



# BETTER FACTORY

## D1.2

# Integrated factory digital twin designer on RAMP 1.0 version 1.0

PUBLIC

**César Toscano**

[ctoscano@inesctec.pt](mailto:ctoscano@inesctec.pt)

**Rui Dias**

[rui.c.dias@inesctec.pt](mailto:rui.c.dias@inesctec.pt)

INESC TEC  
Campus da FEUP  
Rua Dr. Roberto Frias  
4200 - 465 Porto  
Portugal



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 951813.



<b>Project acronym</b> Better Factory	<b>Project title</b> Grow your manufacturing business	<b>Grant agreement No.</b> 951813
<b>Deliverable No.</b> D1.2	<b>Deliverable title</b> Integrated factory digital twin designer on RAMP 1.0	<b>Version</b> 0.9
<b>Type</b> DEMONSTRATOR	<b>Dissemination level</b> PUBLIC	<b>Due date</b> 30.09.2021
<b>Lead beneficiary</b> INESC TEC		<b>WP No.</b> 1
<b>Main author</b> César Toscano		<b>Reviewed by</b> Martin Kostalek
<b>Accepted by Project Coordinator</b> Päivi Mikkonen		<b>Accepted by Technical Coordinator</b> Ali Muhammad
<b>Contributing author(s)</b> Rui Correia Dias		<b>Pages</b> 52
<b>VTT archive code</b> VTT-R-01363-20		<b>Lead beneficiary archive code</b>

### Abstract

This document is the first release, on M12, of Deliverable D1.2 “Integrated factory digital twin designer on RAMP 1.0”.

Following releases will be produced on M30 and M45 of the project.

The document aims the “Integration of the APM in the RAMP Marketplace and a guide how to use it” and is the output of Task “T1.2 Factory digital twin designer”, M1-M45.

<b>Project Coordinator contact</b> Päivi Mikkonen VTT Technical Research Centre of Finland Ltd Visiokatu 4, PL 1300, 33101 Tampere, Finland E-mail: <a href="mailto:paivi.mikkonen@vtt.fi">paivi.mikkonen@vtt.fi</a> Tel: +358 40 820 6139	<b>Technical Coordinator contact</b> Ali Muhammad European Dynamics SA E-mail: <a href="mailto:ali.muhammad@eurodyn.com">ali.muhammad@eurodyn.com</a> Tel: +358 400 560 851
<b>Notification</b> The use of the name of any authors or organization in advertising or publication in part of this report is only permissible with written authorisation from the VTT Technical Research Centre of Finland Ltd.	
<b>Acknowledgement</b> This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 951813	



## HISTORY OF CHANGES

Date	Version	Author	Comments
01-09-2021	0.1	Project Coordination	Creation of document template
13-09-2021	0.2	César Toscano	Creation of TOC
14-09-2021	0.3	César Toscano Rui Dias	Started inserting contents
20-09-2021	0.9	César Toscano Rui Dias	Sent first document version to internal review in the project

# TABLE OF CONTENT

<b>HISTORY OF CHANGES</b>	<b>5</b>
<b>EXECUTIVE SUMMARY</b>	<b>7</b>
<b>1 INTRODUCTION</b>	<b>8</b>
1.1 Scope and objectives	8
1.2 Document organization	8
1.3 Acronyms	8
<b>2 THE ADVANCED PLANT MODEL AND THE DIGITAL TWIN DESIGNER</b>	<b>9</b>
<b>3 METHODOLOGY</b>	<b>10</b>
<b>4 INTEGRATION WITH RAMP</b>	<b>11</b>
<b>5 USER MANUAL</b>	<b>13</b>
5.1 The Login process	13
5.2 Organization of the user interface	14
5.3 The Administration area	14
5.4 The Catalogue	15
5.4.1 Listing the objects	15
5.4.2 Adjusting the CAD model to the object's bounding volume	16
5.4.3 Creating a new object type	17
5.5 Implantation	20
5.5.1 Specifying the Map	20
5.5.2 Implanting objects in the Map	23
5.5.3 Validating the Model	26
<b>6 HOW TO</b>	<b>27</b>
6.1 How to create a physical area	27
6.2 How to implant objects on a physical area	29
6.3 How to create a physical area with a map	31
6.4 How to add a new rack to the catalog	33
6.5 How to add a new rack to the catalog with STEP	35
6.6 How to add a new equipment to the catalog	40
6.7 How to add a new workstation to the catalogue	45
6.8 How to add a new production line to the catalogue	50

## EXECUTIVE SUMMARY

This document is the first release, on M12, of Deliverable D1.2 “Integrated factory digital twin designer on RAMP 1.0”. Following releases will be produced on M30 and M45 of the project. The document aims the “Integration of the APM in the RAMP Marketplace and a guide how to use it” and is the output of Task “T1.2 Factory digital twin designer”, M1-M45.

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 in 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

This document is the first release on M12 of Deliverable D1.2 “Integrated factory digital twin designer on RAMP 1.0”. Following releases will be produced on M30 and M45 of the project.

The document aims the “Integration of the APM in the RAMP Marketplace and a guide how to use it” and is the output of Task “T1.2 Factory digital twin designer”, M1-M45.

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, pallets, 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 “Integration with RAMP” – identifies the elements that were addressed in the integration of the Digital Twin Designer in the RAMP Platform;
- Chapter 5 “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 6 “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 5.4 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 5.5.1 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 5.5.2 addresses this step.
4. Validate the locations where objects were implanted, by looking at the entire model in a three-dimensional window.  
Section 5.5.3 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 6 addresses this need.

## 4 Integration with RAMP

The Advanced Plant Model and the included Digital Twin Designer is an autonomous system, implemented by two components. One implements the front-end of the system, using HTML technologies such as HTML 5, the Java script language and several Open Source java script frameworks. This component is connected to a back-end component, implemented by java technology and related Open Source frameworks. A REST based API lets the front-end interact with the back-end. An external Data Base Management System provides the data storage and access.

In order to maintain this structure and restrict the changes to the minimum possible, integration of the Digital Twin Designer in the RAMP Platform takes the form depicted on Figure 1:

- A Docker based infrastructure was setup to hold several instances of the APM system (left part on the Figure). Each instance of the system is to be assigned to a distinct company specified in the RAMP Platform, so that there is no data sharing data between the models built by Users of different companies.
- A single Data Base Management System (Mongodb) serves all the instances of the APM. A different data base is assigned to each APM instance.
- The front-end of the APM, running on a HTML browser, is embedded into a HTML frame created by the RAMP Platform. The front-end is launched by the User when a click is made in a given button inside a windows within the RAMP user interface. An HTML 5 frame is created by RAMP and the APM's front-end is embedded inside.
- User authentication is started by the APM but in reality is accomplished by the RAMP Platform, by implementing the OAuth 2 protocol.
- Finally, the user interface of the APM was adapted in order to comply with the RAMP identity, that specifies the form of the visual elements in RAMP (logo, typography, background and foreground colours, etc.).

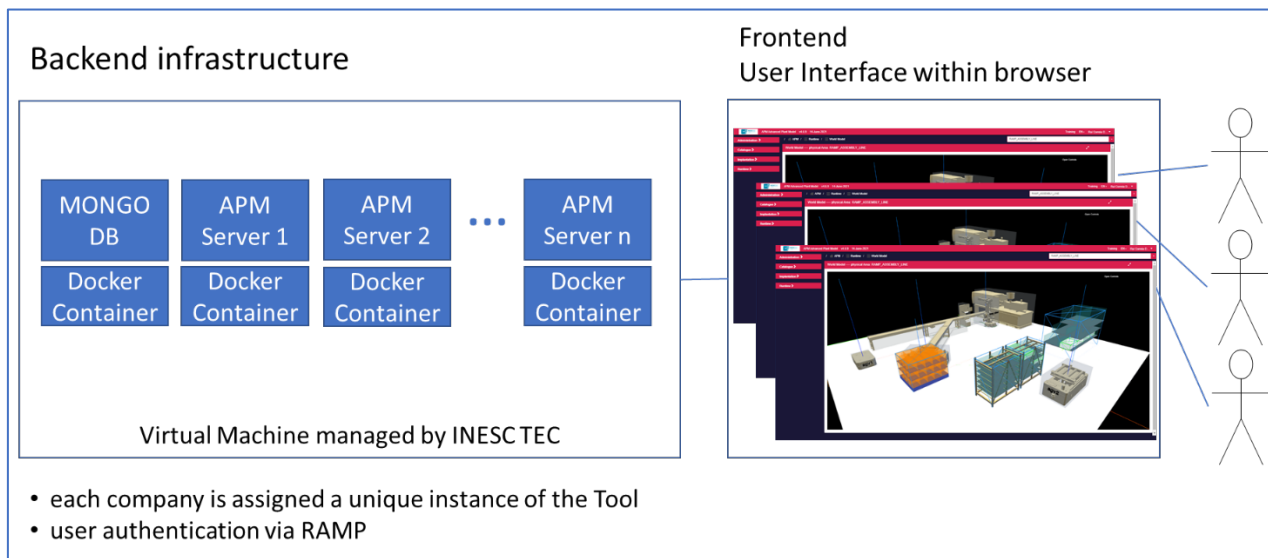


Figure 1 - Digital Twin Designer integration in RAMP

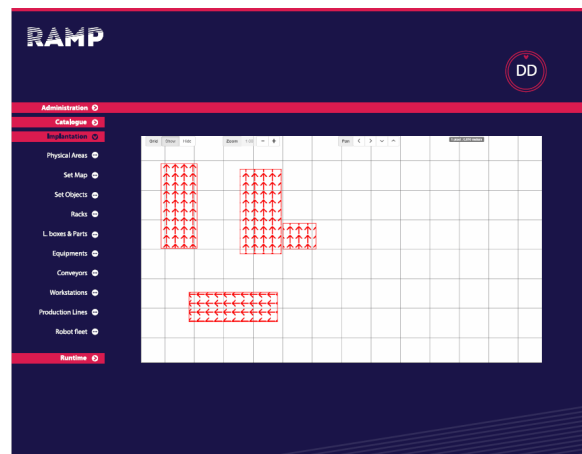


Figure 2 – First refinement of the APM interface to comply with the RAMP identity

## 5 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.

### 5.1 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.

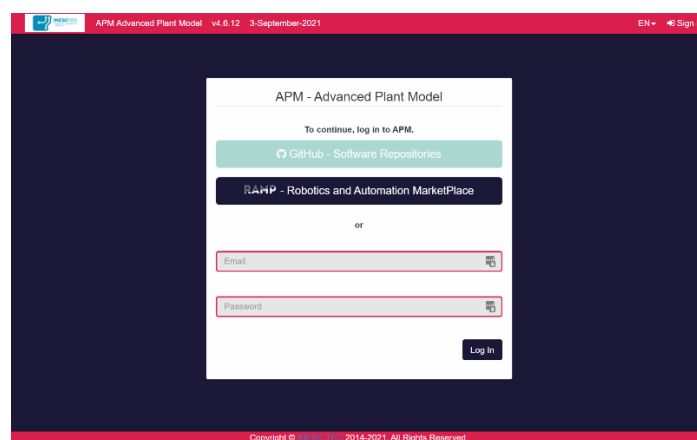


Figure 3 – Login process: 1st step

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 4 – 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 5), allowing the User to start using the Digital Twin Designer.

## 5.2 Organization of the user interface

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

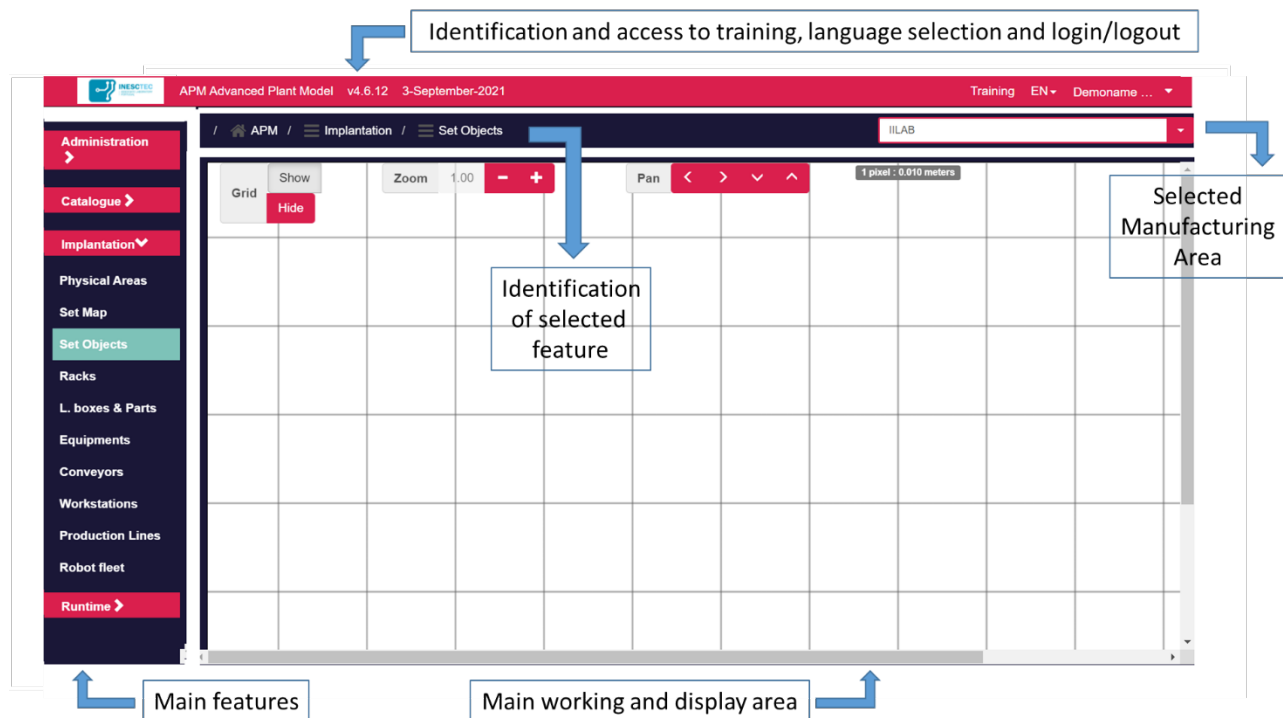


Figure 5 – User Interface: main working areas

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 6 “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.

