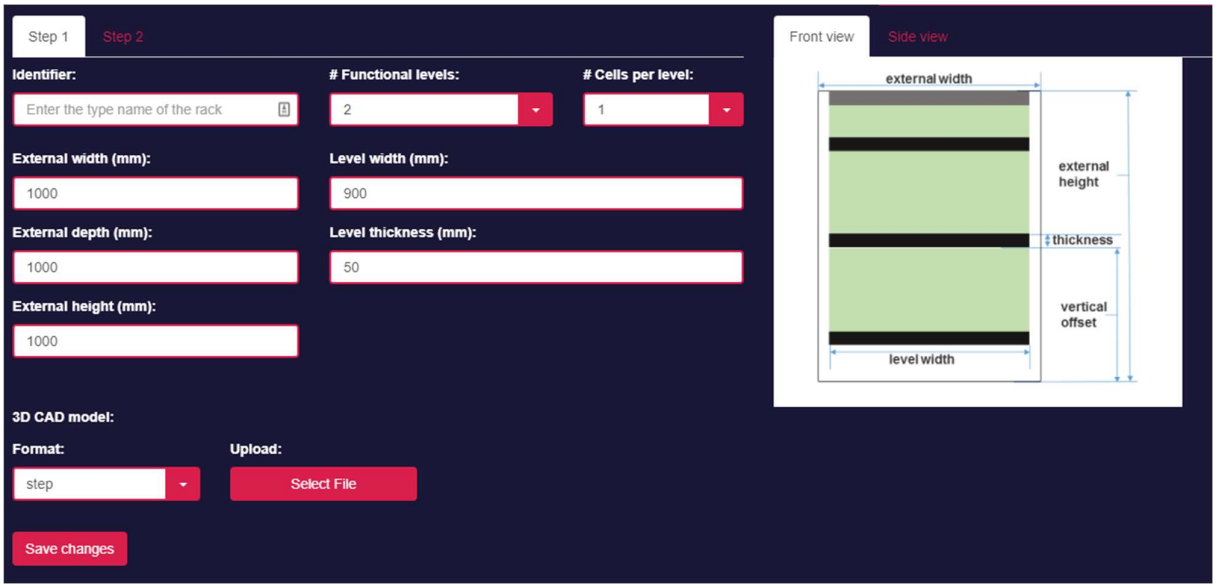


Figure 11 - Catalogue: Internal geometry of a Rack (part 1)

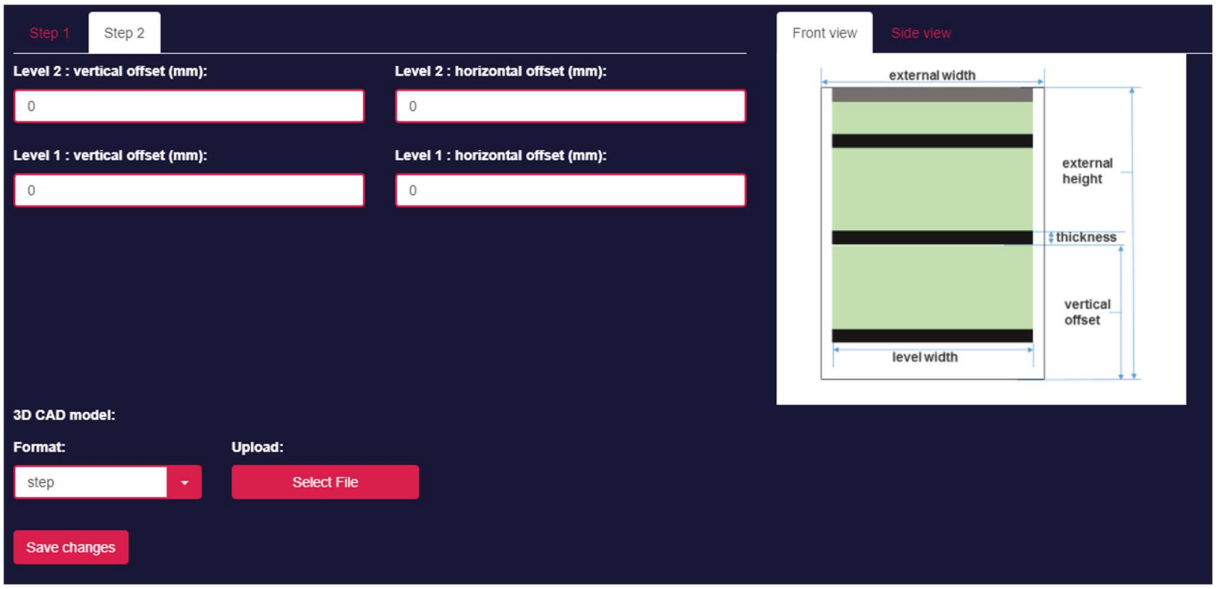


Figure 12 - Catalogue: Internal geometry of a Rack (part 2)

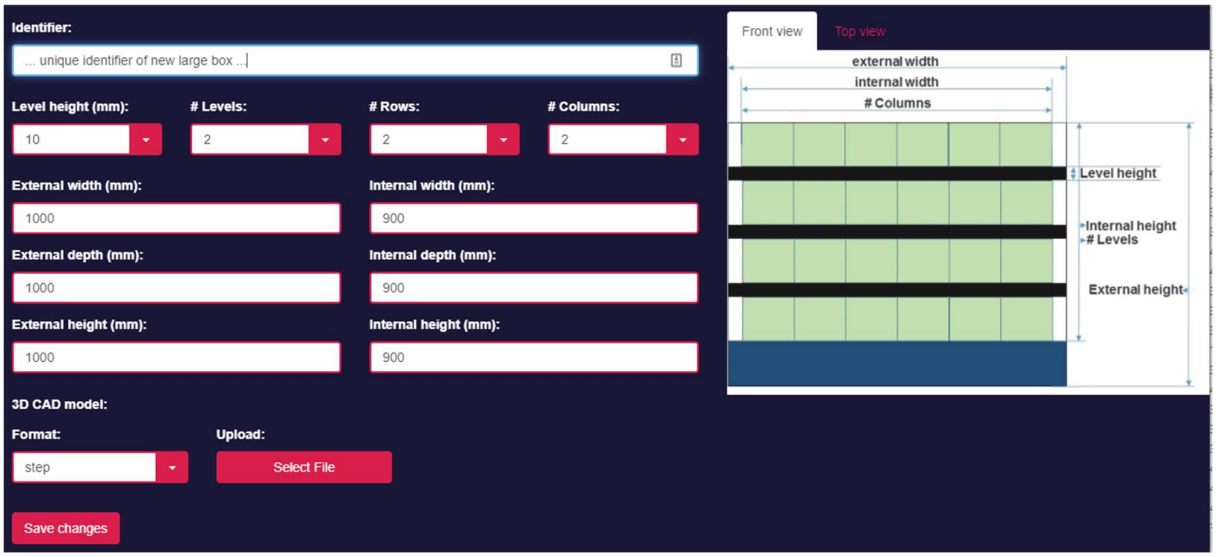


Figure 13 - Catalogue: Internal geometry of a Pallet

4.5 Implantation

The implantation feature aims to enable the User to build the digital representation (model) of a given physical area, be it a logistics area, assembly line or any other manufacturing area. The main elements used to build the model are the Catalogue and a Map of the area. The Catalogue contains the models of the objects that may be used in the creation of the model. The Map of the area constitutes the instrument that will enable the User to 'implant' objects and their proper locations. Naturally, the Map must represent the layout of the area one is targeting to model.

The creation of a given physical area model comprises the following steps:

1. Specification of a Map to represent the physical area to model
2. Implantation of object instances in the Map
3. Checking and validating the entire model by visualizing it in 3D

4.5.1 Specifying the Map

The Map is the first instrument to use in order to build the digital representation of a given physical area. The Map must have a dimension and may have a 2D image that graphically identifies the objects that are presented in the physical area.

By default, if a 2D image is not supplied, the Tool represents the map in the screen as a grid, as shown in the picture below.

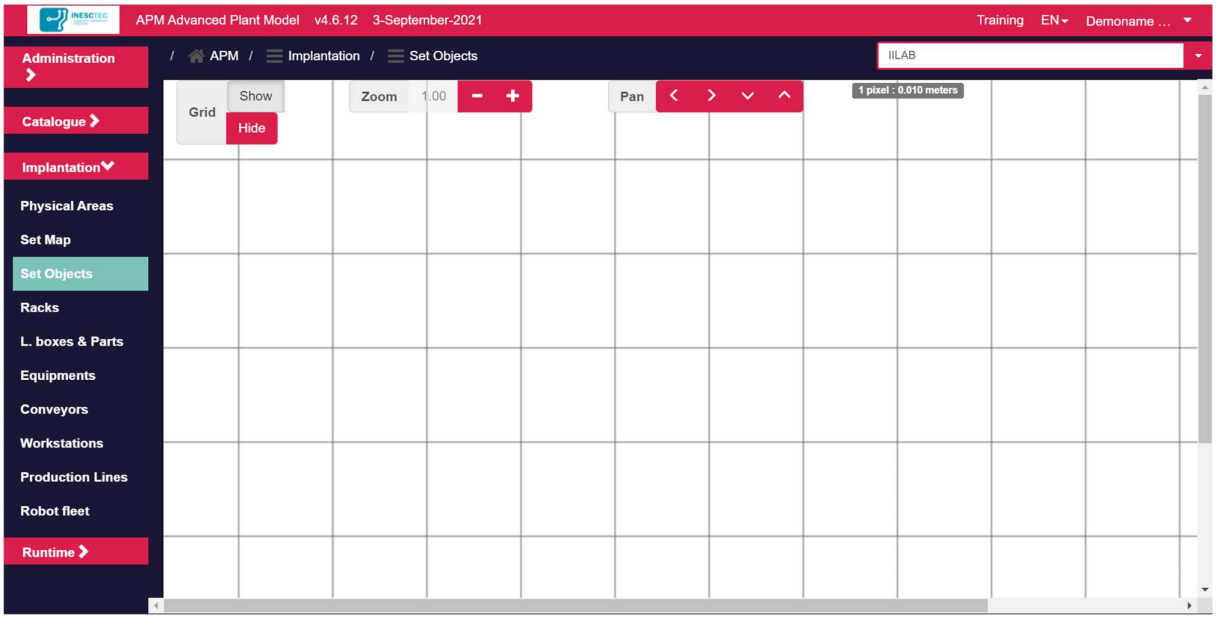


Figure 14 – Implantation, 'Set Objects' screen

The specification of the 2D image, reflecting the layout of the area, must me provided on the first step in the creation of the model, by doing the following steps:

1. On the Implantation area, select the 'Physical Areas' feature. All the physical areas created so far are listed in the central area of the Interface.

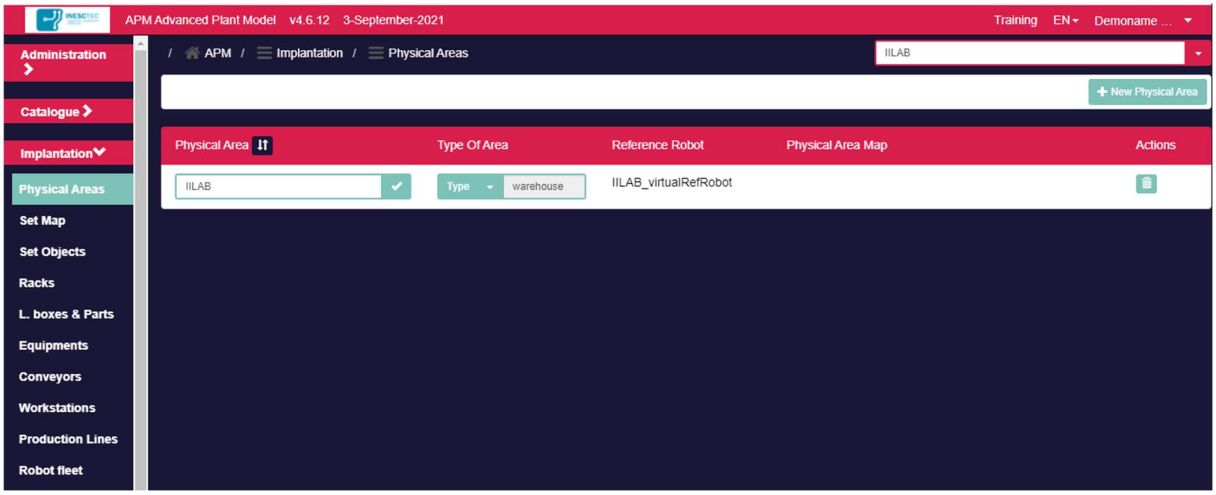


Figure 15 – Implantation, 'Physical Areas' screen

2. Pressing the button 'New Physical Area' (top right zone of picture above), opens the screen shown below. User is requested to name the area, to supply the physical dimension of the area and to optionally provide a 2D image, making an upload of the image from his/her own computer.

Figure 16 – Implantation: Initial creation of a physical real

The following picture, shows the Map that corresponds to the area 'assembly_area_1', for which a 2D image was supplied as map. When supplying the Map, the User has to identify the scale of the image (how many meters are represented by each pixel in the image map).