## 5.3 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 Tool.

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.

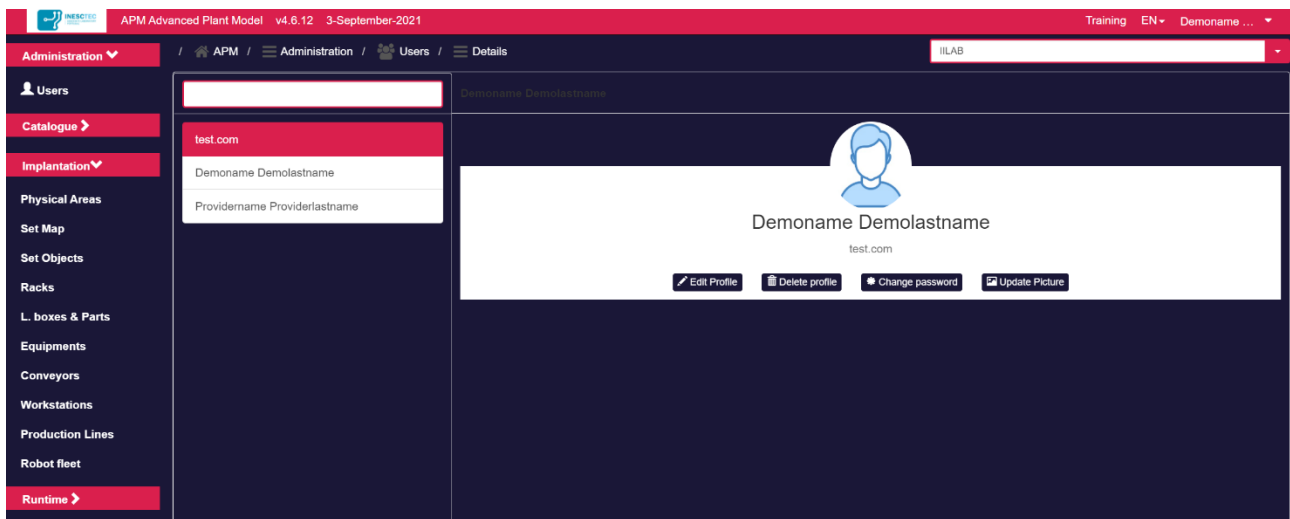


Figure 6 – Administration feature

## 5.4 The Catalogue

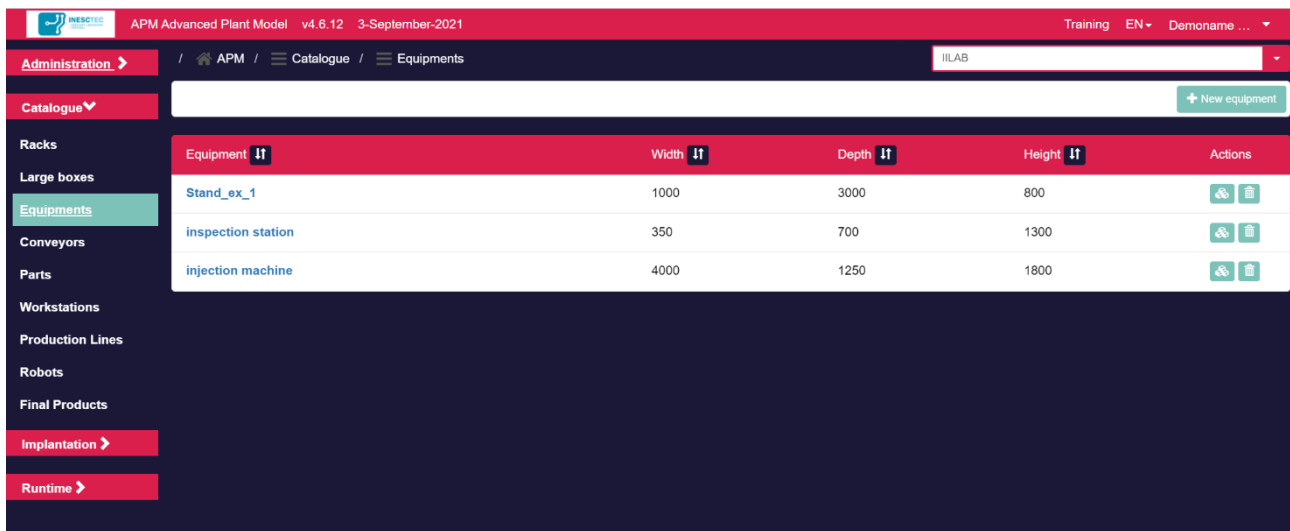
The Catalogue is the application feature responsible for keeping a list of all the known 3D models. Depending on the final aim of the User, each major object present in a physical area (e.g. a workstation) should have a correspondent 3D model. The Catalogue is the feature letting the User create, change 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.

### 5.4.1 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).



Equipment	Width	Depth	Height	Actions
Stand_ex_1	1000	3000	800	[Visualize] [Edit]
inspection station	350	700	1300	[Visualize] [Edit]
injection machine	4000	1250	1800	[Visualize] [Edit]

Figure 7 – 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.

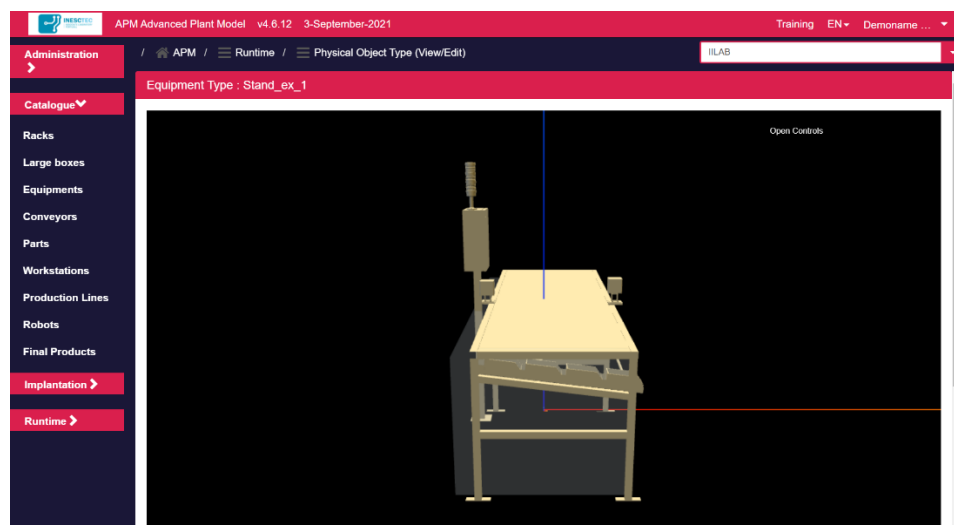


Figure 8 - Catalogue: Access to the 3D Model of an object type

#### 5.4.2 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.

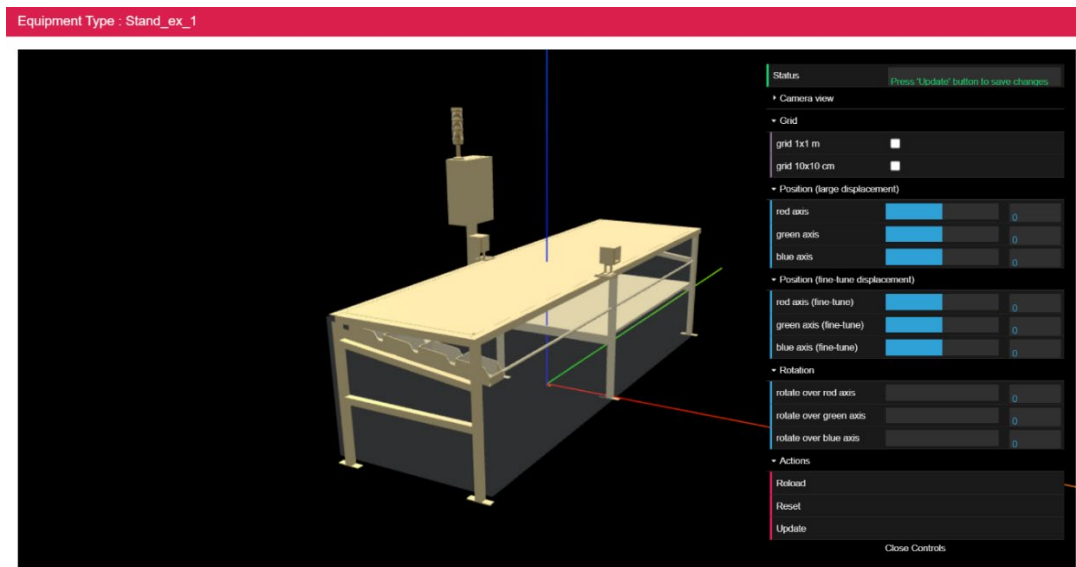


Figure 9 – Catalogue: Access to the 3D model of an object

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.

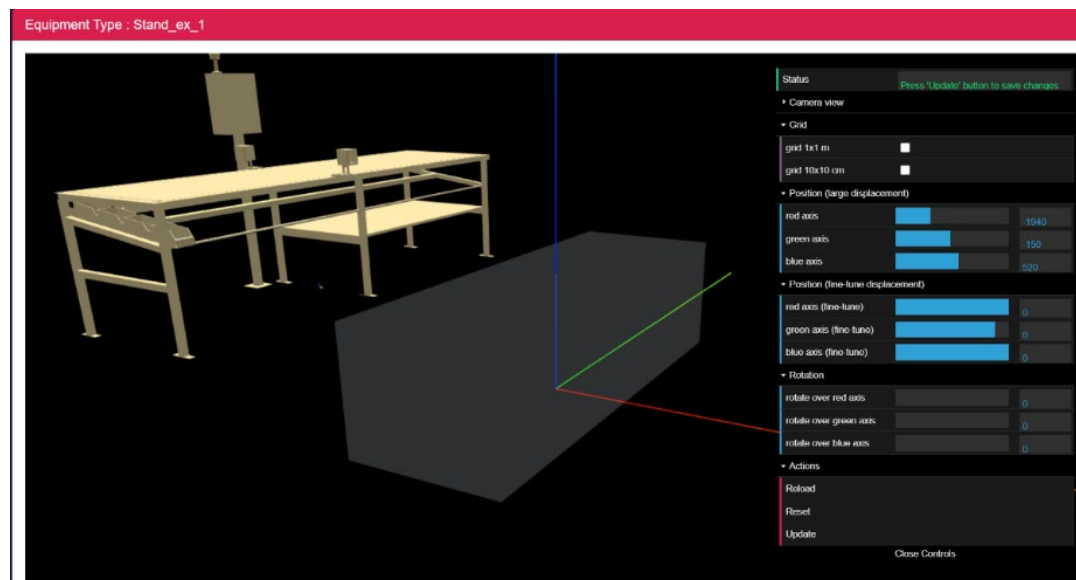


Figure 10 - Catalogue: separation between the CAD model and the bounding volume of an object

### 5.4.3 Creating a new object type

As shown on Figure 7, 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.

The screenshot shows the 'Add equipment type' interface. At the top, there's a breadcrumb trail: / APM / Catalogue / Equipments / Add equipment type. A dropdown menu on the right is set to 'IILAB'. Below this, the 'Identifier:' field contains the placeholder text '... unique identifier for the new object ...'. Three input fields for dimensions are present: 'External width (mm):' with value '2000', 'External depth (mm):' with value '500', and 'External height (mm):' with value '1000'. Under the '3D CAD model:' section, the 'Format:' dropdown is set to 'step', and the 'Upload:' section has a red 'Select File' button. A red 'Save changes' button is located at the bottom left.

Figure 11 - 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).

This screenshot shows the same form after a file upload. The 'Select File' button is now greyed out, and the text 'attached file: agv\_conveyor.stp' is visible next to it. A new input field labeled 'Conversion to mm (1000):' has been added, containing the value '1'. The 'Save changes' button is still present at the bottom left.

Figure 12 - 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 5.5) 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.

Step 1 Step 2

Identifier:  # Functional levels:  # Cells per level:

External width (mm):  Level width (mm):

External depth (mm):  Level thickness (mm):

External height (mm):

3D CAD model:

Format:  Upload:

Front view Side view

external width external height level width level thickness vertical offset

Figure 13 - Catalogue: Internal geometry of a Rack (part 1)

Step 1 Step 2

Level 2 : vertical offset (mm):  Level 2 : horizontal offset (mm):

Level 1 : vertical offset (mm):  Level 1 : horizontal offset (mm):

3D CAD model:

Format:  Upload:

Front view Side view

external width external height level width level thickness vertical offset

Figure 14 - Catalogue: Internal geometry of a Rack (part 2)

**Identifier:**

**Level height (mm):**  **# Levels:**  **# Rows:**  **# Columns:**

**External width (mm):**  **Internal width (mm):**

**External depth (mm):**  **Internal depth (mm):**

**External height (mm):**  **Internal height (mm):**

**3D CAD model:**  
**Format:**  **Upload:**

**Front view** **Top view**

The 3D model preview shows a pallet structure with dimensions labeled: external width, internal width, # Columns, Level height, Internal height, # Levels, and External height.