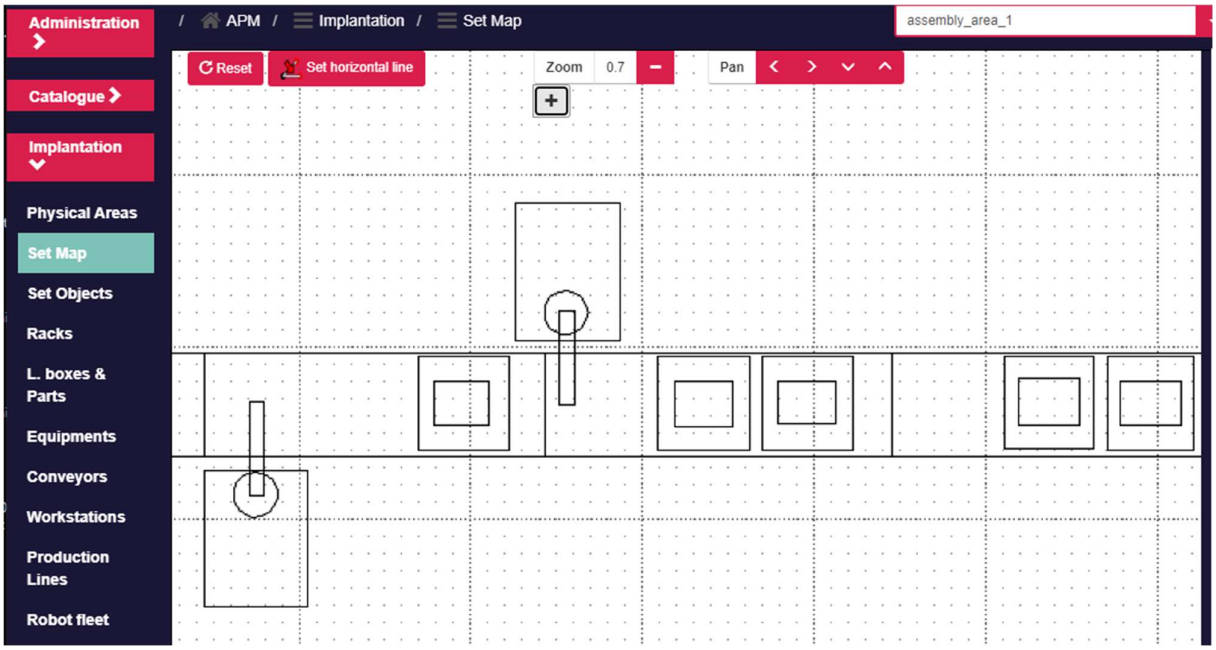


Figure 17 – Implantation: 'Set Map' screen

In the case the map image has not the same orientation as the screen used to visualize the map (left picture on the following Figure), User can specify a horizontal line in the map by selecting two points in the image. This is done by selecting the 'Set horizontal line' button, available on the top of the image. See the first picture below, showing a non-horizontally aligned image and the picture on the right that shows the very same image but aligned horizontally, after the selection of two points in the image (the image shown on the second image below was generated by a mobile robot, that has navigated around in the physical area and analysed by laser scanning the area in order to detect opaque zones).

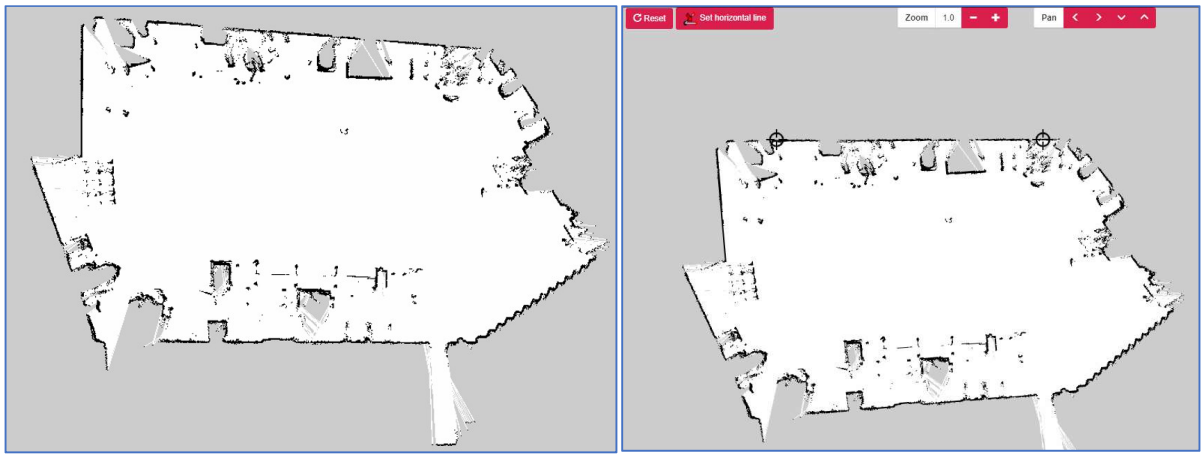


Figure 18 – Implantation: Map non-horizontally aligned (on the left) and horizontally aligned (on the right)

The visualization of the map may be adjusted by clicking the 'Zoom' and 'Pan' red buttons available on the top of the image.

The 'Reset' button resets the horizontal alignment of the image.

4.5.2 Implanting objects in the Map

The implantation of objects in the Map is done on the 'Set Objects' screen (see picture below).

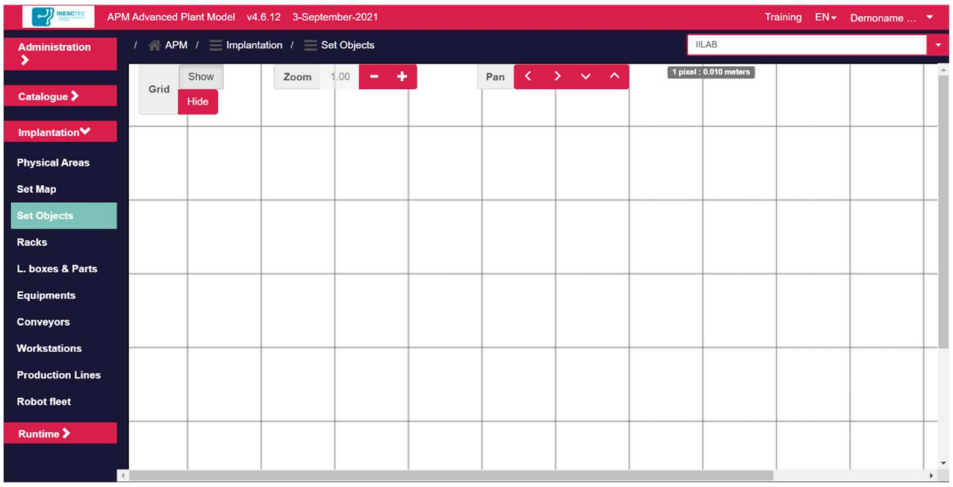


Figure 19 – Implantation: 'Set Objects' screen

After zooming and moving the image to a proper representation of the area, the procedure is very simple. The mouse right hand button must be pressed and the Catalogue is presented, letting the User the object he/she intends to deploy (picture below).

Figure 20 – Implantation: selecting an object from the Catalogue

By selecting object types from the Catalogue, the Tool is creating the correspondent instances and placing them on the location where the right hand button was pressed. A rectangle with red arrows represents the external volume of the object instance. Following picture shows three objects implanted in the map. In this scope, one can move each object instance by pressing and holding the left mouse button, and dragging it until the object reaches the intended location.

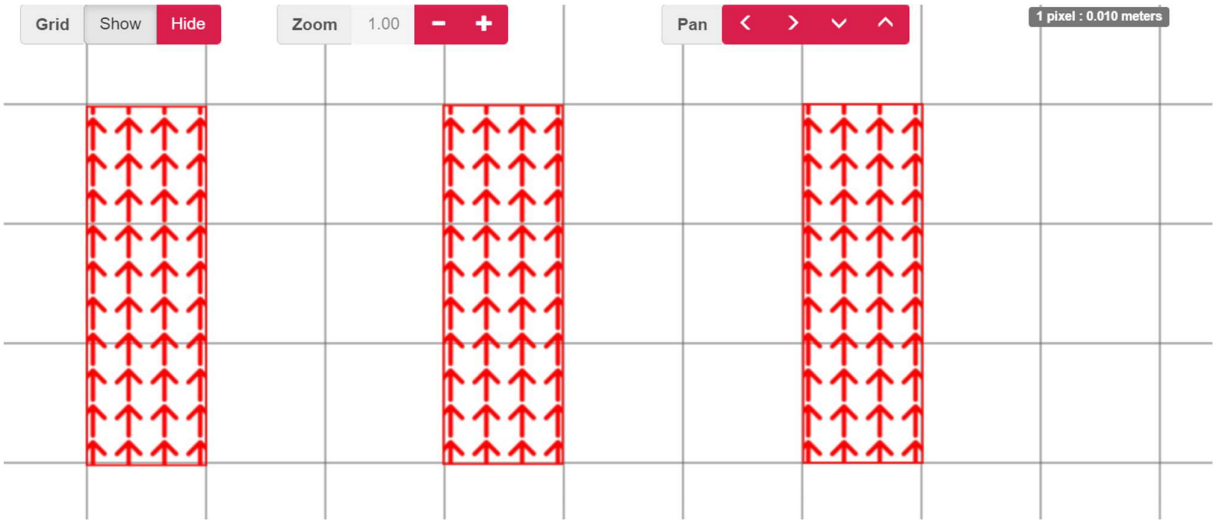


Figure 21 – Implantation: Populating the map with objects

When selecting an object by pressing the mouse right hand button, a pop-up is shown, presenting actions that can be performed on the selected object (e.g. cloning the object, renaming the object, rotating it or removing it from the map).

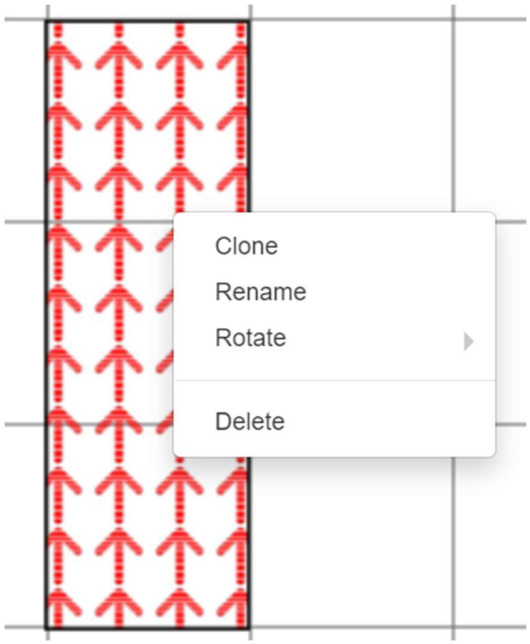


Figure 22 – Implantation: selecting an object to act on it

It is also possible to select several objects and align vertically/horizontally their representations, to rotate them and to remove all of them from the map (see next picture).

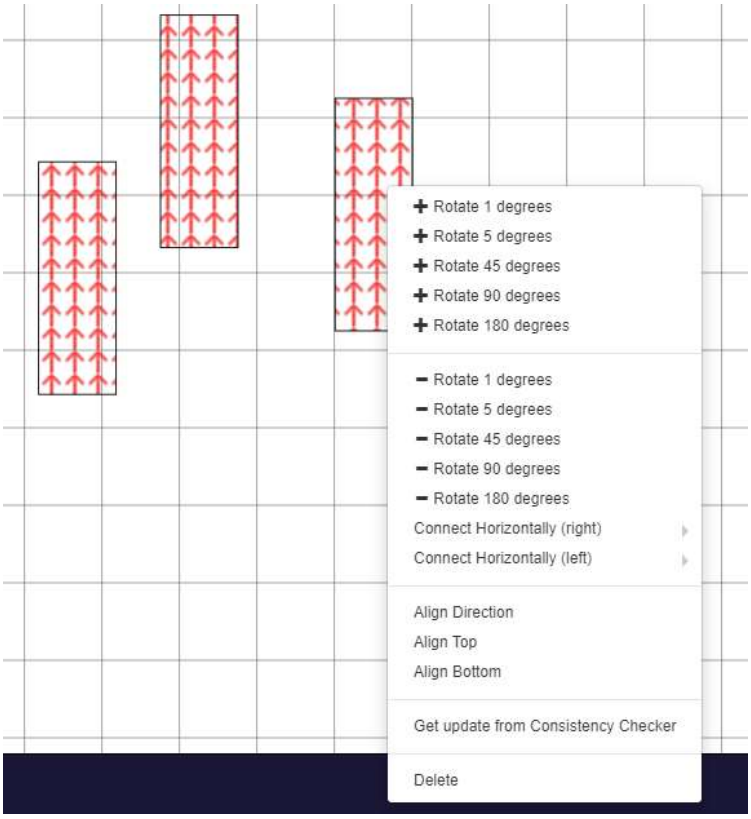


Figure 23 – Implantation: Selecting several objects in order to act on them

4.5.3 Validating the Model

The visual validation of the Model (the digital representation of a given physical area) is done by looking at the three-dimensional model that one has built so far. This is achieved in the 'World Model' feature as shown below.