Figure 15 - Catalogue: Internal geometry of a Pallet

## 5.5 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

### 5.5.1 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.

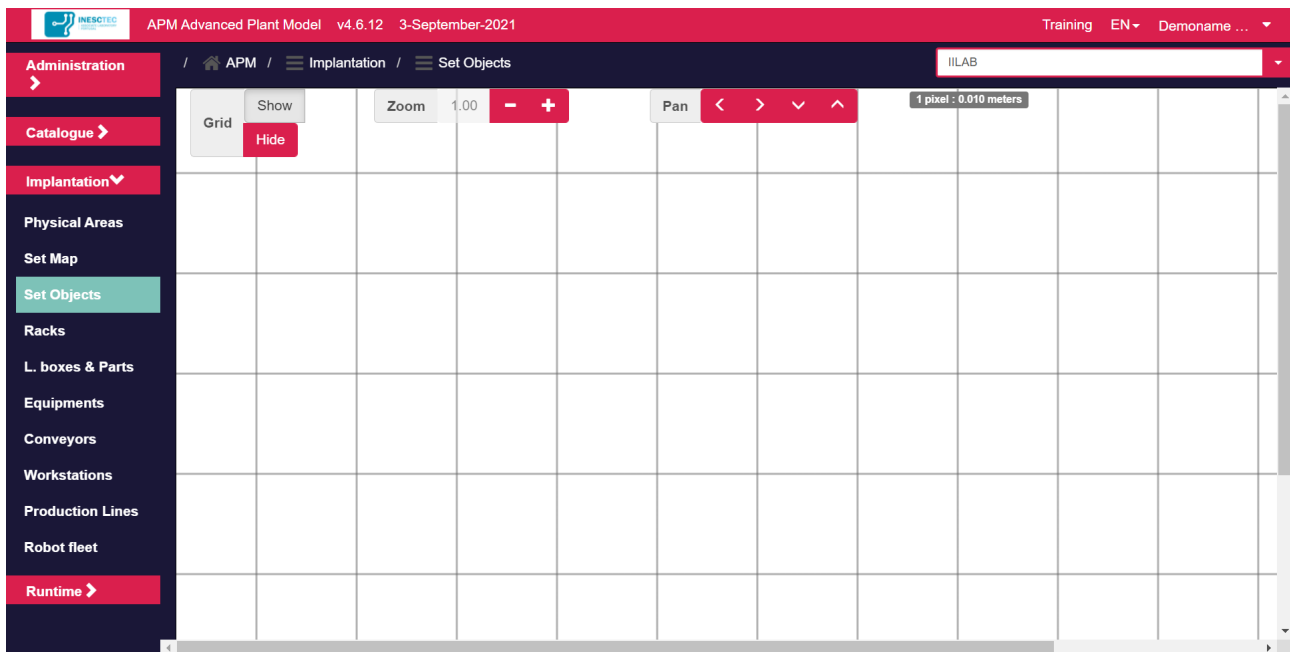


Figure 16 – Implantation, 'Set Objects' screen

The specification of the 2D image, reflecting the layout of the area, must be 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.

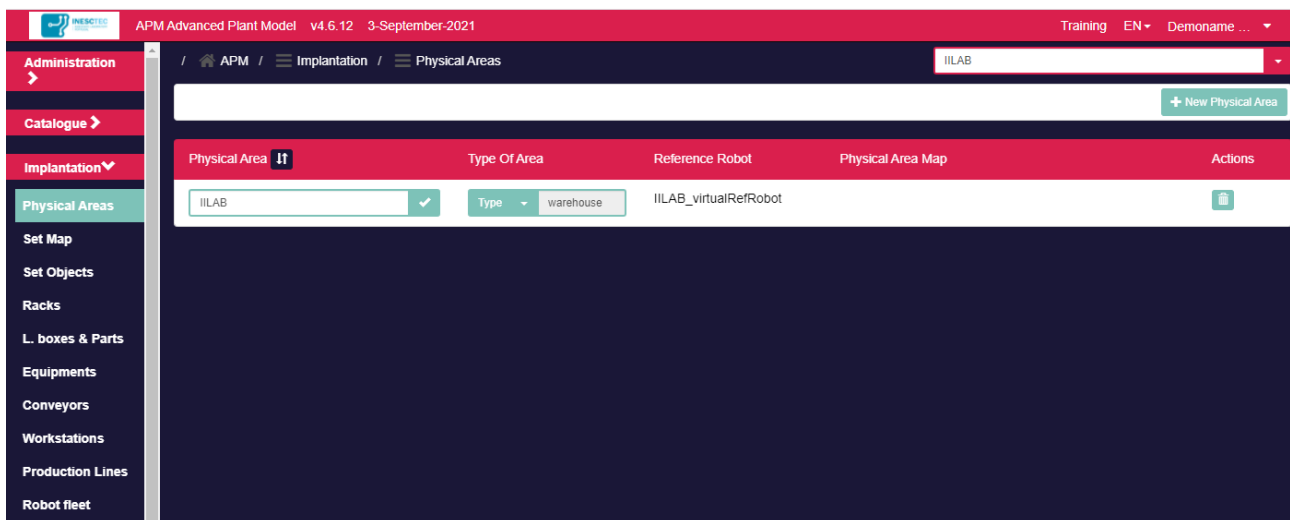


Figure 17 – Implantation, 'Physical Areas' screen

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.

Identifier: ... unique name for the new physical area

Type: warehouse

Physical area width (m): 20

Physical area height (m): 10

Map: Select File, Save changes

Figure 18 – 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).

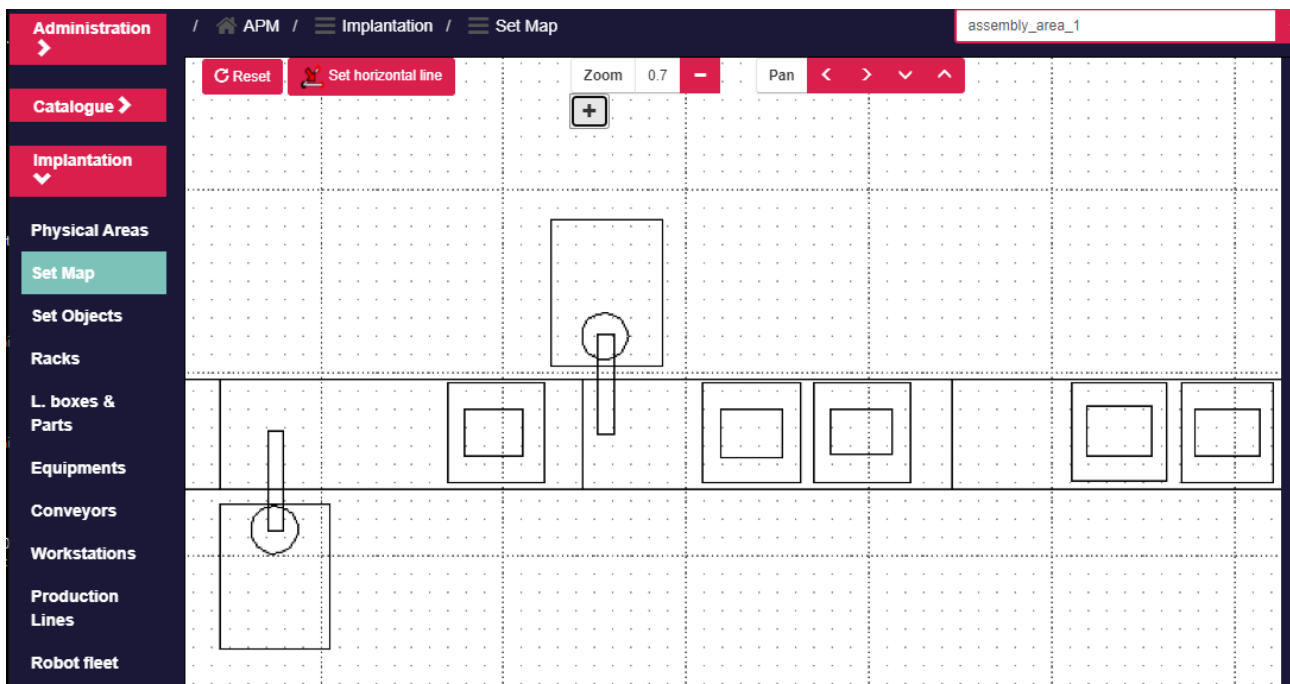


Figure 19 – Implantation: 'Set Map' screen

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 20 – 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.

### 5.5.2 Implanting objects in the Map

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

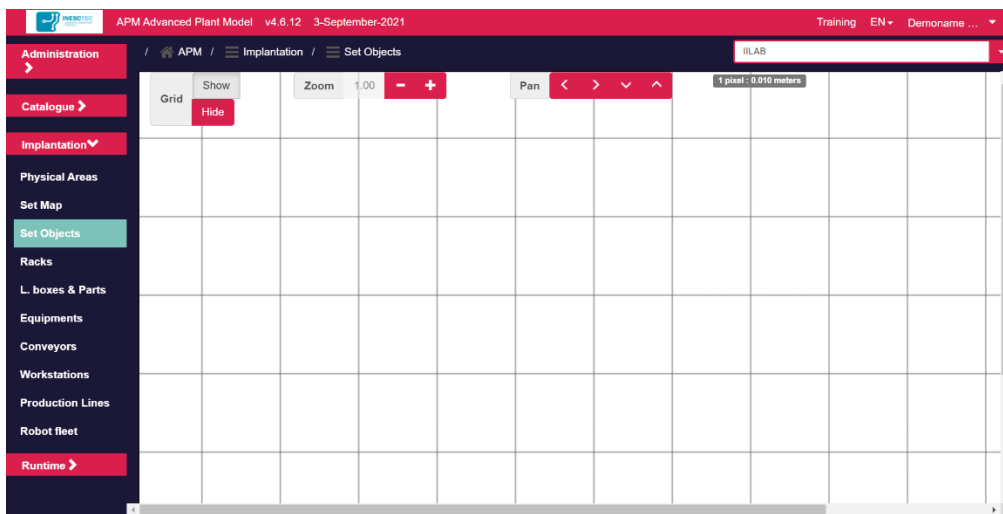


Figure 21 – Implantation: 'Set Objects' screen

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).

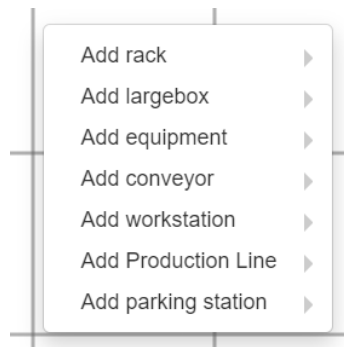


Figure 22 – Implantation: selecting an object from the Catalogue

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.

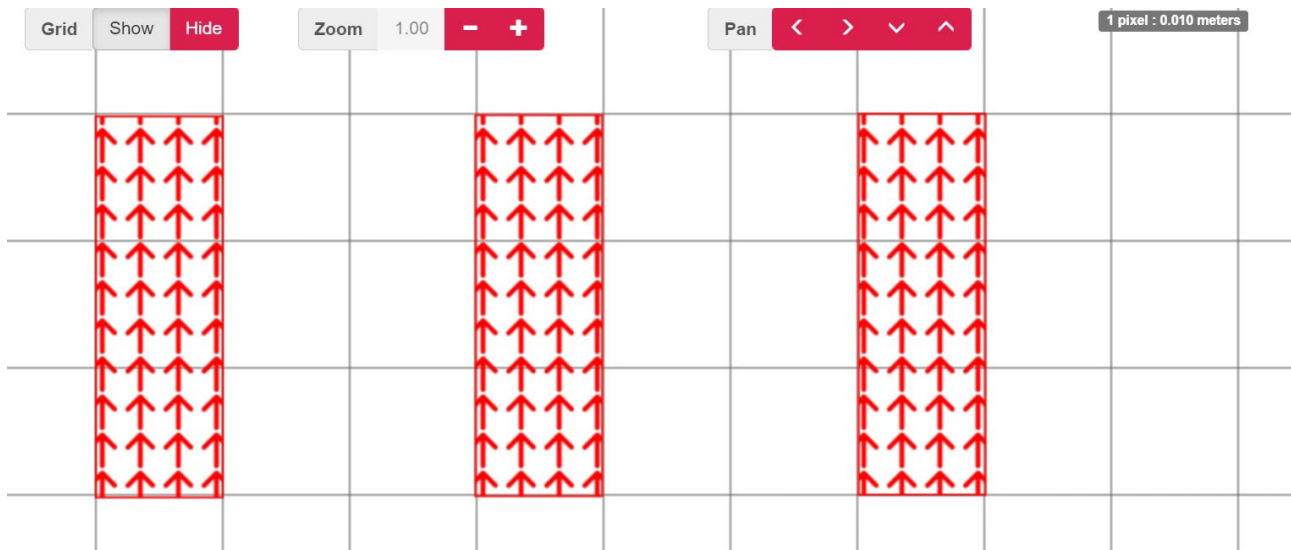


Figure 23 – Implantation: Populating the map with objects

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).

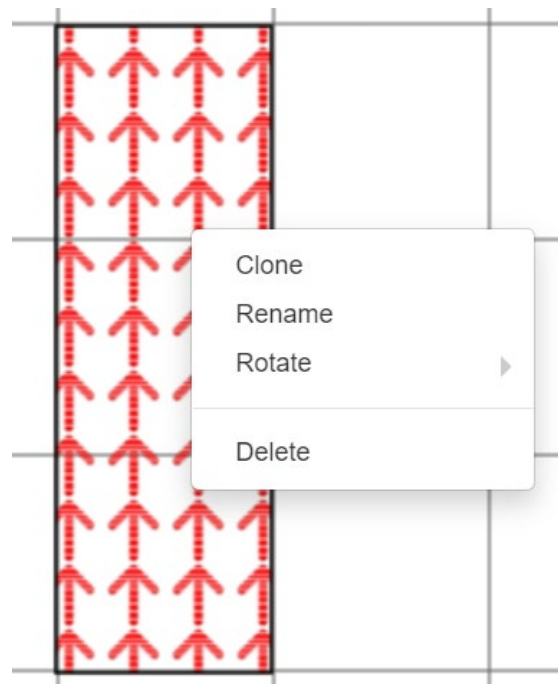


Figure 24 – Implantation: selecting an object to act on it

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).

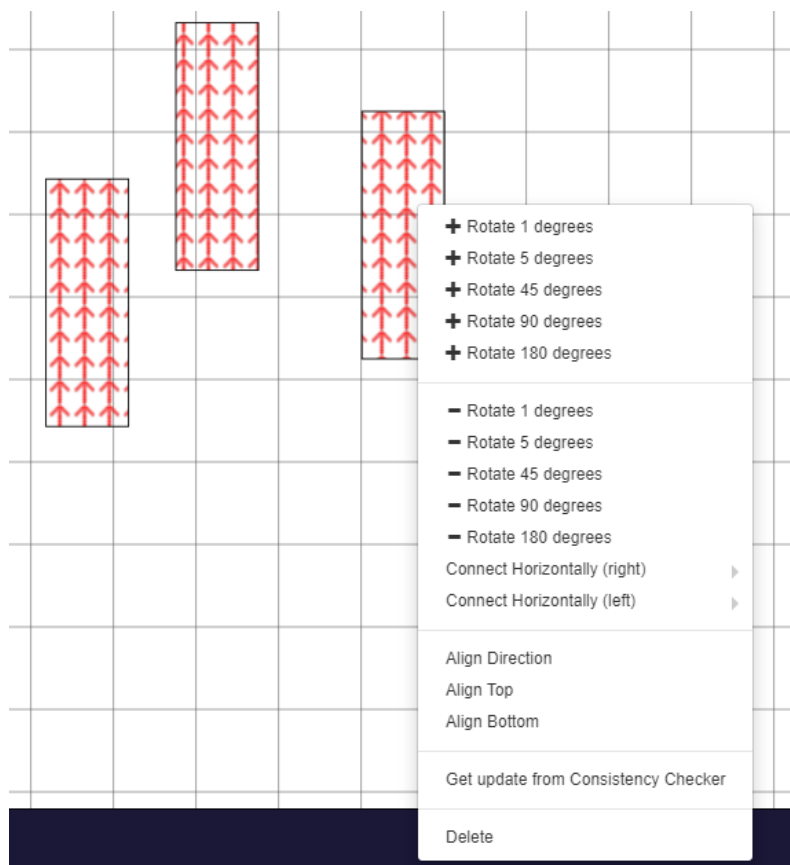
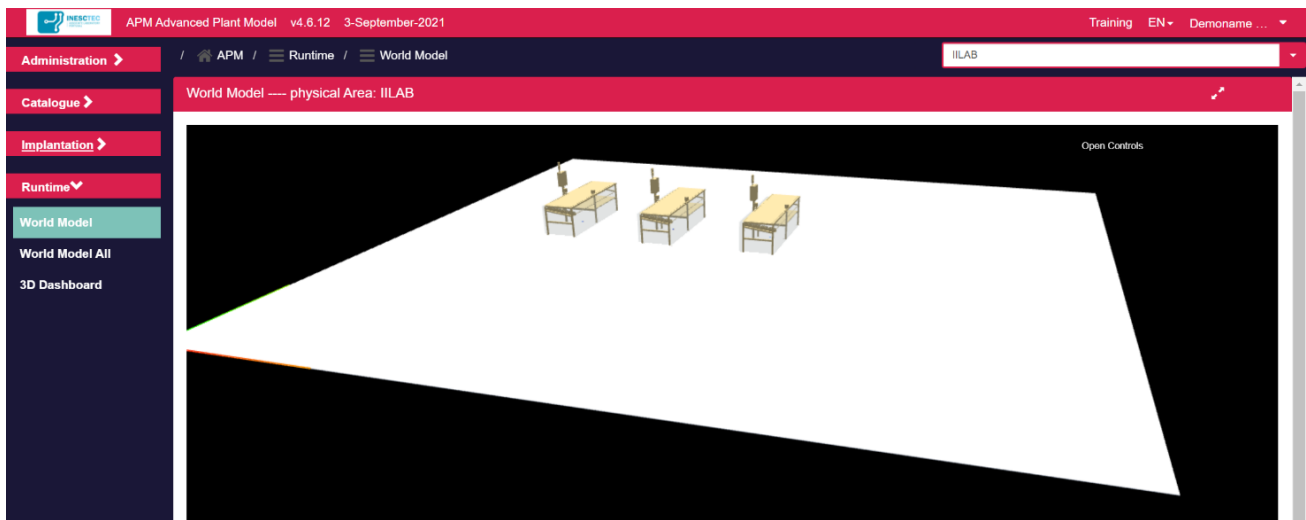


Figure 25 – Implantation: Selecting several objects in order to act on them

### 5.5.3 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 26 – 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.

## 6 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”):

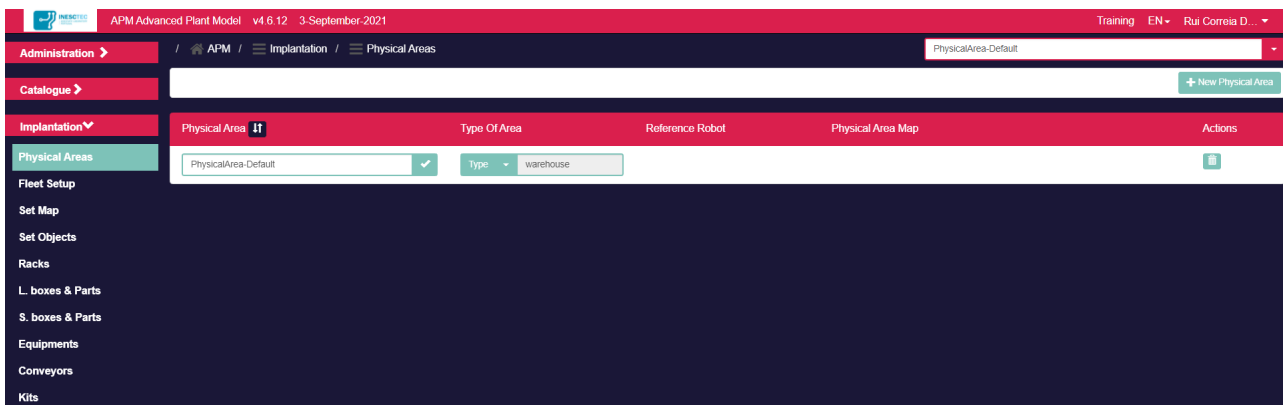
- How to create a physical area
- How to implant objects on a physical area
- How to create a physical area with a map
- How to add a new rack to the catalog
- How to add a new rack to the catalog with STEP
- How to add a new equipment to the catalog
- How to add a new workstation to the catalog
- How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

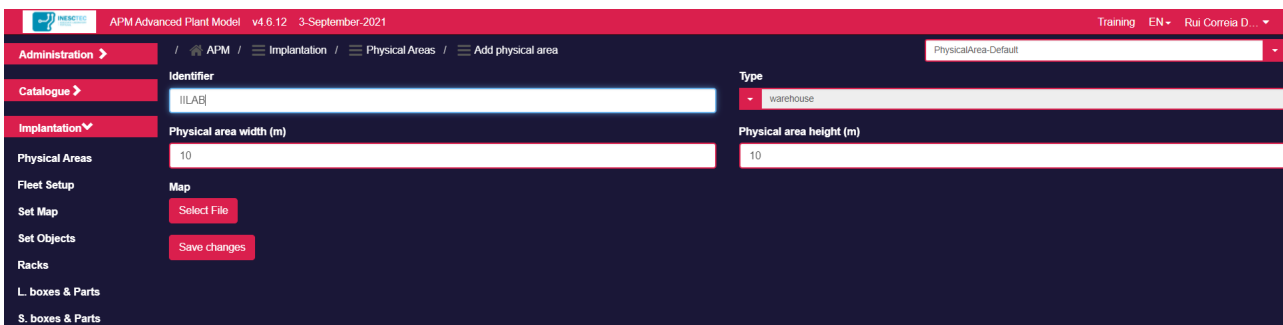
### 6.1 How to create a physical area

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”

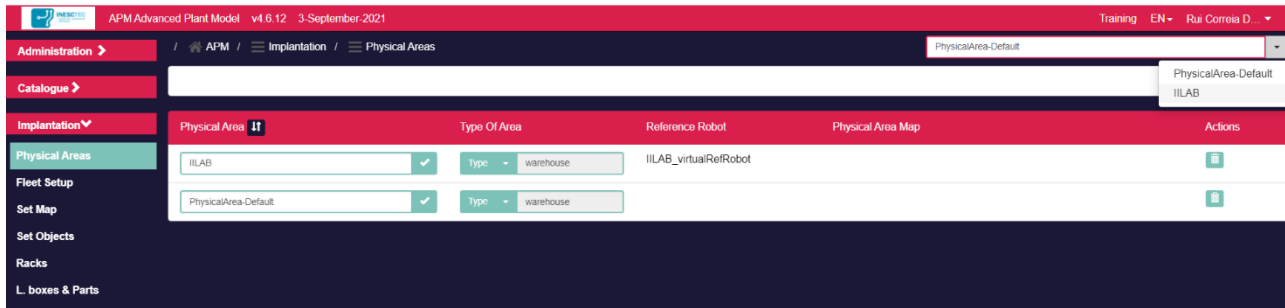


#### 2. Press “New Physical Area” button (top right in the above screen)

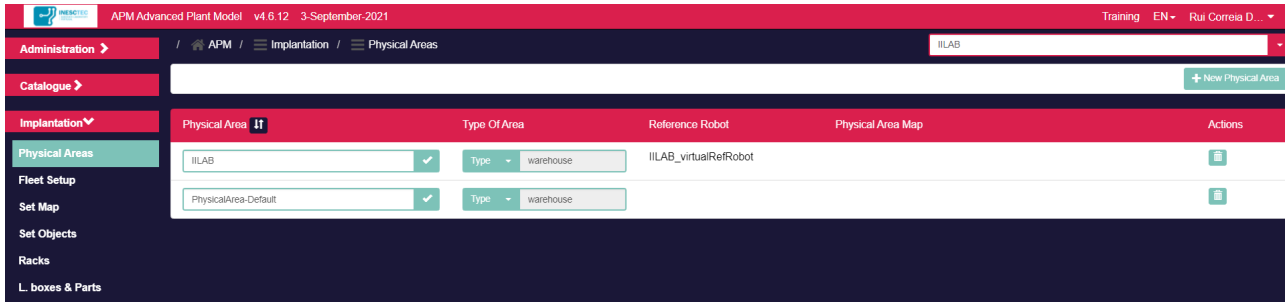


- Supply an **identifier** (e.g. IILAB)
- Specify the **type** (warehouse or assembly line)
- Specify the **width** and **height** (meters) of the physical area
- Press “**Save changes**”

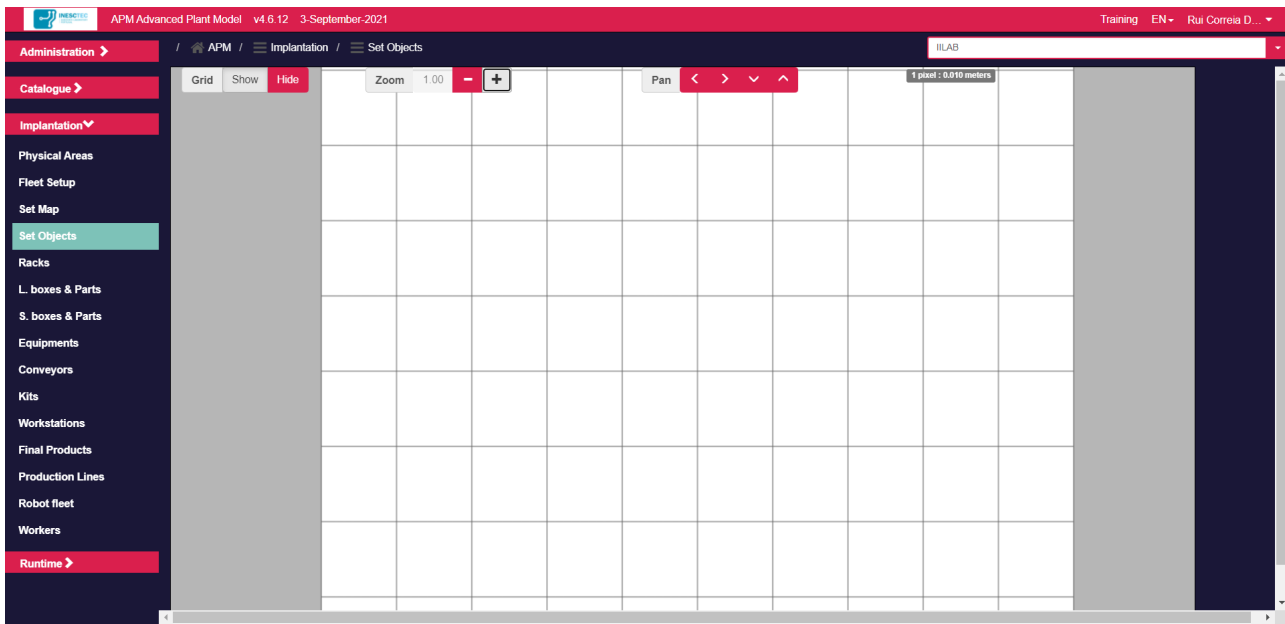
- Confirm the creation of the physical area (press the combo box on the top right).



- 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.

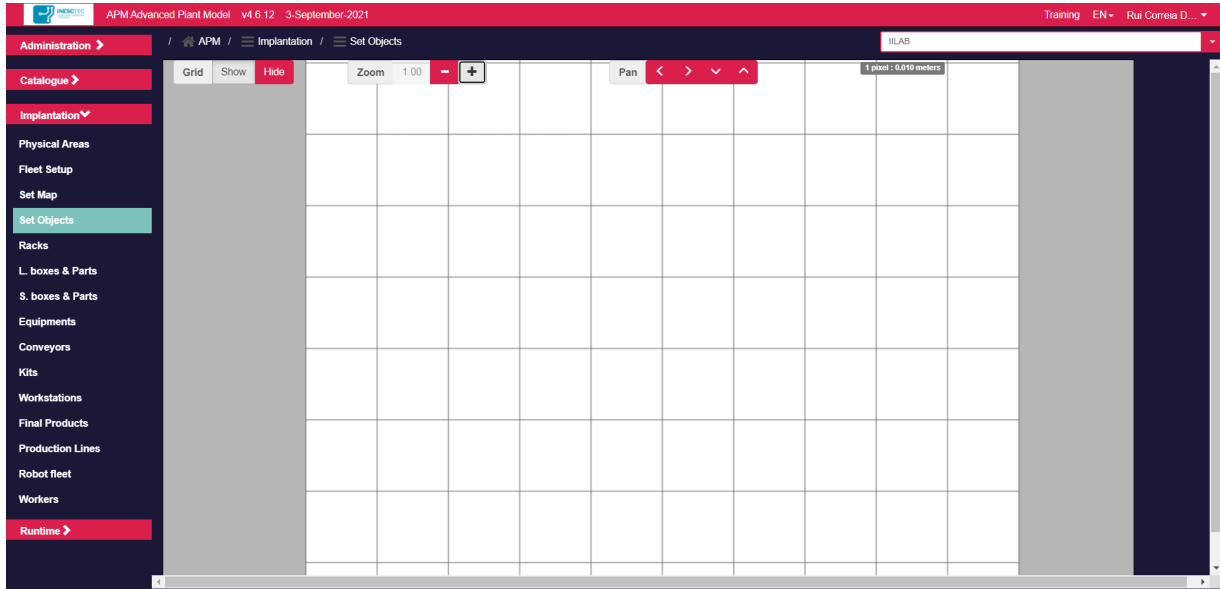
You can zoom in or zoom out by pressing the Zoom button.