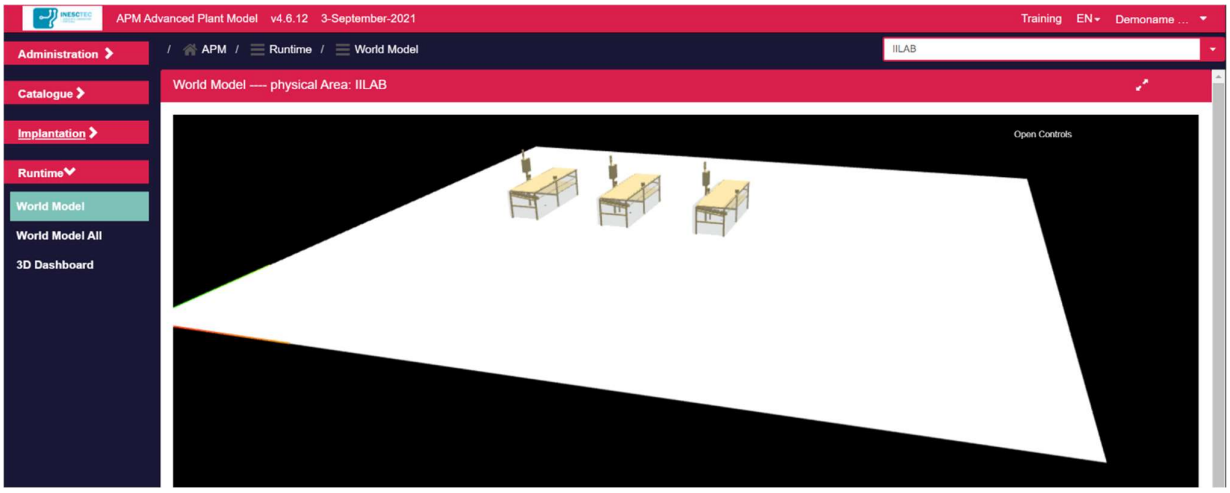


Figure 24 – World Model World Model screen

The Interface allows the User to navigate in the 3D model, by zooming in and out, and orbiting around the objects. The mouse is used in the same way as used to visualize the 3D Model of a single object:

- Pressing the left button and dragging the mouse allows one to orbit around the object's image;
- Rolling the central button allows one to zoom in or zoom out the image;
- Pressing the right button and dragging the mouse allows one to pan the object's image.

5 How to

This section provides eight cases oriented to helping the User to accomplish typical actions on the construction of a Model through the Digital Twin Designer (mentioned in the text as "The Tool"):

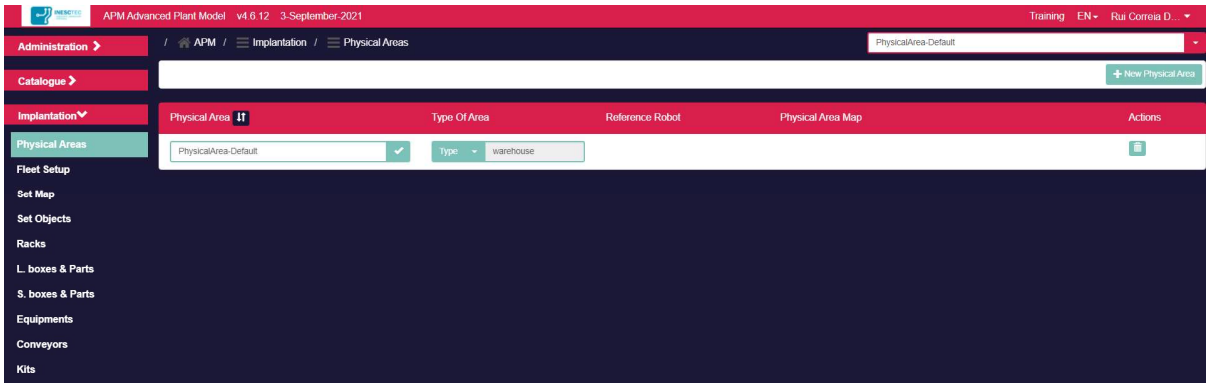
- How to create a physical area
- How to implant objects on a physical area
- How to create a physical area with a map
- How to add a new rack to the catalog
- How to add a new rack to the catalog with STEP
- How to add a new equipment to the catalog
- How to add a new workstation to the catalog
- How to add a new production line to the catalog

These cases are directly provided by the Tool itself on the training area, which also gives the User access to examples of CAD models that are required to go through these cases.

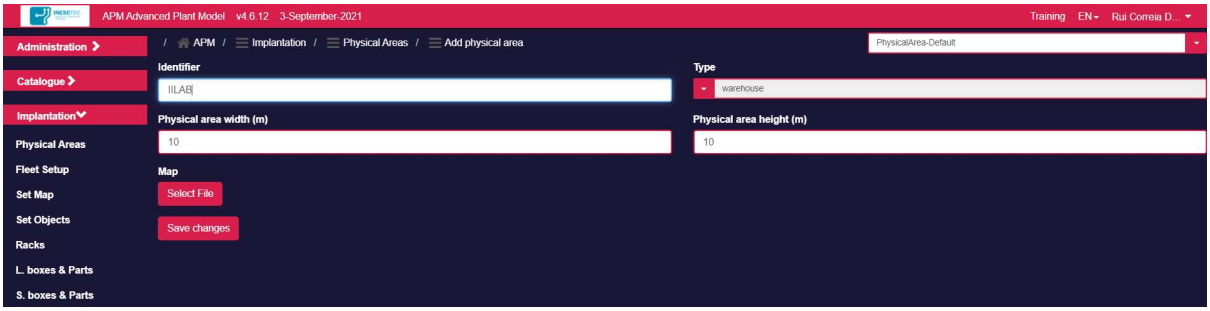
5.1 How to create a physical area

The Tool lets you model a given manufacturing area. The first thing you should do is to create a "Physical Area" in the Tool:

1. Go to "**Implantation / Physical Areas**"

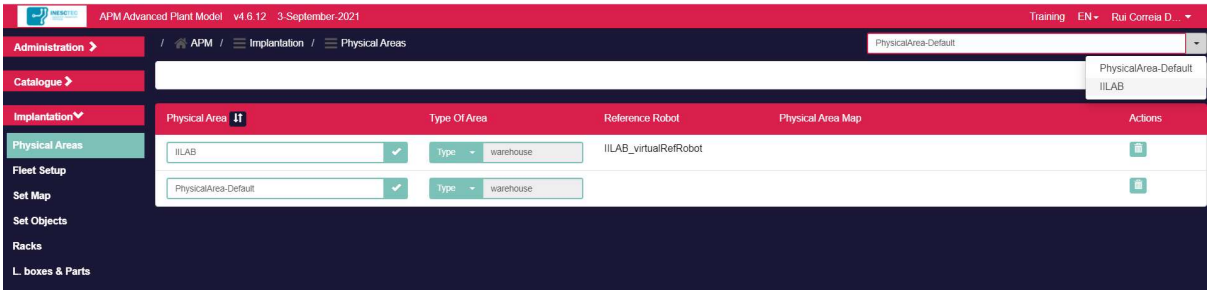


2. Press "**New Physical Area**" button (top right in the above screen)

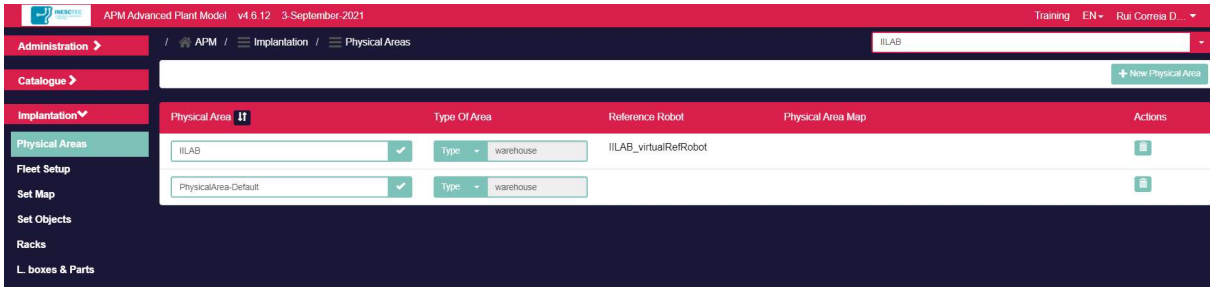


- Supply an **identifier** (e.g. IILAB)
- Specify the **type** (warehouse or assembly line)
- Specify the **width** and **height** (meters) of the physical area
- Press "**Save changes**"

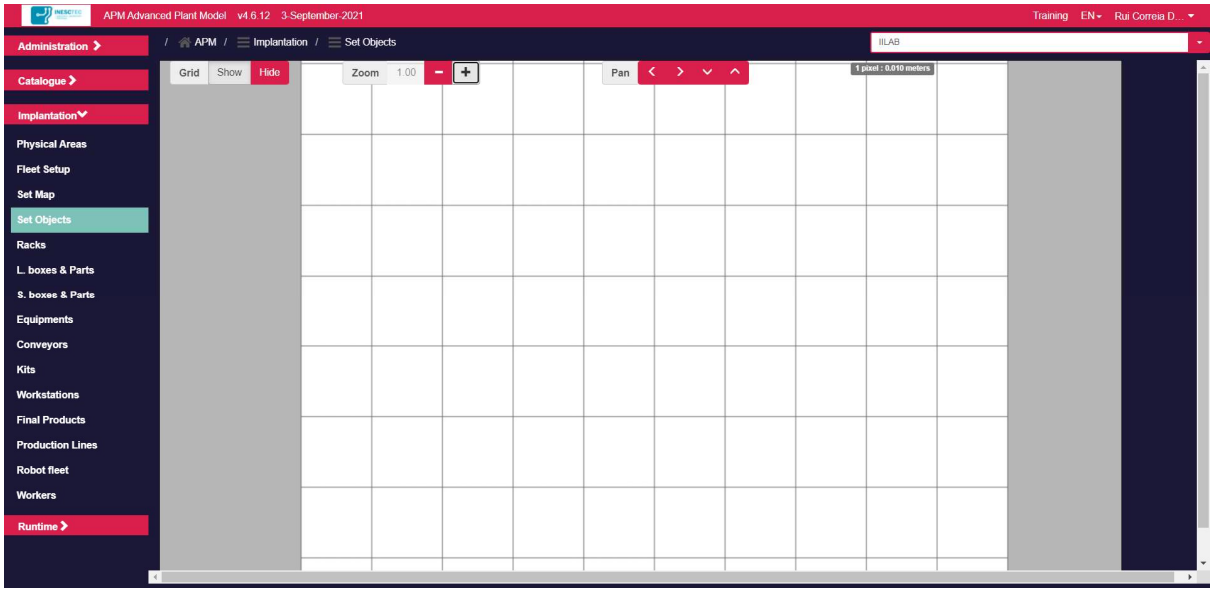
- Confirm the creation of the physical area (press the combo box on the top right).



- Select it so that you start modelling this new physical area.



- In case this is the first physical area you create, please remove the physical area with the name 'PhysicalArea-Default'.
- Go to "**Implantation / Set Objects**". This is the place where you will implant objects on the Physical Area.



The grid is configured to show 1 x 1 meters of area.

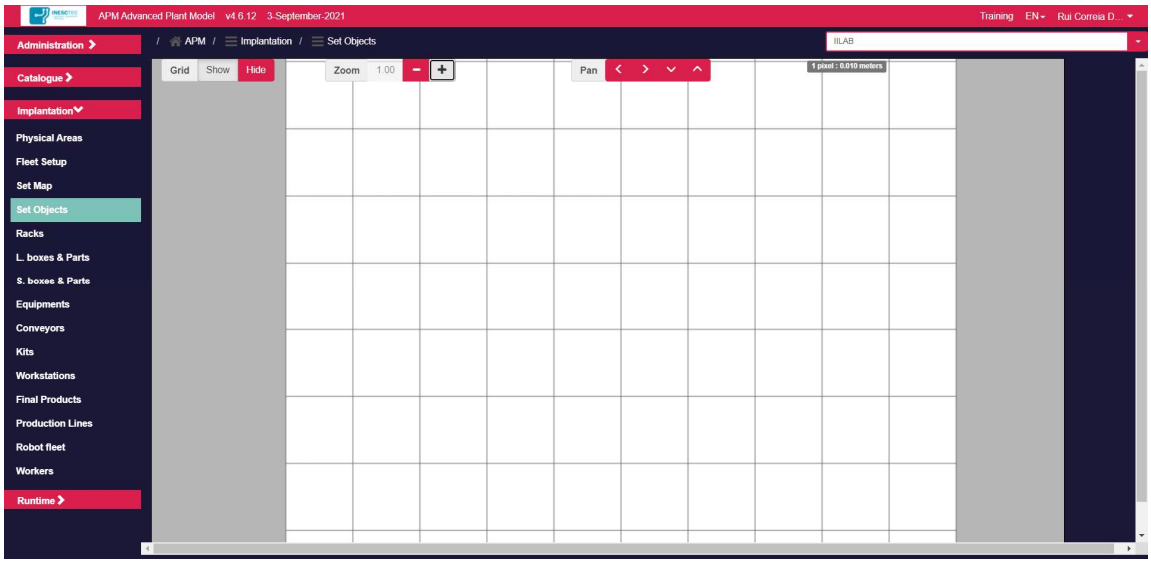
You can zoom in or zoom out by pressing the Zoom button.

You can move in the area by pressing the fours Pan buttons.

5.2 How to implant objects on a physical area

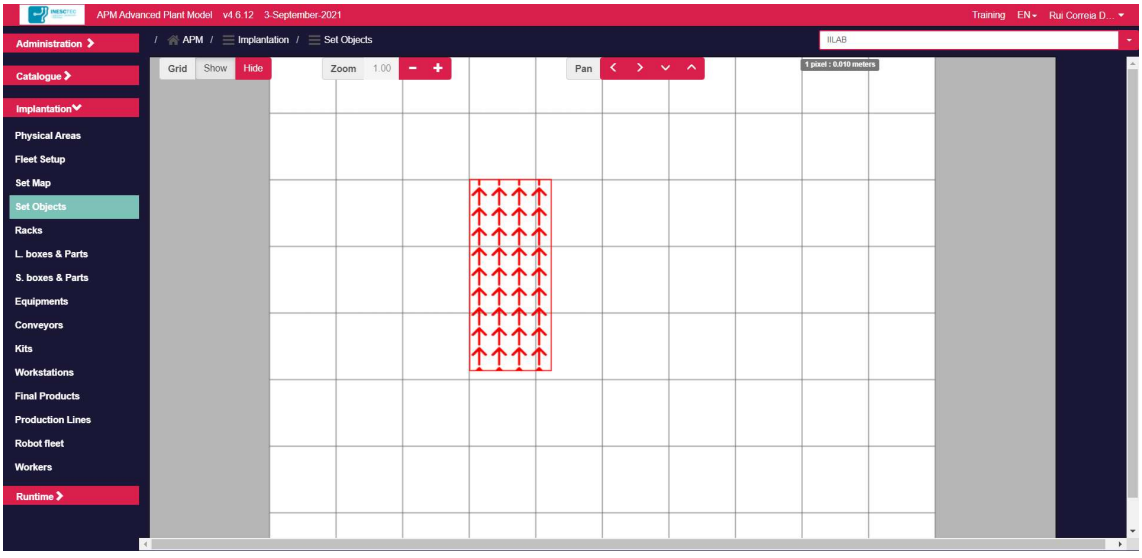
The Model of a given Physical Area is built by selecting objects defined on the Catalog and adding them to the Physical Area.