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

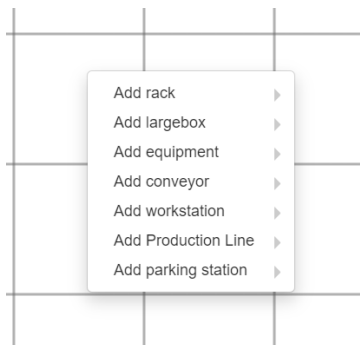
## 6.2 How to implant objects on a physical area

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

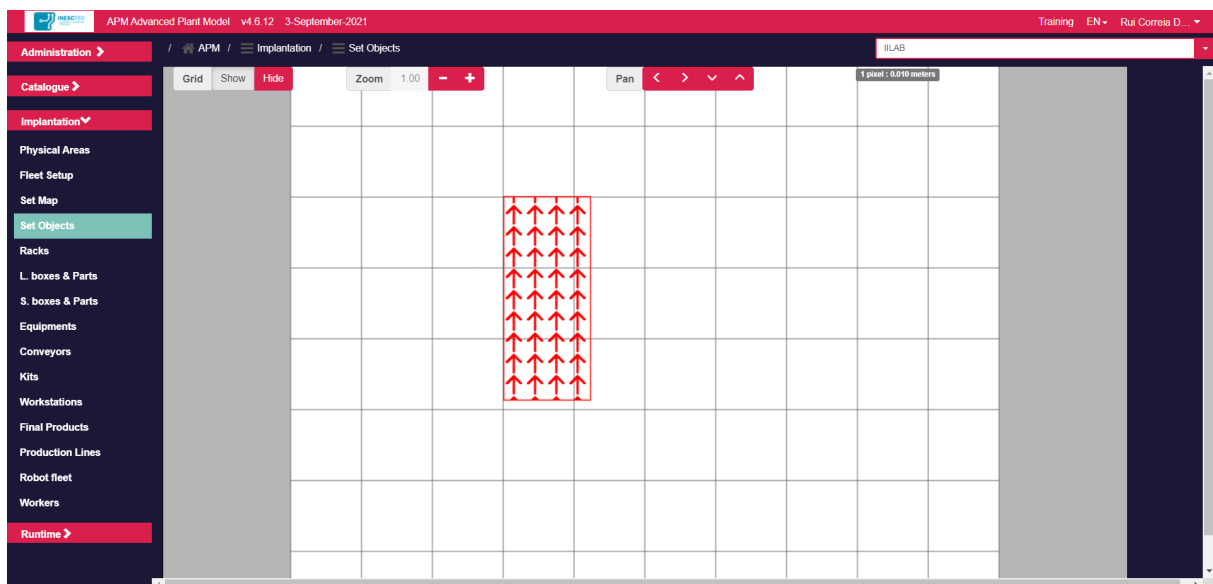
1. Go to “Implantation / Set Objects” (make sure you have selected your Physical Area in the top right combo box)



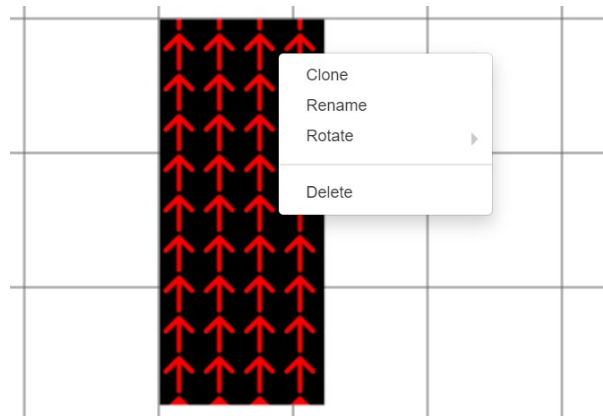
2. Press the right button in the mouse, you'll get options that let you select an object from the Catalogue



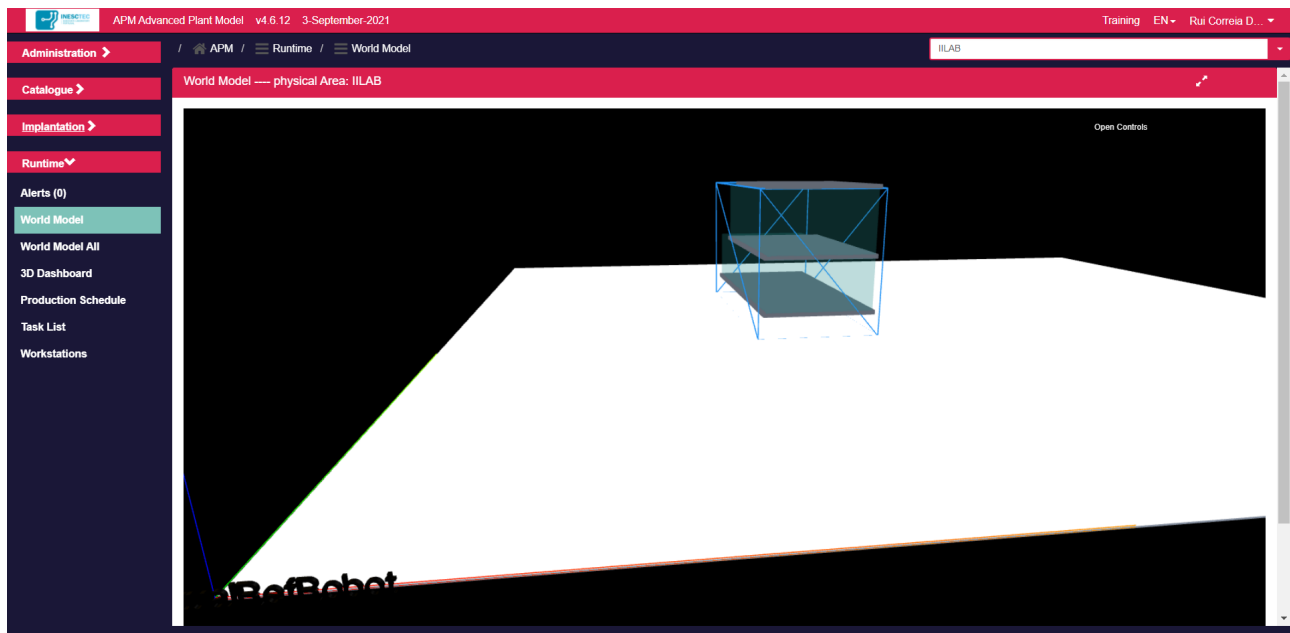
3. Select one of the objects (e.g. rack / PSA 2870x1225), a red rectangle will appear in the working space



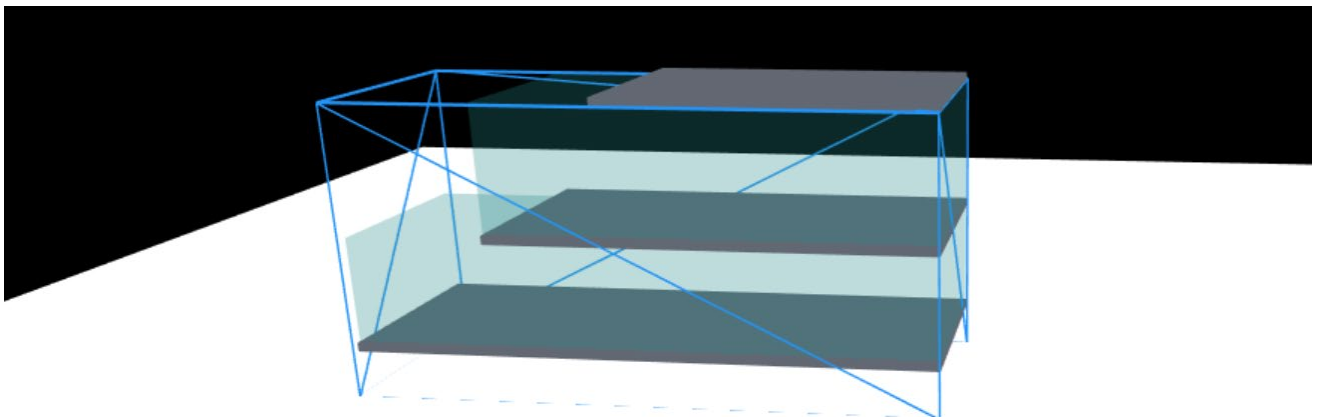
4. You can now select the object and move it in the working area
5. You can clone, rename, rotate and delete the object by selecting it and press the right button in the mouse



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



## 6.3 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.

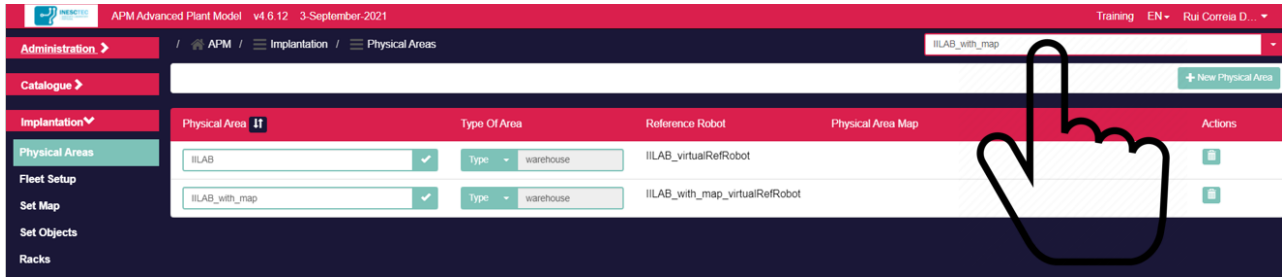
### 1. Go to “Implantation / Physical Areas”

### 2. Press “New Physical Area” button (top right in the above screen)

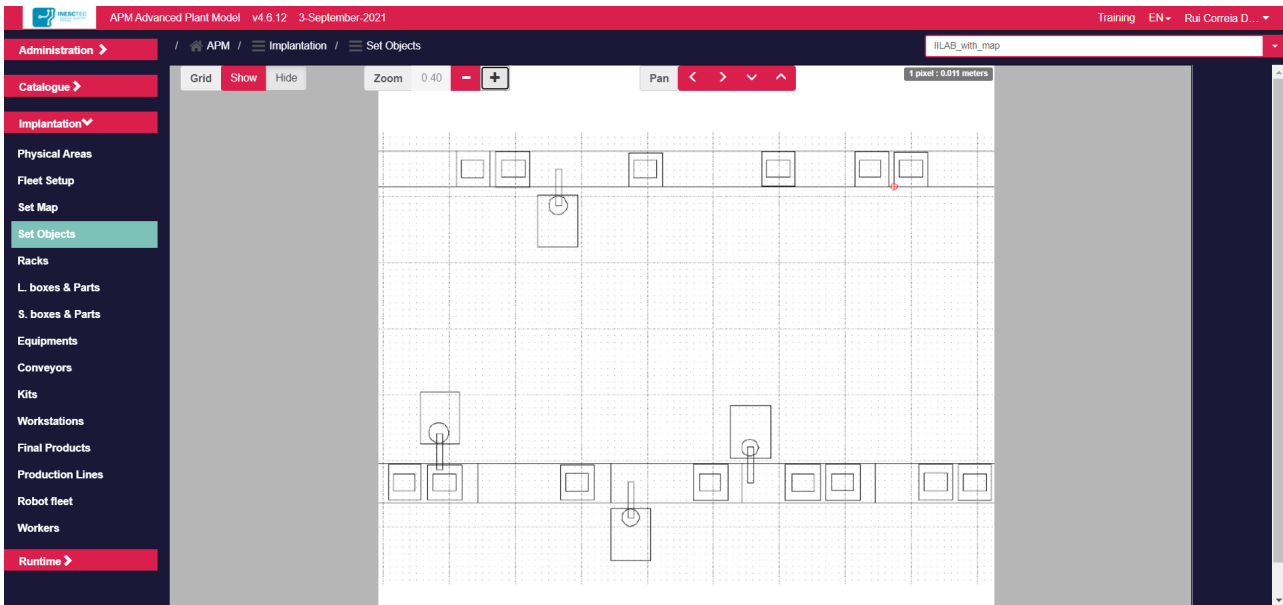
- Supply an **identifier** (e.g. IILAB)
- Specify the **type** (warehouse or assembly line)
- Press “**Map / Select file**” button
- Supply a file containing the map for the physical area
- Identify the scale of the map: how many meters correspond to a pixel

- 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 four Pan buttons.