1. Go to “Implantation / Set Objects” (make sure you have selected your Physical Area in the top right combo box)



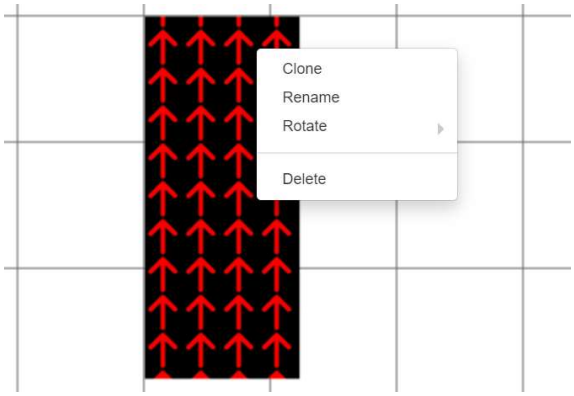
2. Press the right button in the mouse, you’ll get options that let you select an object from the Catalogue

3. Select one of the objects (e.g. rack / PSA 2870x1225), a red rectangle will appear in the working space

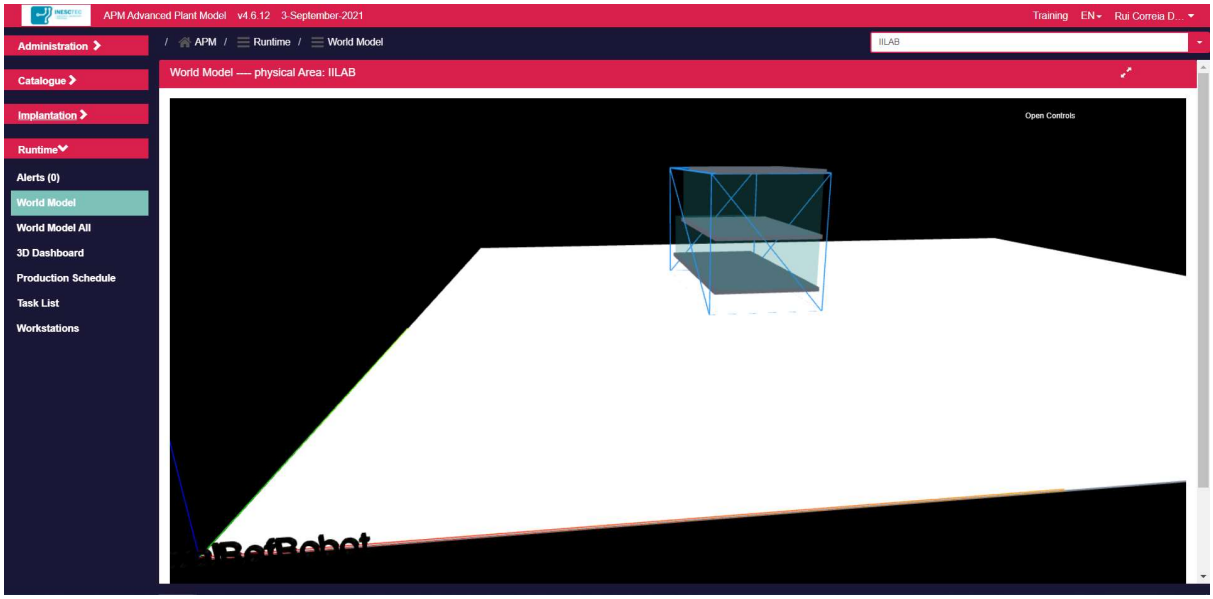


4. You can now select the object and move it in the working area

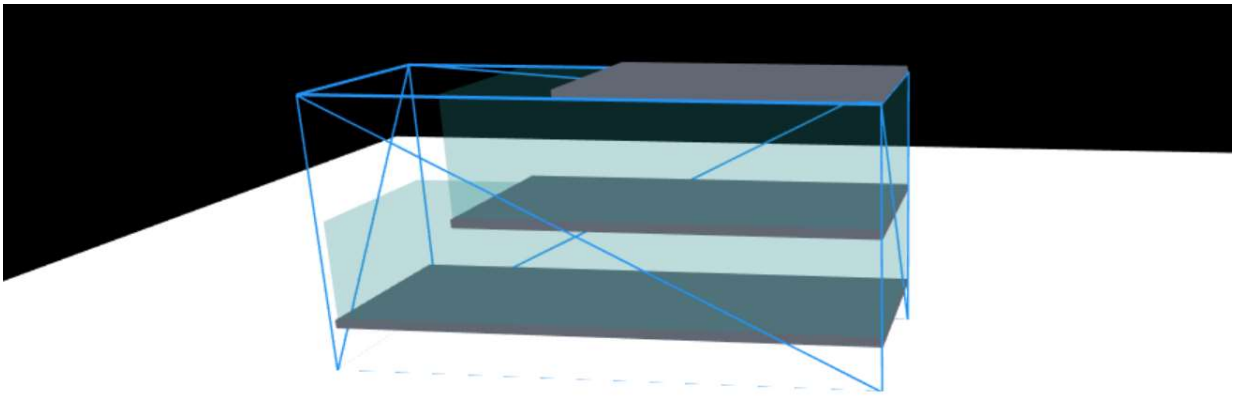
5. You can clone, rename, rotate and delete the object by selecting it and press the right button in the mouse



6. Go to "**Runtime / World Model**", a 3D visualization of the Model created so far is shown



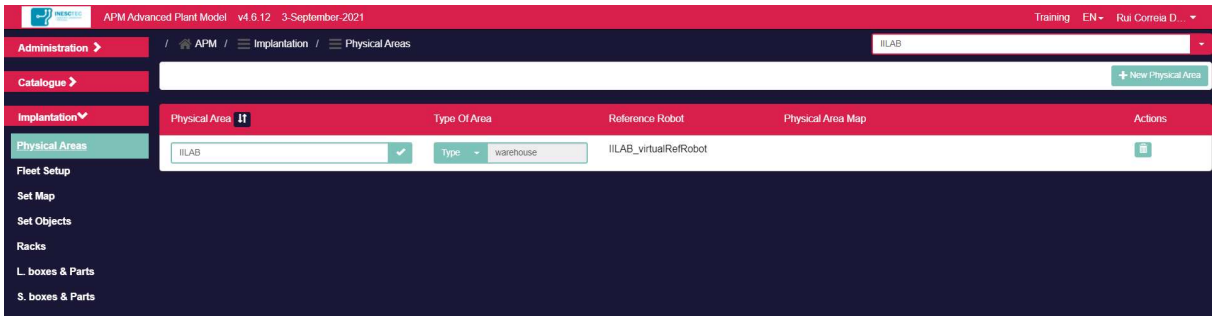
7. You can zoom in and out by using the mouse wheel
8. You can change the viewing perspective by selecting the left button in the mouse and moving the mouse around
9. You can also press the right button in the mouse and move the mouse



5.3 How to create a physical area with a map

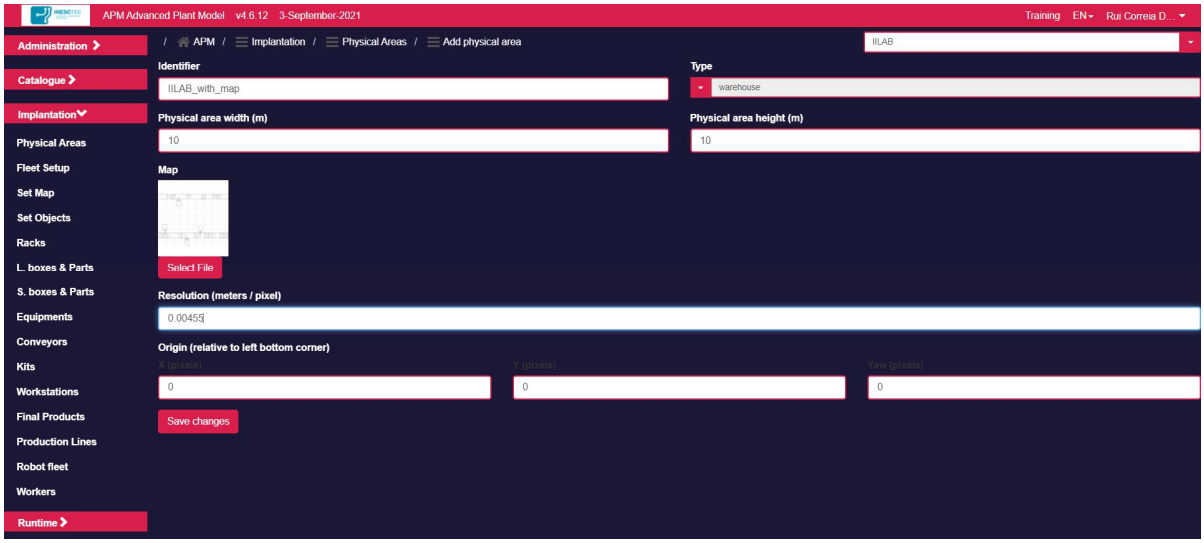
The APM lets you model a given manufacturing area. The first thing you should do is to create a "Physical Area" in the APM. You should supply a 2D image of the target area.

1. Go to "**Implantation / Physical Areas**"

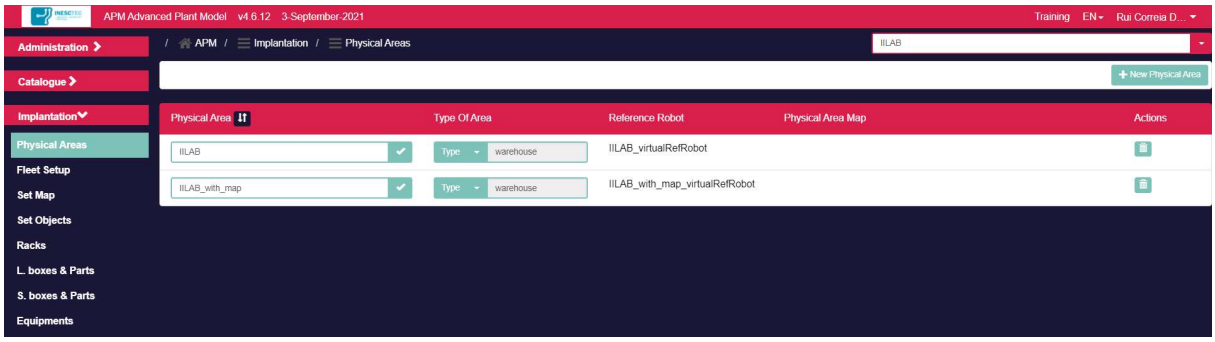


2. Press "New Physical Area" button (top right in the above screen)

- Supply an **identifier** (e.g. IILAB)
- Specify the **type** (warehouse or assembly line)
- Press "**Map / Select file**" button
- Supply a file containing the map for the physical area
- Identify the scale of the map: how many meters correspond to a pixel

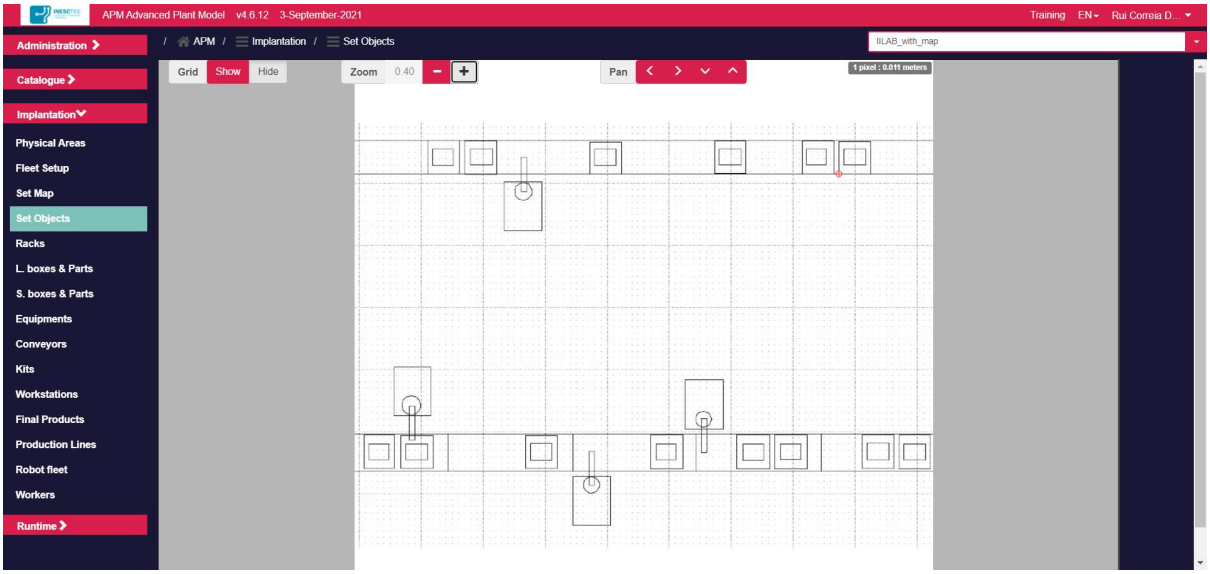


- Press "**Save changes**"
- Confirm the creation of the physical area (press the combo box on the top right).