## 6.4 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.

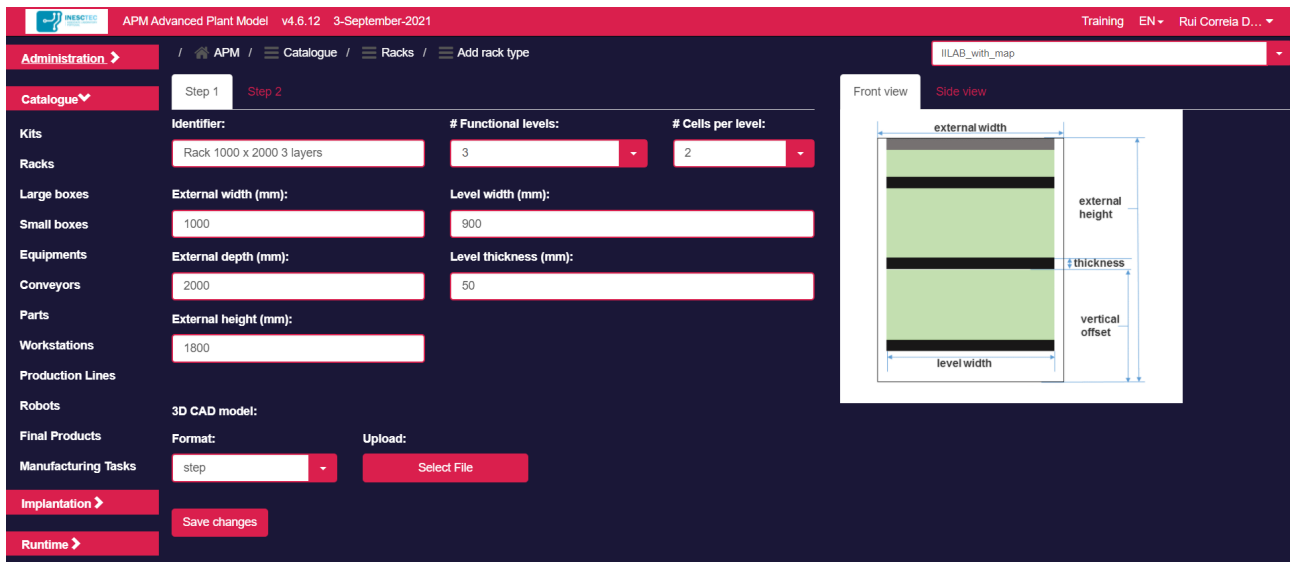
Let's add a new Rack to the Catalogue.

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



Rack ID	Width	Depth	Height	# Levels	Actions
PSA_AJUL1	1391	2501	1598	3	
embraer 1000X1000	1000	1000	1500	2	
embraer 1000X1000 type 2	1000	1000	1500	2	
embraer 1000X1000 type 3	1000	1000	1500	2	
rack_step_ex_1	1100	700	1200	6	
flowmat automated warehouse	2800	700	2000	4	
flowmat operator workstation	900	610	1200	2	
flowmat table	420	1300	1200	2	
EMB 845x800	845	800	3000	2	
ilab 800x600x750	845	600	3000	2	
MakProfile 1115x870 4x3 levels	1115	870	1570	5	
MakProfile 371x870 4x1 levels	371.66	870	1570	5	
Table 800x600x750	800	600	2000	2	
Table 400x600x750 cell on left	400	600	2000	2	
Table 400x600x750 cell on right	400	600	2000	2	
rack	2800	700	2000	4	
Table 600x800x750	600	800	2000	2	
Hamover 550 X 360	550	360	500	3	
PSA 2870x1225	1225	2870	1425	3	
PSA 2870x1410	1410	2870	1425	3	
EMB 750x500	757.5	900	3000	2	

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



Administration > / APM / Catalogue / Racks / Add rack type

ILAB\_with\_map

Step 1 Step 2

Kits

Racks

Large boxes

Small boxes

Equipments

Conveyors

Parts

Workstations

Production Lines

Robots

Final Products

Manufacturing Tasks

Implementation >

Runtime >

Identifier: Rack 1000 x 2000 3 layers

# Functional levels: 3

# Cells per level: 2

External width (mm): 1000

Level width (mm): 900

External depth (mm): 2000

Level thickness (mm): 50

External height (mm): 1800

3D CAD model:

Format: step

Upload: Select File

Save changes

Front view

Side view

external width

external height

level width

level thickness

vertical offset

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

APM Advanced Plant Model v4.6.12 3-September-2021 Training EN Rui Correia D...

Administration > / APM / Catalogue / Racks / Add rack type

ILLAB\_with\_map

Catalogue▼ Step 1 Step 2

Kits

Racks

Large boxes

Small boxes

Equipments

Conveyors

Parts

Workstations

Production Lines

Robots

Final Products

Manufacturing Tasks

3D CAD model:

Format: step Upload: Select File

Save changes

Implantation > Runtime >

Front view Side view

external width

external height

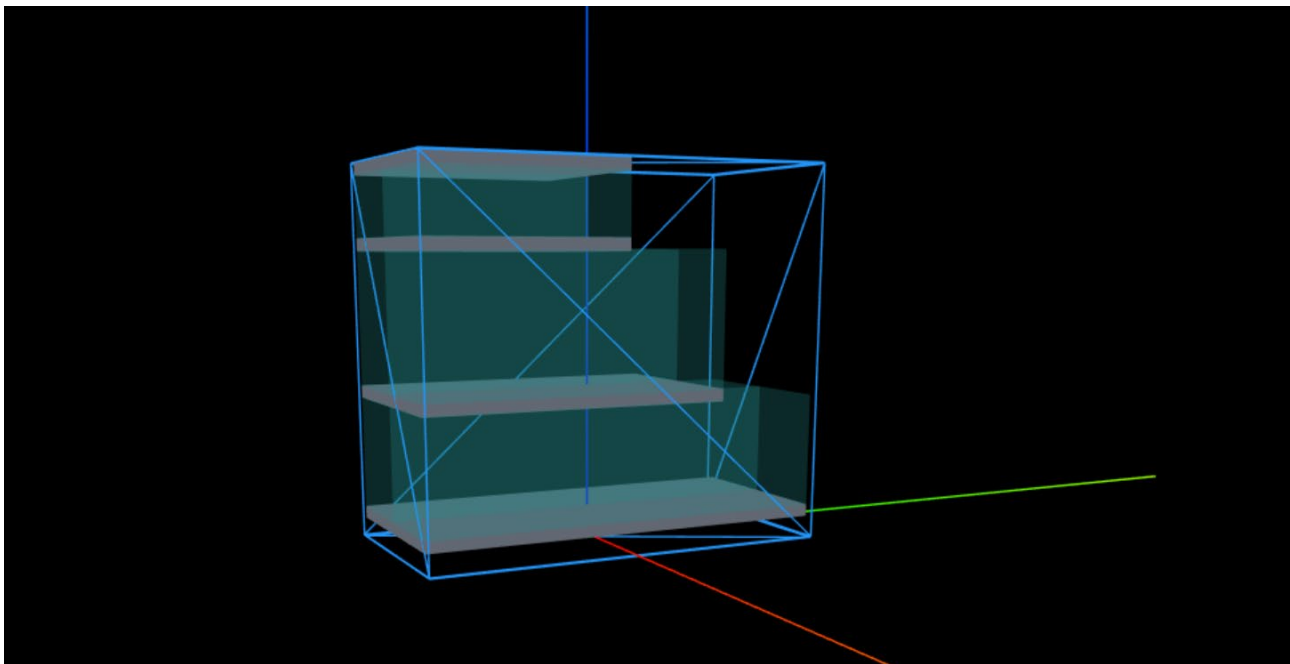
thickness

level width

vertical offset

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.



## 6.5 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.

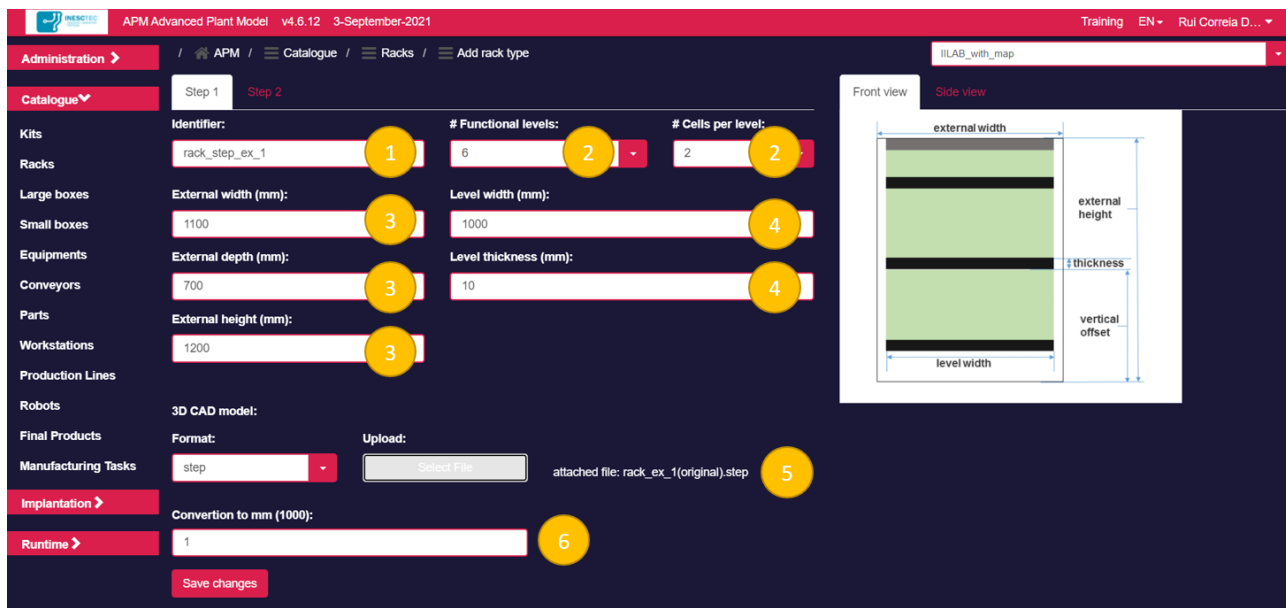
### 1. Go to "Catalogue / Racks"



Rack	Width	Depth	Height	# Levels	Actions
PSA.AUL1	1391	2501	1598	3	
embraer 1000X1000	1000	1000	1500	2	
embraer 1000X1000 type 2	1000	1000	1500	2	
embraer 1000X1000 type 3	1000	1000	1500	2	
rack_step_ex_1	1100	700	1200	6	
flowmat automated warehouse	2800	700	2000	4	
flowmat operator workstation	900	610	1200	2	
flowmat table	420	1300	1200	2	
EMB 845x800	845	800	3000	2	
ilab 800x600x750	845	600	3000	2	
MakProfile 1115x870 4x3 levels	1115	870	1570	5	
MakProfile 371x870 4x1 levels	371.66	870	1570	5	
Table 800x600x750	800	600	2000	2	
Table 400x600x750 cell on left	400	600	2000	2	
Table 400x600x750 cell on right	400	600	2000	2	
rack	2800	700	2000	4	
Table 600x600x750	600	600	2000	2	
Hannover 550 X 360	550	360	500	3	
PSA 2670x1225	1225	2670	1425	3	
PSA 2670x1410	1410	2670	1425	3	
EMB 750x900	757.5	900	3000	2	

### 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 "Conversion to mm" field



APM Advanced Plant Model v4.6.12 3-September-2021 Training EN Rui Correia D...

Administration > APM / Catalogue / Racks / Add rack type

ILAB\_with\_map

Step 1 Step 2

Identifier: rack\_step\_ex\_1 (1)

# Functional levels: 6 (2)

# Cells per level: 2 (2)

External width (mm): 1100 (3)

Level width (mm): 1000 (4)

External depth (mm): 700 (3)

Level thickness (mm): 10 (4)

External height (mm): 1200 (3)

3D CAD model:

Format: step Upload: attached file: rack\_ex\_1(original).step (5)

Conversion to mm (1000): 1 (6)

Save changes

Front view Side view

external width external height level width level thickness vertical offset

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.

APM Advanced Plant Model v4.6.12 3-September-2021 Training EN Rui Correia D...

Administration > / APM / Catalogue / Racks / Add rack type

Step 1 Step 2

Level 6 : vertical offset (mm): 920 Level 6 : horizontal offset (mm): 0

Level 5 : vertical offset (mm): 750 Level 5 : horizontal offset (mm): 0

Level 4 : vertical offset (mm): 590 Level 4 : horizontal offset (mm): 0

Level 3 : vertical offset (mm): 420 Level 3 : horizontal offset (mm): 0

Level 2 : vertical offset (mm): 260 Level 2 : horizontal offset (mm): 0

Level 1 : vertical offset (mm): 100 Level 1 : horizontal offset (mm): 0

3D CAD model:


Format: step Upload: Select File attached file: rack\_ex\_1(original).step

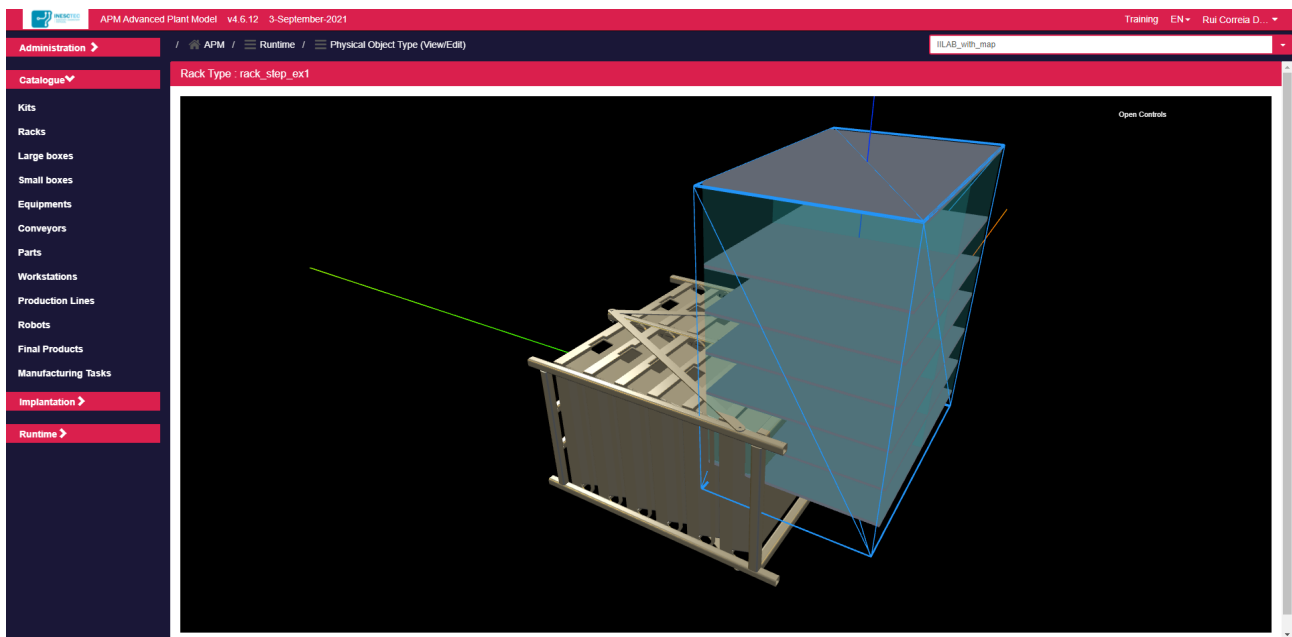
Conversion to mm (1000): 1

Save changes

Front view Side view

external width external height thickness level width vertical offset

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.