- Select it so that you start modelling this new physical area.

- Go to "**Implantation / Set Objects**". This is the place where you will implant objects on the Physical Area.



The grid is configured to show 1 x 1 meters of area.

You can zoom in or zoom out by pressing the Zoom button.

You can move in the area by pressing the fours Pan buttons.

5.4 How to add a new rack to the catalog

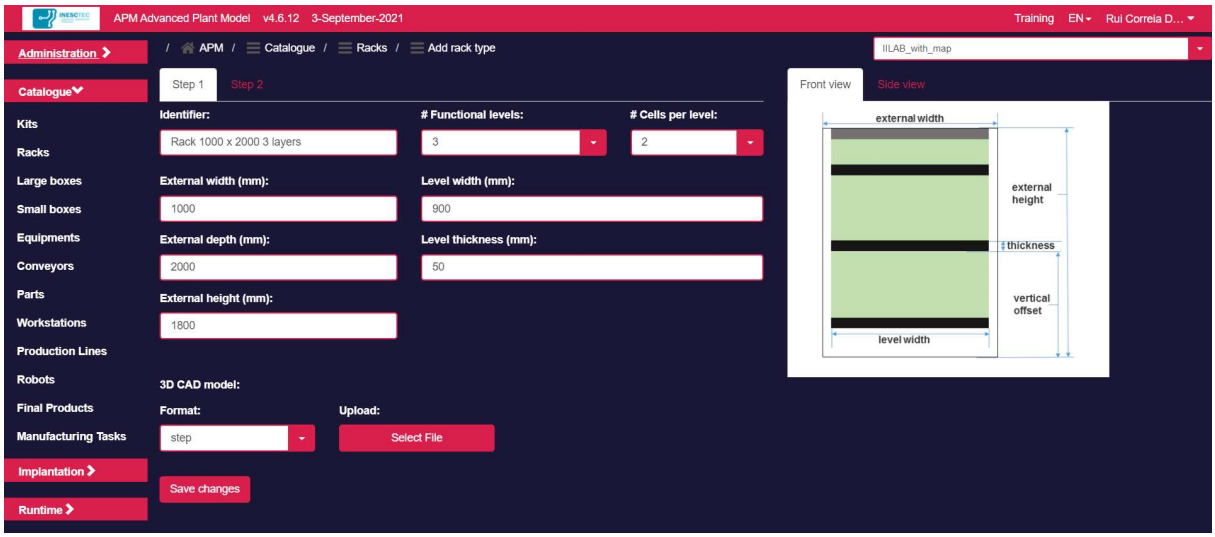
The Catalogue contains the 3D model of all the objects that may be used to build the Model of a given Physical Area.

The Catalogue supports the following types of objects: Kits, Racks, Large boxes, Small boxes, Equipments, Conveyors, Parts, Workstations, Production Lines, Robots and Final Products.

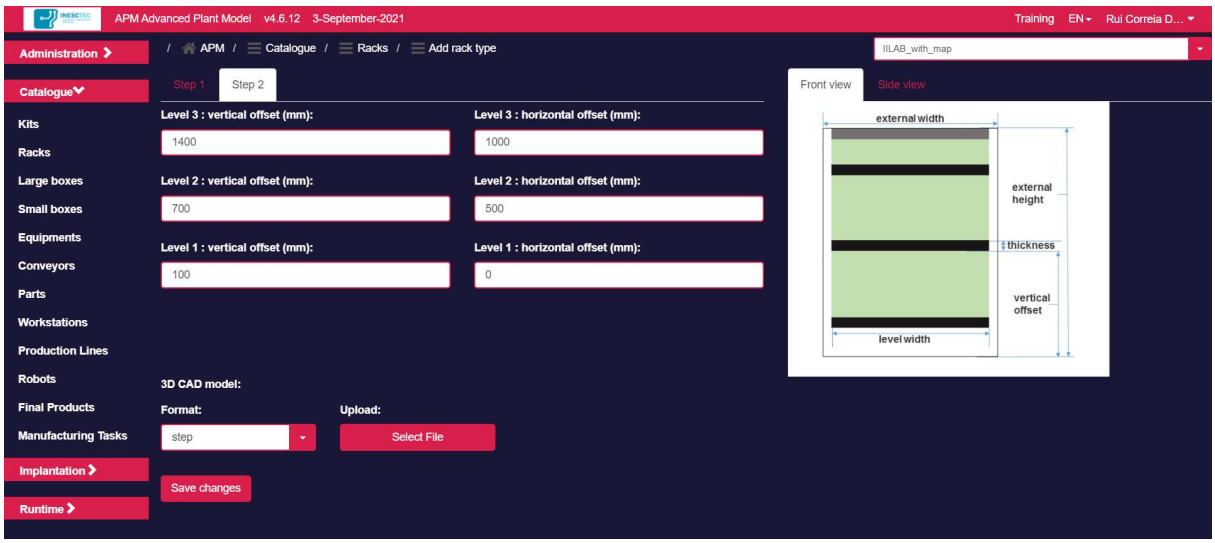
Let's add a new Rack to the Catalogue.

1. Go to "**Catalog / Racks**"

2. Press the top right button "**New rack**" and fill the fields according to the picture (Front view)

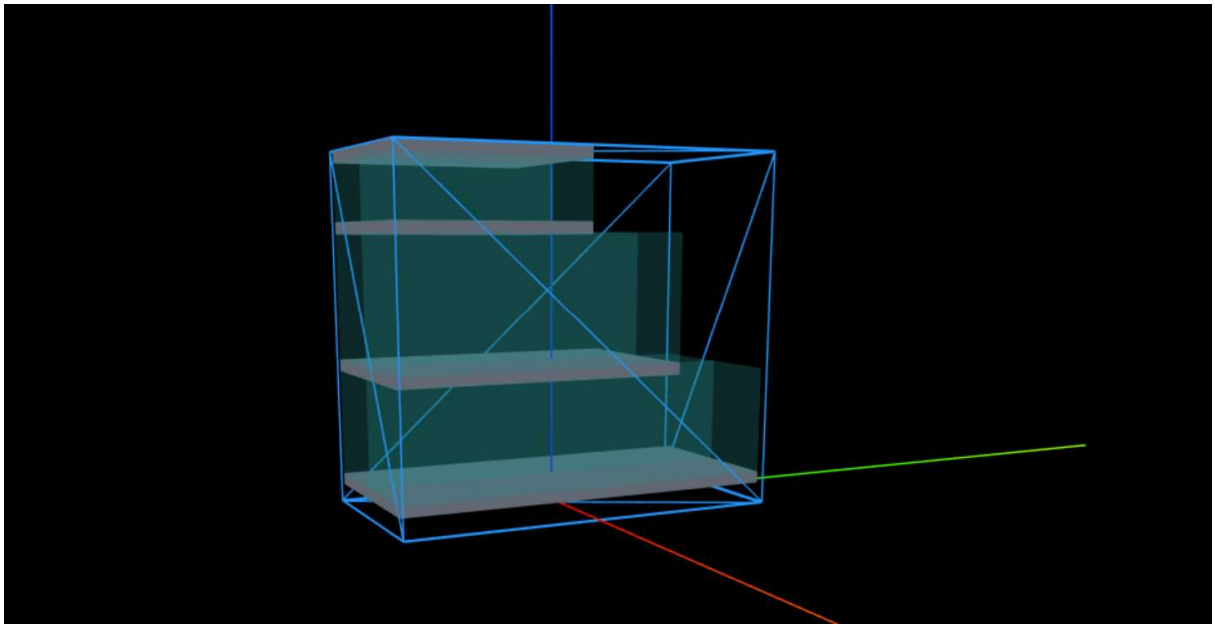


3. Select "**Step 2**" in the form and fill the fields according to the picture (Side view)



4. Press the "**Save changes**" button

5. In the list of Racks, press the  icon and check if the defined Rack has the right form.



5.5 How to add a new rack to the catalog with STEP

The Catalogue contains the 3D model of all the objects that may be used to build the Model of a given Physical Area.

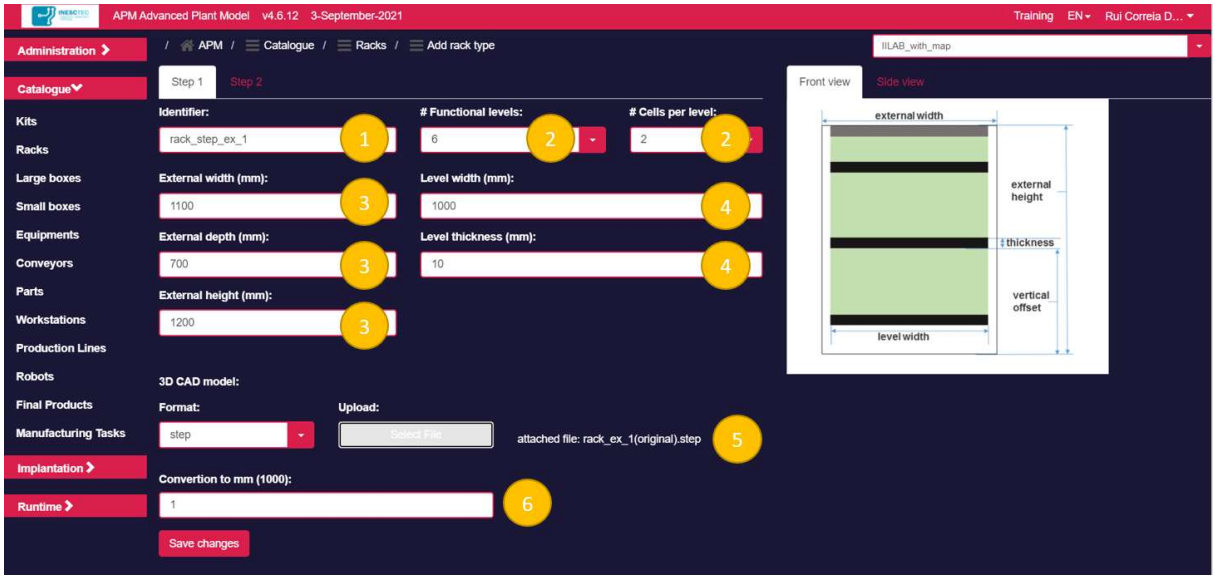
The Catalogue supports the following types of objects: Kits, Racks, Large boxes, Small boxes, Equipments, Conveyors, Parts, Workstations, Production Lines, Robots and Final Products.

Let's add a new Rack to the Catalogue by using a STEP model.

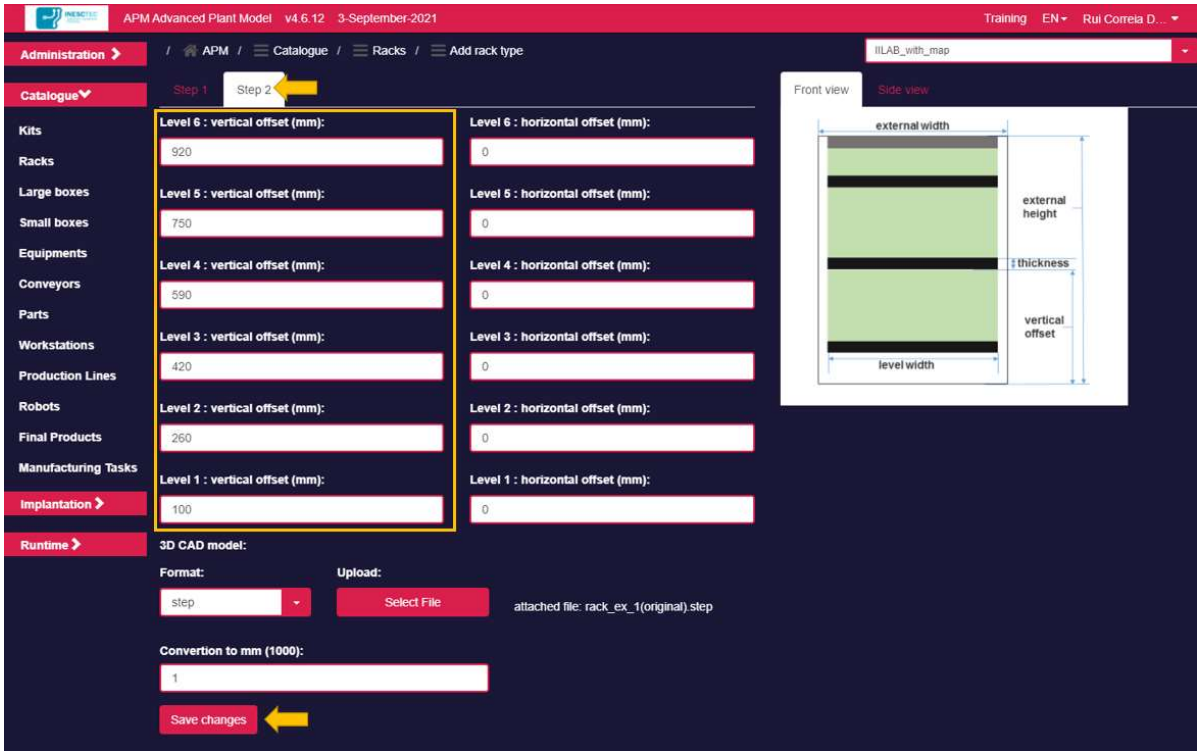
1. Go to "**Catalogue / Racks**"