The screenshot displays a dark-themed control panel with the following sections:

- Status**: A green message box stating "The configuration is up to date".
- Camera view**: A section header.
- Grid**: Two toggle switches for "grid 1x1 m" and "grid 10x10 cm", both currently turned off.
- Position (large displacement)**: Three sliders for "red axis", "green axis", and "blue axis", each with a numerical value of 0.
- Position (fine-tune displacement)**: Three sliders for "red axis (fine-tune)", "green axis (fine-tune)", and "blue axis (fine-tune)", each with a numerical value of 0.
- Rotation**: Three sliders for "rotate over red axis", "rotate over green axis", and "rotate over blue axis", each with a numerical value of 0.
- Actions**: Three buttons labeled "Reload", "Reset", and "Update".
- Close Controls**: A button at the bottom of the panel.

- 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.

The screenshot displays a dark-themed control panel for a CAD model. At the top, a 'Status' section shows a green message: 'The configuration is up to date', highlighted by a yellow arrow. Below this is a 'Camera view' section. The 'Grid' section has two options: 'grid 1x1 m' and 'grid 10x10 cm', both with checkboxes. The 'Position (large displacement)' section contains three rows for 'red axis', 'green axis', and 'blue axis', each with a blue progress bar and a numerical value of 0. The 'Position (fine-tune displacement)' section has three rows for 'red axis (fine-tune)', 'green axis (fine-tune)', and 'blue axis (fine-tune)', each with a blue progress bar and numerical values of 19, 0, and 0 respectively. The 'Rotation' section has three rows: 'rotate over red axis' with a blue progress bar and value 1.5707963, 'rotate over green axis' with value 0, and 'rotate over blue axis' with value 0. The 'Actions' section at the bottom contains three buttons: 'Reload', 'Reset', and 'Update'. The 'Update' button is highlighted by a yellow arrow. A 'Close Controls' button is located at the very bottom of the panel.

Section	Item	Value / State
Status	Message	The configuration is up to date
Grid	grid 1x1 m	<input type="checkbox"/>
Grid	grid 10x10 cm	<input type="checkbox"/>
Position (large displacement)	red axis	0
	green axis	0
	blue axis	0
Position (fine-tune displacement)	red axis (fine-tune)	19
	green axis (fine-tune)	0
	blue axis (fine-tune)	0
Rotation	rotate over red axis	1.5707963
	rotate over green axis	0
	rotate over blue axis	0
Actions	Reload	Button
	Reset	Button
	Update	Button
Close Controls		

## 6.6 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"

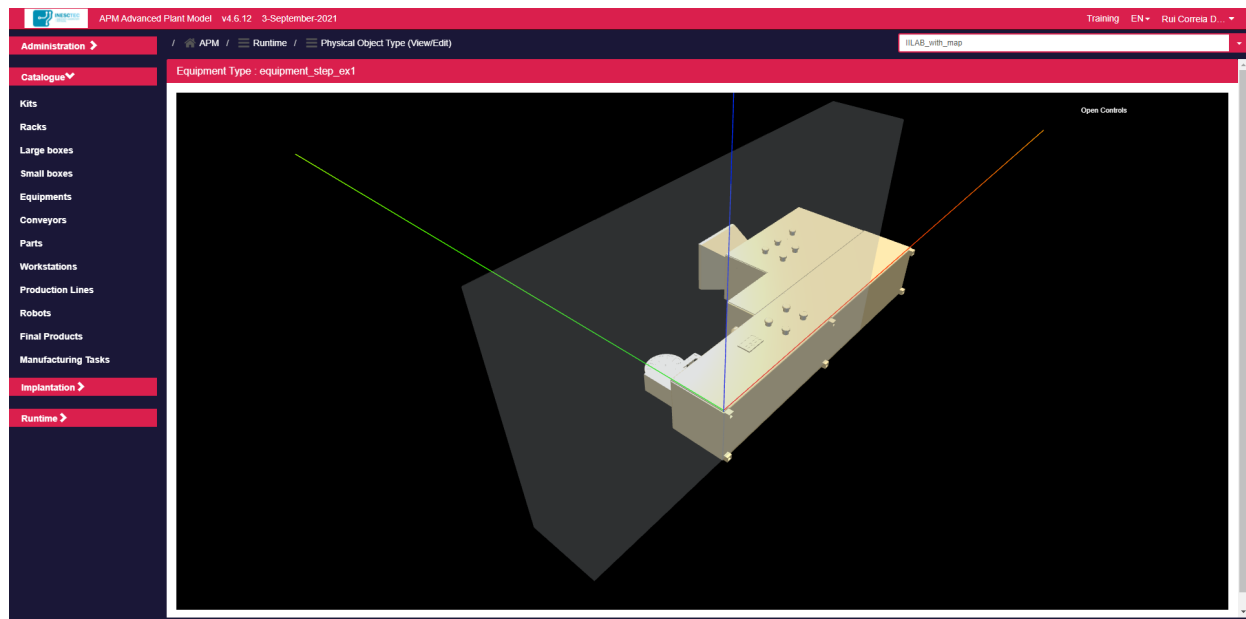
You may optionally associate a STEP model with the Equipment (DON't use spaces in the Identifier field)

  - (3) Press the "3D CAD model / Select file" button
  - (4) Set the "Conversion 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.

The screenshot shows the 'Add equipment type' form in the APM Advanced Plant Model v4.6.12 interface. The form is titled 'Add equipment type' and is located under the 'Catalogue / Equipments' section. The form includes the following fields and buttons:

- Identifier:** A text input field with a placeholder 'Enter the type name of the equipment'. A yellow circle with the number 1 is next to it.
- External width (mm):** A text input field with the value '1000'. A yellow circle with the number 2 is next to it.
- External depth (mm):** A text input field with the value '1000'. A yellow circle with the number 2 is next to it.
- External height (mm):** A text input field with the value '1000'. A yellow circle with the number 2 is next to it.
- 3D CAD model:** A section with a 'Format' dropdown menu set to 'step' and an 'Upload' button labeled 'Select File'. A yellow circle with the number 3 is next to the 'Select File' button. Below the 'Select File' button, it says 'attached file: 06-equipment-example-1-step-model-original (5).step'.
- Conversion to mm (1000):** A text input field with the value '1'. A yellow circle with the number 4 is next to it.
- Save changes:** A button at the bottom of the form.

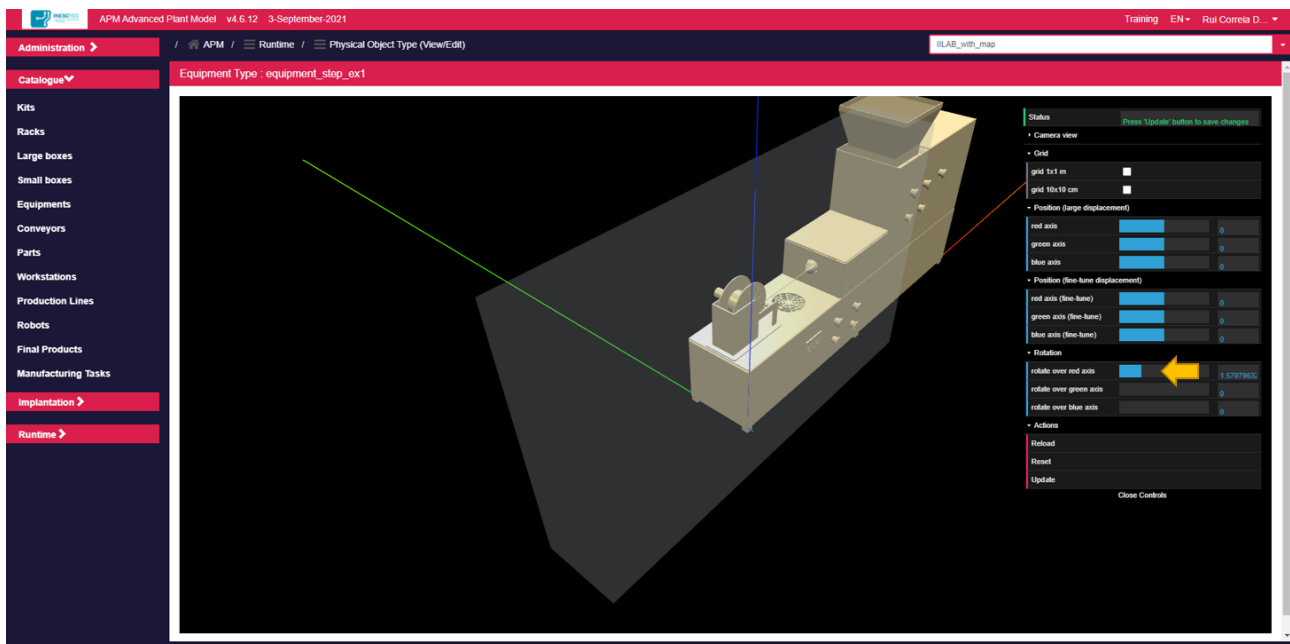
4. In the list of Equipments, press the  icon and check if the defined Equipment has the right form. It may be necessary to align the CAD model with the respective Bounding Volume (like in the picture below).



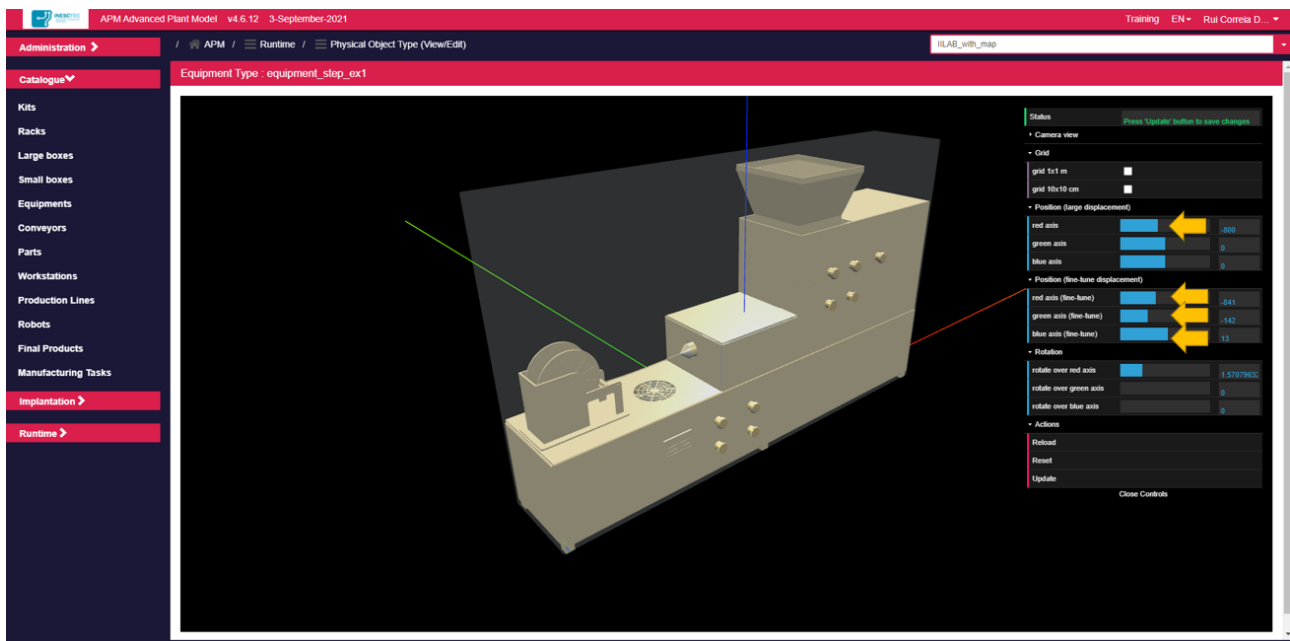
5. To align the CAD model with the respective Bounding Volume, press the top right button “**Open Controls**”. The following menu comprising four categories will expand:
- **Status**: gives feedback about the user’s actions.
  - **Position**: adjusts the CAD model position.
  - **Rotation**: adjusts 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.

The screenshot displays a control panel for a digital twin designer. At the top, a 'Status' section shows a green message: 'The configuration is up to date', with a yellow arrow pointing to it. Below this are several expandable sections: 'Camera view', 'Grid', 'Position (large displacement)', 'Position (fine-tune displacement)', 'Rotation', and 'Actions'. The 'Grid' section has two rows: 'grid 1x1 m' and 'grid 10x10 cm', each with a white square icon. The 'Position (large displacement)' section contains three rows: 'red axis' with a blue slider and value '-800', 'green axis' with a blue slider and value '0', and 'blue axis' with a blue slider and value '0'. The 'Position (fine-tune displacement)' section contains three rows: 'red axis (fine-tune)' with a blue slider and value '-841', 'green axis (fine-tune)' with a blue slider and value '-142', and 'blue axis (fine-tune)' with a blue slider and value '13'. The 'Rotation' section contains three rows: 'rotate over red axis' with a blue slider and value '1.5707963', 'rotate over green axis' with a slider and value '0', and 'rotate over blue axis' with a slider and value '0'. The 'Actions' section at the bottom has three buttons: 'Reload', 'Reset', and 'Update'. A yellow arrow points to the 'Update' button. At the very bottom of the panel is a 'Close Controls' button.