2. Press the top right button "**New rack**"

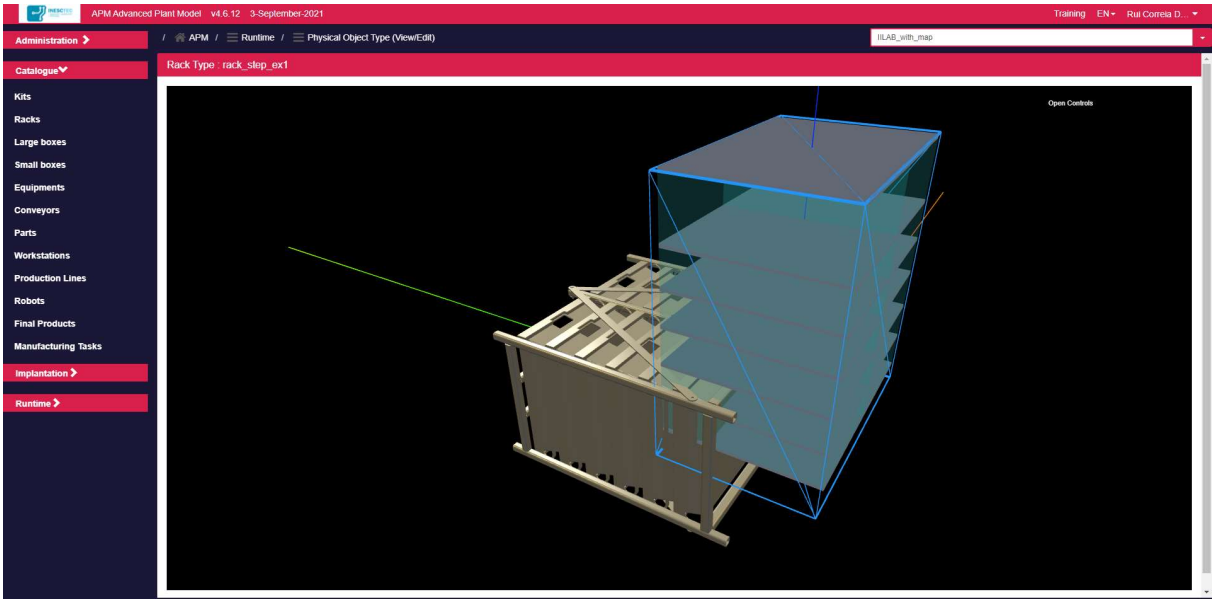
- (1) Set the field: "**Identifier field**" (DON't use blank spaces)
- (2) Set the fields: "**Functional Levels**" and "**Cells per level**"
- (3) Set the fields: "**External width**", "**External depth**" and "**External height**"
- (4) Set the fields: "**Level width**" and "**Level thickness**"
- (5) Press the "**3D CAD model / Select file**" button
- (6) Set the "**Convertion to mm**" field



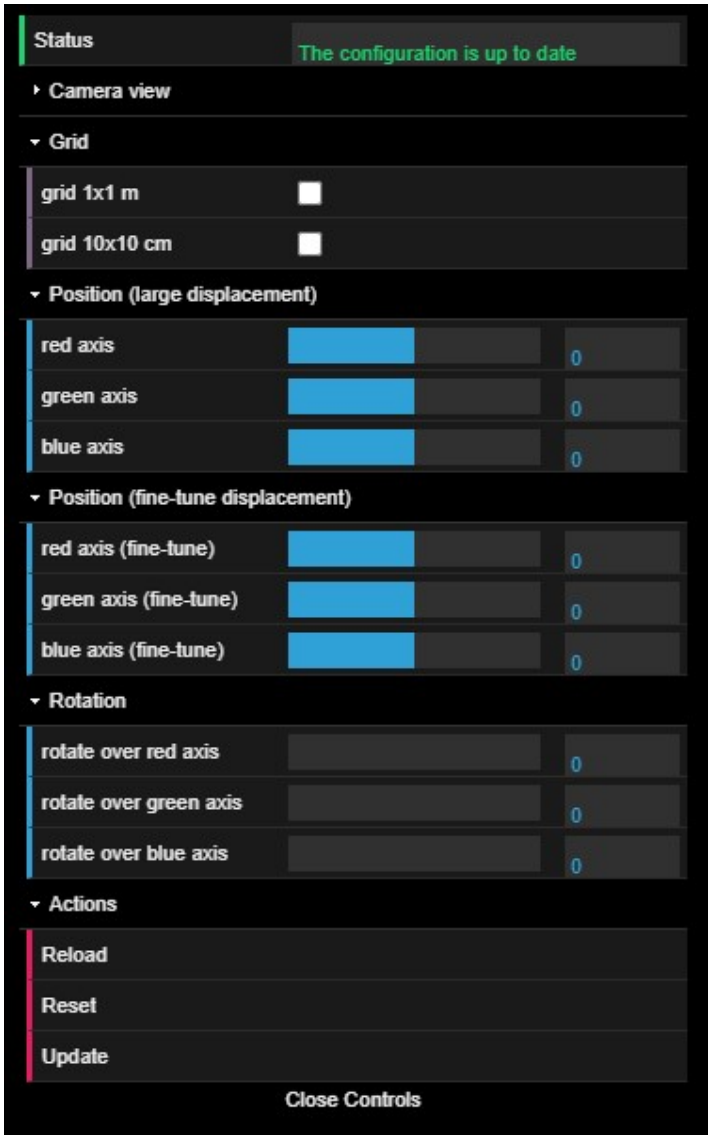
3. Select "**Step 2**" in the form and adjust the vertical offset of each level (In the **Step 1** were defined 6 levels). Then press the "**Save changes**" button and wait. When the upload is concluded the navigation will be redirected to the list of Racks in the catalogue.



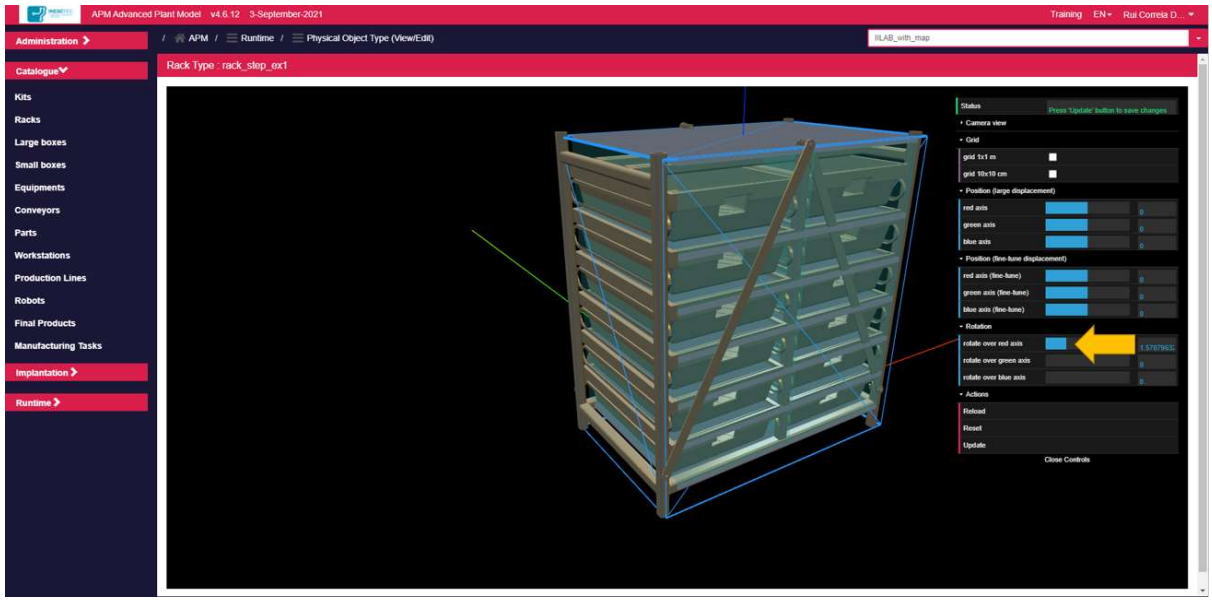
4. In the list of Racks, press the  icon and check if the defined Rack has the right form. It may be necessary to align the CAD model with the respective Bounding Volume (like in the picture below).



5. To align the CAD model with the respective Bounding Volume, press the top right button "**Open Controls**". The following menu comprising four categories will expand:
   - **Status**: gives feedback about the user's actions.
   - **Position**: adjusts the CAD model position.
   - **Rotation**: adjusts the CAD model orientation.
   - **Actions**: allows to **undo**, **reset** and **update** the configuration.
     - **Undo :** loads the last saved configuration.
     - **Reset :** sets to zero the configuration.
     - **Update:** saves the current configuration.

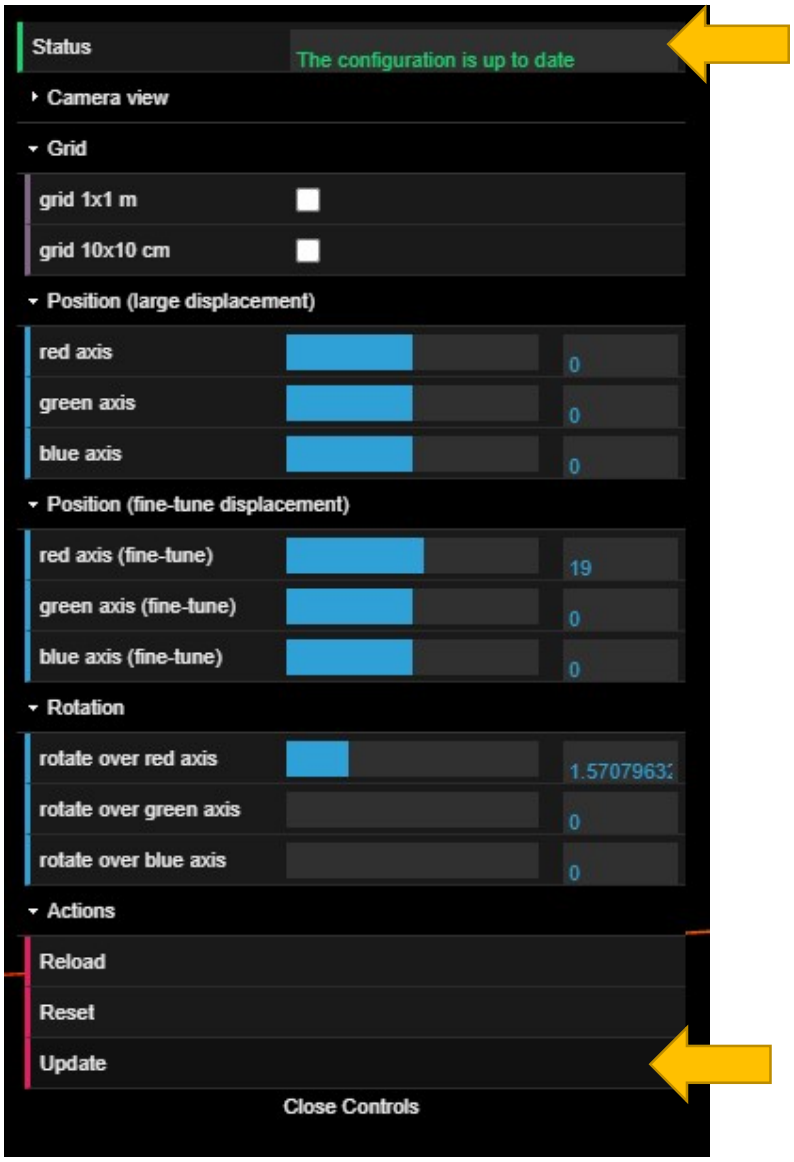


a. Adjust CAD model **orientation** using the **Rotation sliders**. Each slider performs the rotation over a specific axis (red, green, or blue).



b. Adjust CAD model **location** using the **Position sliders**. Each slider performs a translation over a specific axis (red, green, or blue).

c. Once the CAD model is aligned with the Bounding Volume, press Update button to save the configuration. A message is presented “The configuration is up to date” confirming the action.



5.6 How to add a new equipment to the catalog

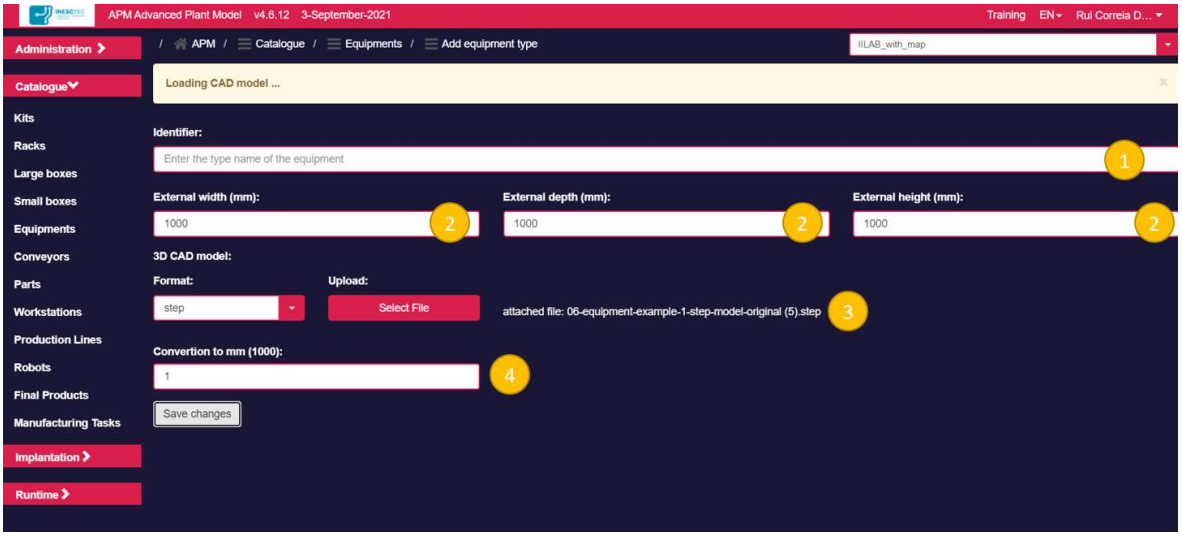
The Catalogue contains the 3D model of all the objects that may be used to build the Model of a given Physical Area.

The Catalogue supports the following types of objects: Kits, Racks, Large boxes, Small boxes, Equipments, Conveyors, Parts, Workstations, Production Lines, Robots and Final Products.

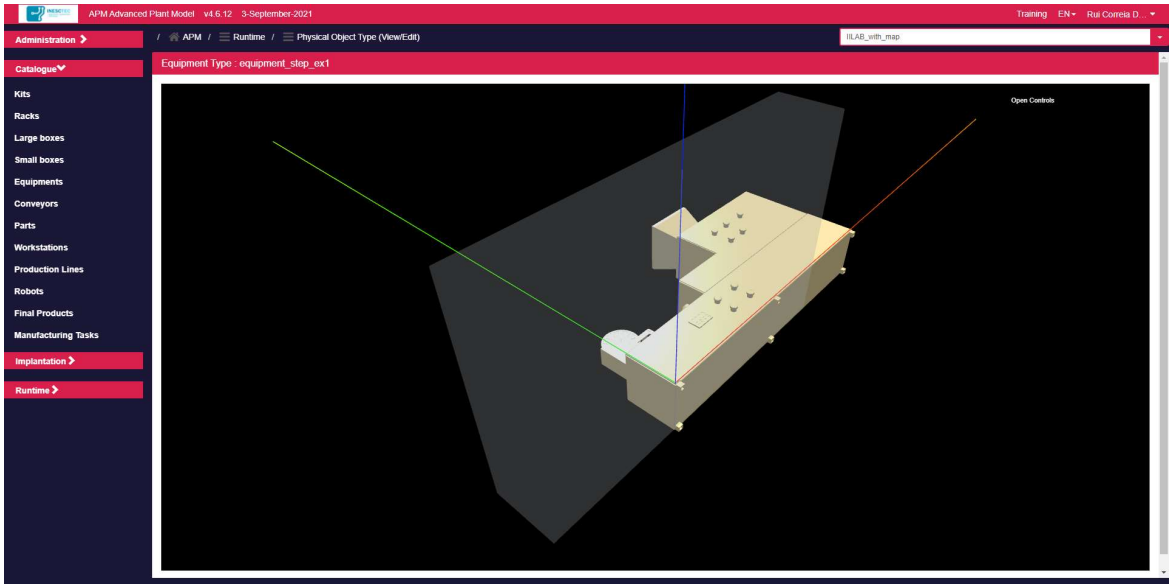
Let's add a new Equipment to the Catalogue by using a STEP model.

1. Go to "**Catalogue / Equipments**"
2. Press the top right button "**New equipment**"
   - (1) Set the field "Identifier field" (DON't use blank spaces)
   - (2) Set the fields: "External width", "External depth" and "External height"

   You may optionally associate a STEP model with the Equipment (DON't use spaces in the Identifier field)
   - (3) Press the "3D CAD model / Select file" button
   - (4) Set the "Convertion to mm" field
3. Press the "**Save changes**" button and wait. When the upload is concluded the navigation will be redirected to the list of Equipments in the catalogue.

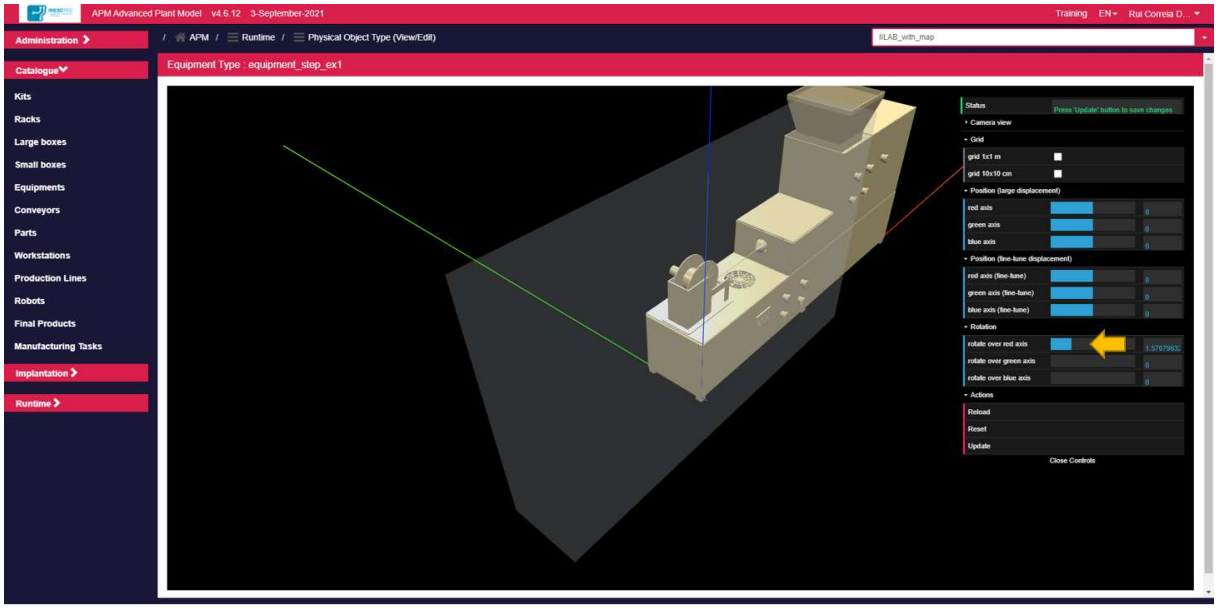


4. In the list of Equipments, press the  icon and check if the defined Equipment has the right form. It may be necessary to align the CAD model with the respective Bounding Volume (like in the picture below).

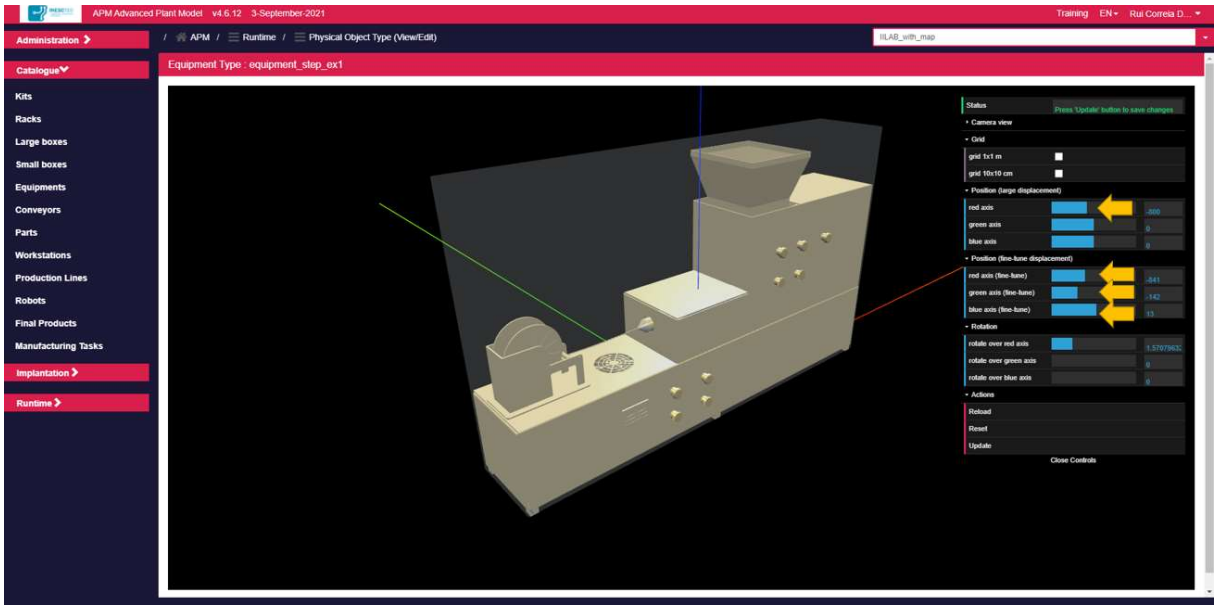


5. To align the CAD model with the respective Bounding Volume, press the top right button "**Open Controls**". The following menu comprising four categories will expand:
   - **Status**: gives feedback about the user's actions.
   - **Position**: adjusts the CAD model position.
   - **Rotation**: adjusts the CAD model orientation.
   - **Actions**: allows to **undo**, **reset** and **update** the configuration.
     - **Undo :** loads the last saved configuration.
     - **Reset :** sets to zero the configuration.
     - **Update:** saves the current configuration.

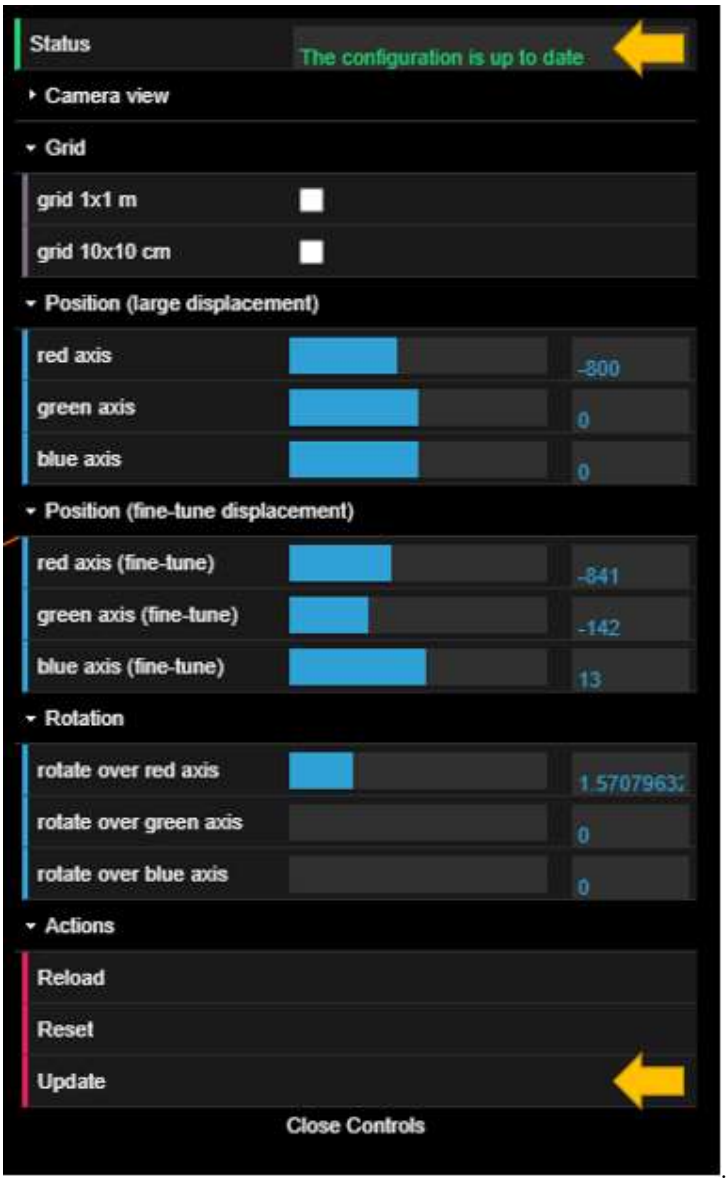
a. Adjust CAD model **orientation** using the **Rotation sliders**. Each slider performs the rotation over a specific axis (red, green, or blue).



b. Adjust CAD model **location** using the **Position sliders**. Each slider performs a translation over a specific axis (red, green, or blue).



c. Once the CAD model is aligned with the Bounding Volume, press **Update** button to save the configuration. A message is presented “The configuration is up to date” confirming the action.



5.7 How to add a new workstation to the catalogue

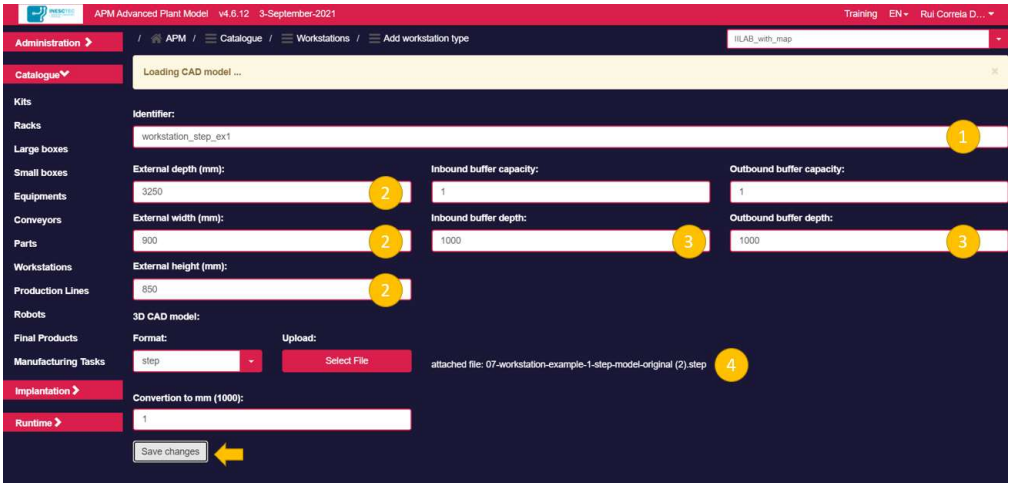
The Catalogue contains the 3D model of all the objects that may be used to build the Model of a given Physical Area.