Section	Item	Value / Status
Grid	grid 1x1 m	<input type="checkbox"/>
	grid 10x10 cm	<input type="checkbox"/>
Position (large displacement)	red axis	-800
	green axis	0
	blue axis	0
Position (fine-tune displacement)	red axis (fine-tune)	-841
	green axis (fine-tune)	-142
	blue axis (fine-tune)	13
Rotation	rotate over red axis	1.5707963
	rotate over green axis	0
	rotate over blue axis	0
Actions	Reload	
	Reset	
	Update	

Close Controls

## 6.7 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 "Conversion 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.

APM Advanced Plant Model v4.6.12 3-September-2021 Training EN Rui Correia D...

Administration / APM / Catalogue / Workstations / Add workstation type

ILAB\_with\_map

Loading CAD model ...

Kits

Racks

Large boxes

Small boxes

Equipments

Conveyors

Parts

Workstations

Production Lines

Robots

Final Products

Manufacturing Tasks

Implantation

Runtime

Identifier:

workstation\_step\_ext1

External depth (mm): 3250

External width (mm): 900

External height (mm): 850

Inbound buffer capacity: 1

Inbound buffer depth: 1000

Outbound buffer capacity: 1

Outbound buffer depth: 1000

3D CAD model:


Format: step

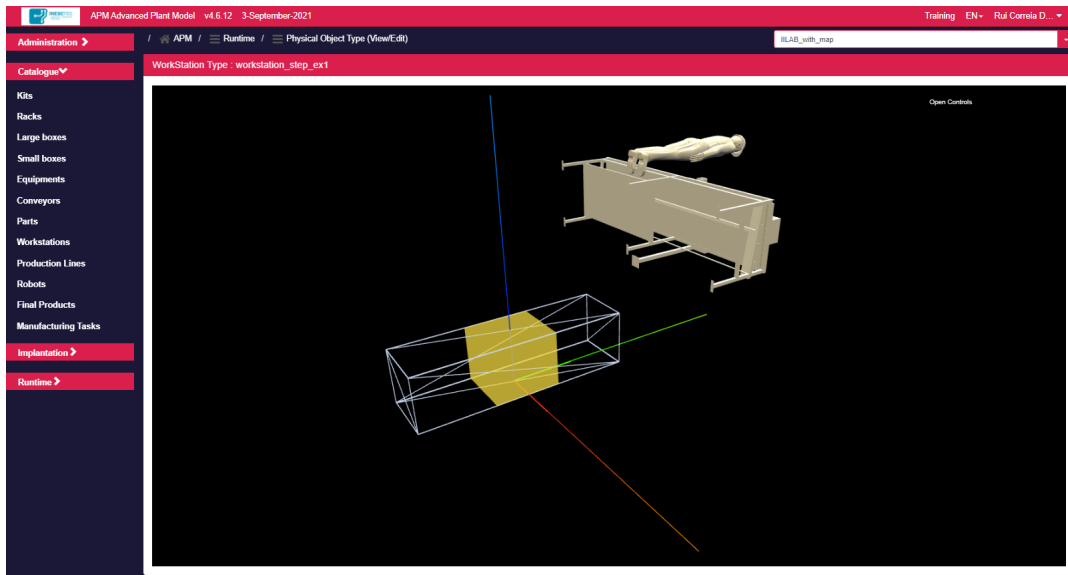
Upload: Select File

attached file: 07-workstation-example-1-step-model-original (2).step

Conversion to mm (1000): 1

Save changes

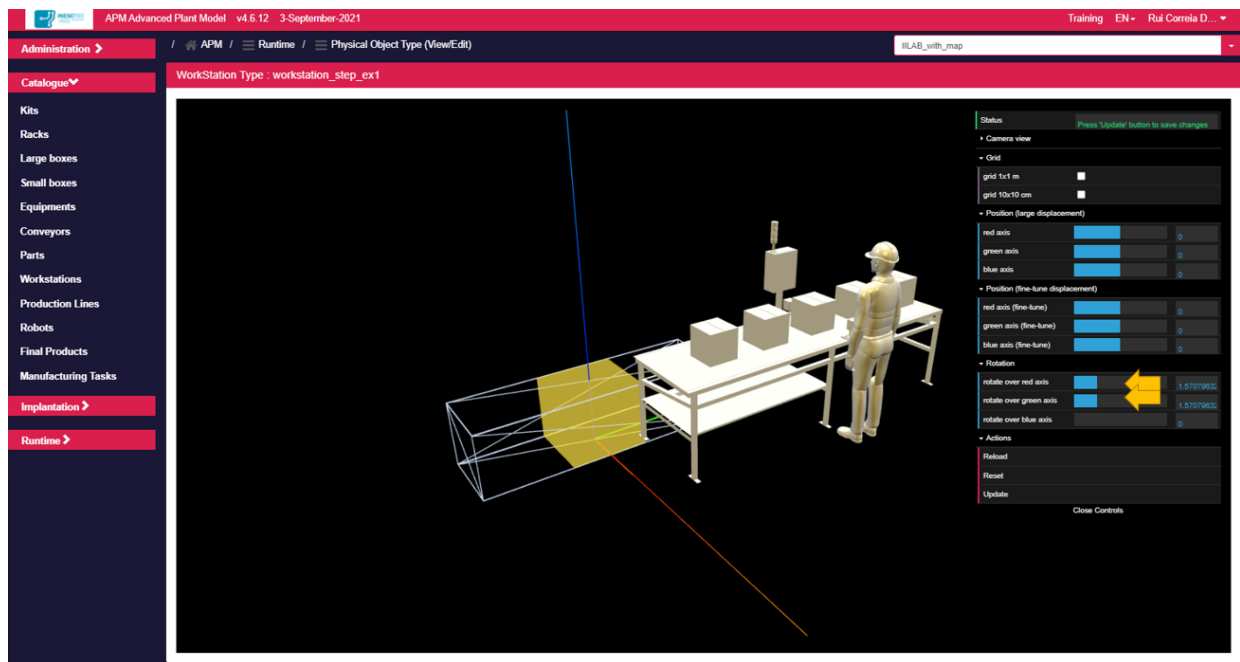
4. In the list of Workstations, press the  icon and check if the defined Workstation has the right form. It may be necessary to align the CAD model with the respective Bounding Volume (like in the picture below).



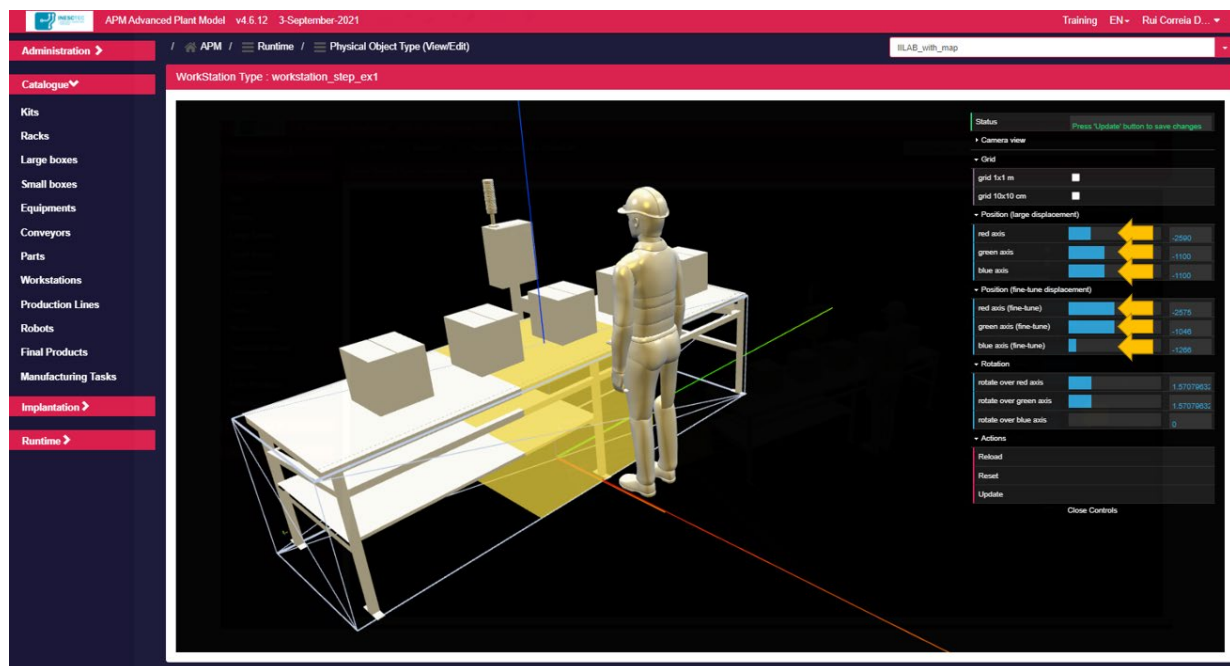
5. To align the CAD model with the respective Bounding Volume, press the top right button “**Open Controls**”. The following menu comprising four categories will expand:
- **Status**: gives feedback about the user’s actions.
  - **Position**: adjusts the CAD model position.
  - **Rotation**: adjusts 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.



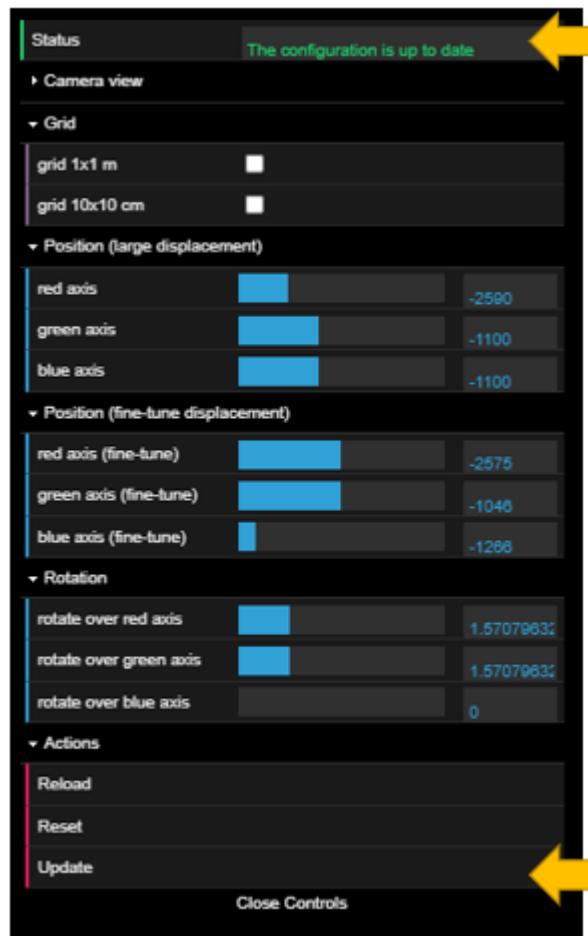
- a. Adjust CAD model **orientation** using the **Rotation sliders**. Each slider performs the rotation over a specific axis (red, green, or blue).



- 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.



## 6.8 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.

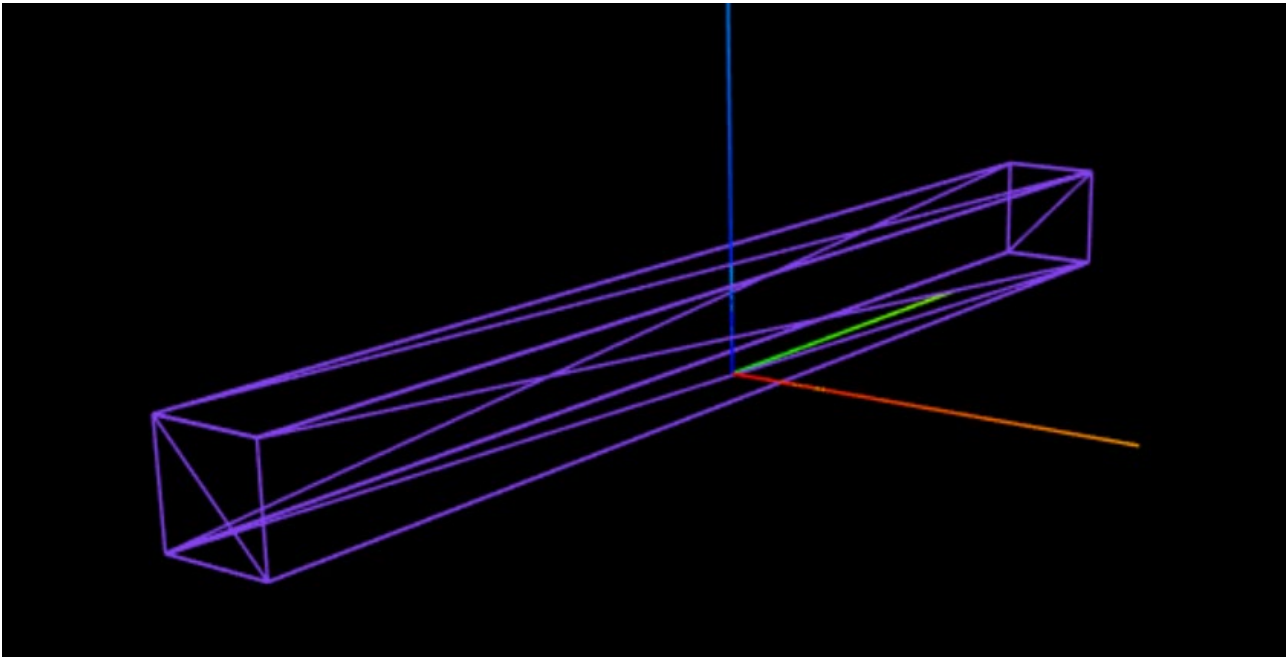
The Catalogue supports the following types of objects: Kits, Racks, Large boxes, Small boxes, Equipments, Conveyors, Parts, Workstations, Production Lines, Robots and Final Products.

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

The screenshot displays the 'Add production line type' form within the APM Advanced Plant Model v4.6.12 interface. The top navigation bar includes the INESCITE logo, version information, and a date. The left sidebar lists various object types, with 'Production Lines' highlighted. The main form area contains three input fields: 'Identifier' (with a placeholder 'Enter the type name of the production line'), '# Number of workstations:' (set to 2), and '# workstation type:' (set to WS 780x5260). A 'Save changes' button is located below the 'Identifier' field.

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 see it in the 3D visualization in a future version of the software).





H2020 Innovation Action – This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 951813.