The Catalogue supports the following types of objects: Kits, Racks, Large boxes, Small boxes, Equipments, Conveyors, Parts, Workstations, Production Lines, Robots and Final Products.

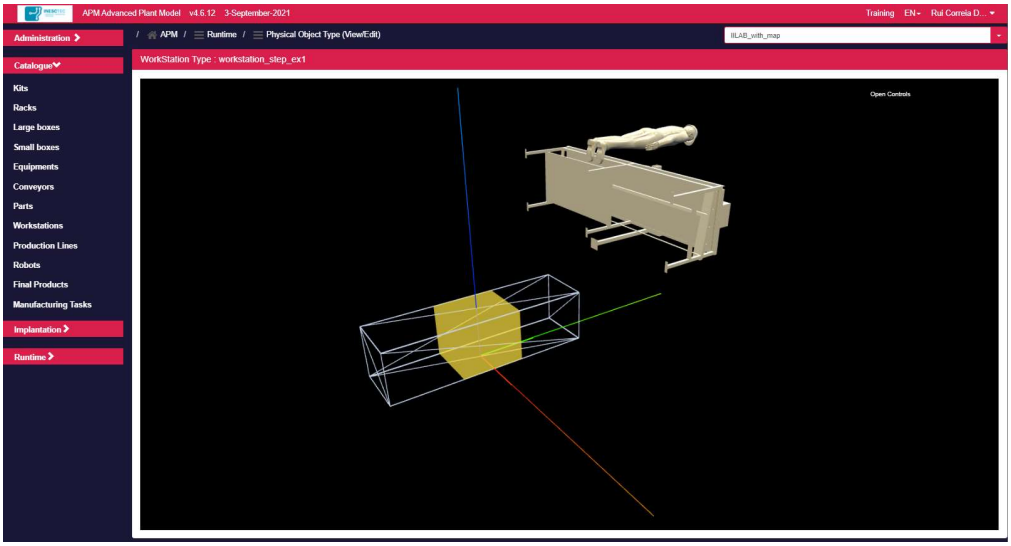
Let's add a new Workstation to the Catalogue.

1. Go to "**Catalogue / Workstations**"
2. Press the top right button "**New workstation**" set the description fields (a workstation may have an inbound buffer and an outbound buffer which correspondent to the inbound / outbound spaces that may store temporarily the work in progress)
   - (1) Set the field "Identifier field" (DON't use blank spaces)
   - (2) Set the fields: "External width", "External depth" and "External height"
   - (3) Set the fields: "Inbound buffer depth" and "Outbound buffer depth"

   You may optionally associate a STEP model with the workstation (DON't use spaces in the Identifier field)
   - (4) Press the "3D CAD model / Select file" button
   - (5) Set the "Convertion to mm" field
3. Press the "**Save changes**" button and wait. When the upload is concluded the navigation will be redirected to the list of Workstations in the catalogue.

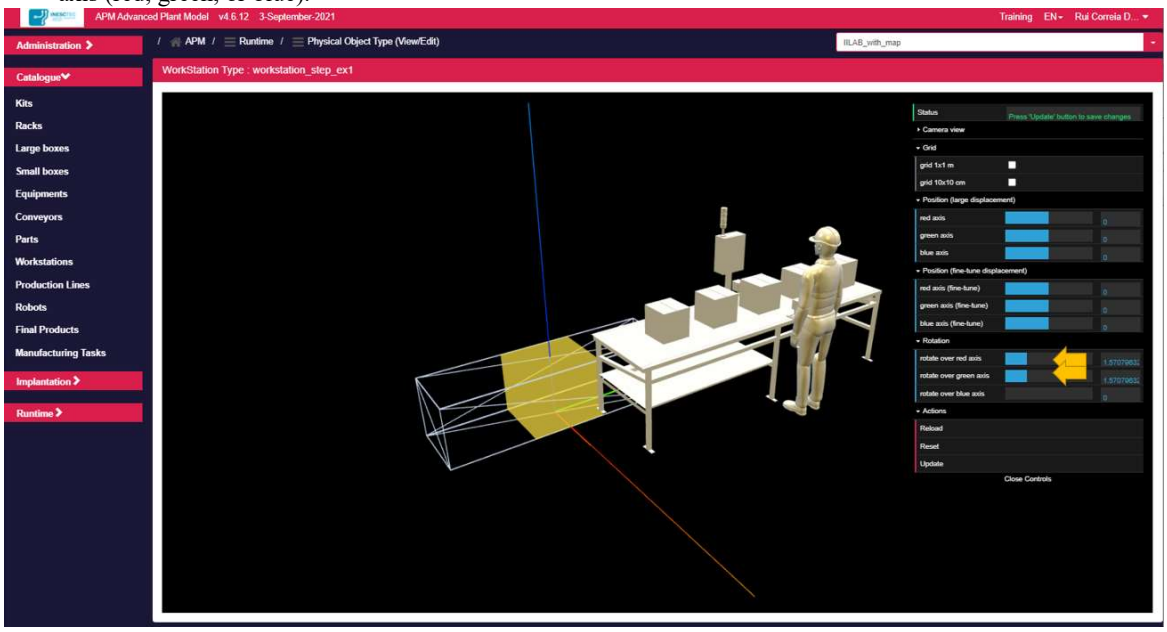


4. In the list of Workstations, press the  icon and check if the defined Workstation has the right form. It may be necessary to align the CAD model with the respective Bounding Volume (like in the picture below).

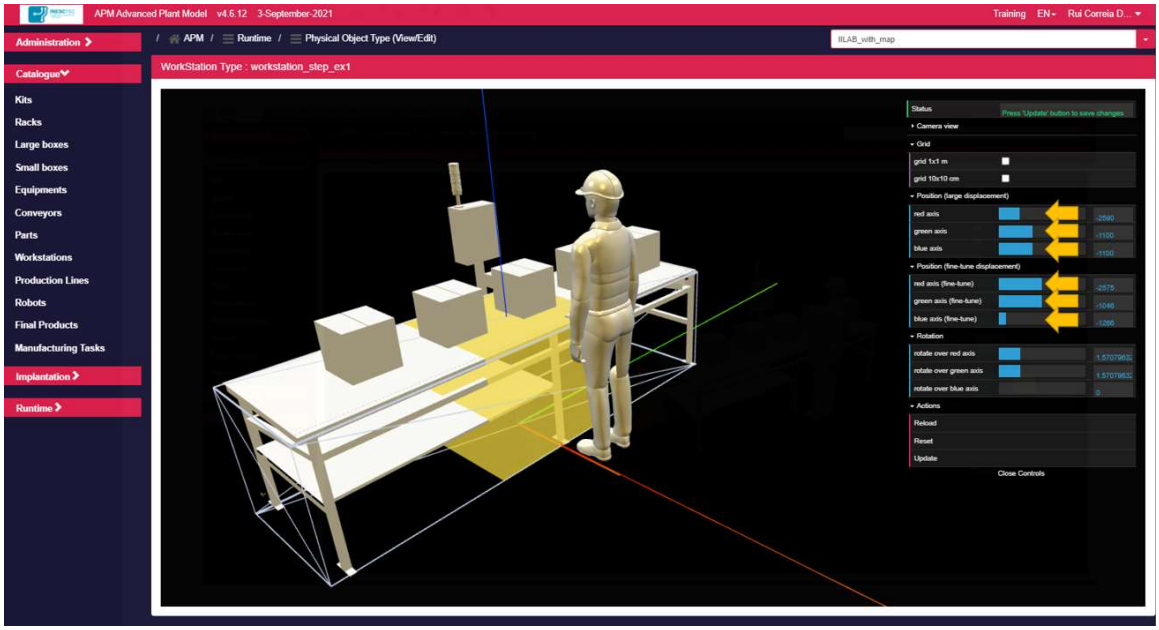


5. To align the CAD model with the respective Bounding Volume, press the top right button "**Open Controls**". The following menu comprising four categories will expand:
   - **Status**: gives feedback about the user's actions.
   - **Position**: adjusts the CAD model position.
   - **Rotation**: adjusts the CAD model orientation.
   - **Actions**: allows to **undo**, **reset** and **update** the configuration.
     - **Undo :** loads the last saved configuration.
     - **Reset :** sets to zero the configuration.
     - **Update:** saves the current configuration.

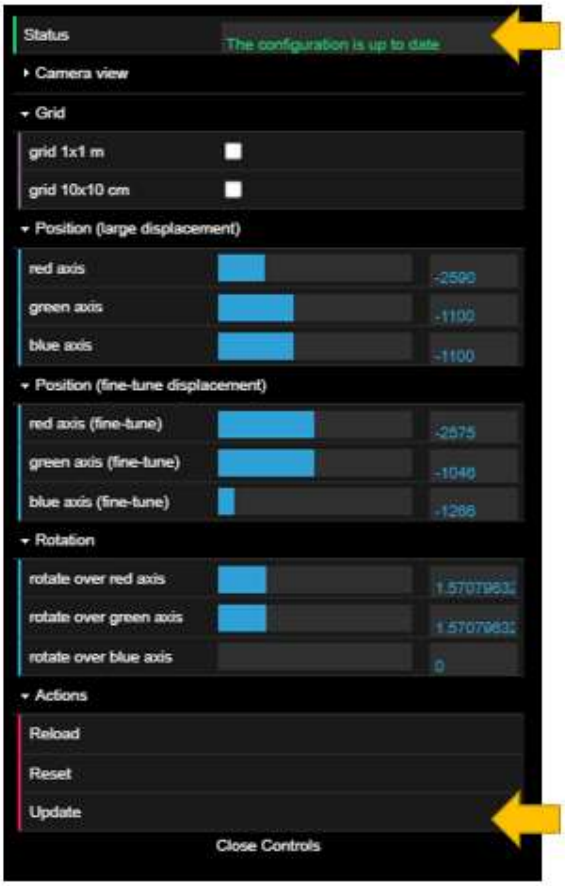
a. Adjust CAD model **orientation** using the **Rotation sliders**. Each slider performs the rotation over a specific axis (red, green, or blue).



b. Adjust CAD model **location** using the **Position sliders**. Each slider performs a translation over a specific axis (red, green, or blue).



c. Once the CAD model is aligned with the Bounding Volume press Update button to save the configuration. A message is presented “The configuration is up to date” confirming the action.


Status
The configuration is up to date
Camera view
Grid
grid 1x1 m
grid 10x10 cm
Position (large displacement)
red axis
-2590
green axis
-1100
blue axis
-1100
Position (fine-tune displacement)
red axis (fine-tune)
-2575
green axis (fine-tune)
-1046
blue axis (fine-tune)
-1286
Rotation
rotate over red axis
1.5707963
rotate over green axis
1.5707963
rotate over blue axis
0
Actions
Reload
Reset
Update
Close Controls

5.8 How to add a new production line to the catalogue

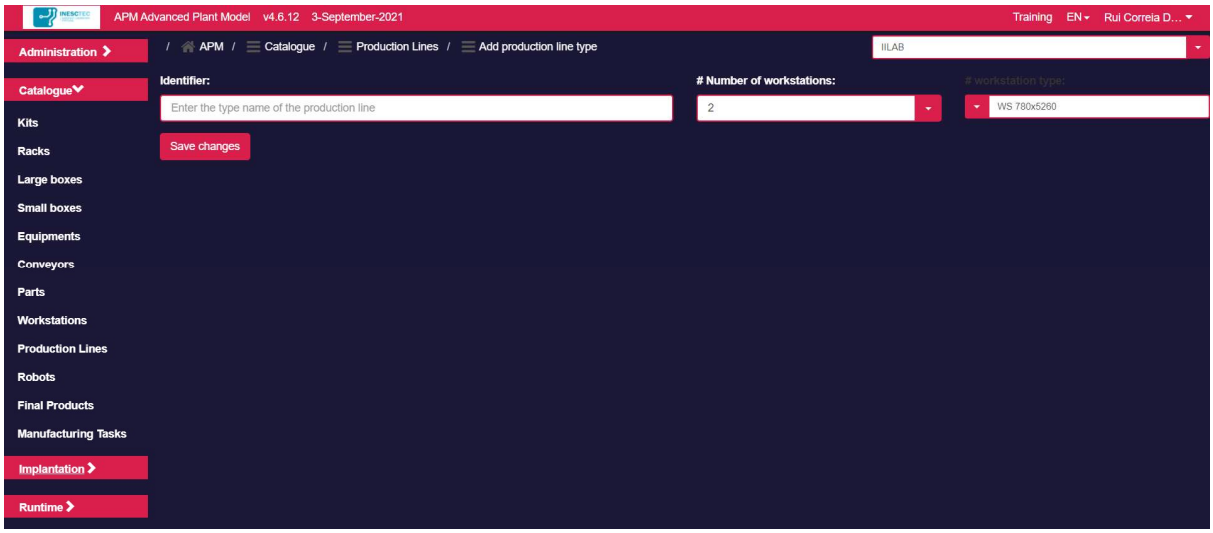
The Catalogue contains the 3D model of all the objects that may be used to build the Model of a given Physical Area.

The Catalogue supports the following types of objects: Kits, Racks, Large boxes, Small boxes, Equipments, Conveyors, Parts, Workstations, Production Lines, Robots and Final Products.

Let's add a new Production Line to the Catalogue.

1. Go to "**Implantation / Production Lines**"
2. Press the top right button "**New production line**" and set the description fields (a production line comprises several workstation in line; you have to create the model for the workstation before)
3. You may optionally associate a STEP model with the production line (DON't use spaces in the Identifier field)

- Press the "**Save changes**" button



4. In the list of Racks, press the  icon and check if the defined Rack has the right form (if specified a STEP model for the workstation, you will you see it in the 3D visualization in a future version of the software).