AGILEHAND

User Manual: WP6.2 – BUILD: Agile, Flexible and Rapid Reconfigurable SUITE

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AGILEHAND

Document Information

GRANT AGREEMENT NUMBER	101092043	ACRONYM	**AGILEHAND**
FULL TITLE	Smart grading, handling, and packaging solutions for soft and deformable products in agile and reconfigurable lines		
START DATE	01-01-2023	DURATION	36 months
PROJECT URL	https://agilehand.eu/		
WORK PACKAGE	WP6 – BUILD: Agile, Flexible and Rapid Reconfigurable SUITE		
LEAD BENEFICIARY	UPM		
RESPONSIBLE AUTHOR	Mazzuto Giovanni, Ortenzi Marco, Croci Stefano, Iacovanelli Matteo		
CONTRIBUTIONS FROM	UPM		
TARGET AUDIENCE	Solution user(s)		
CONTENT	User manual		
ABSTRACT	The scope of this document is to guide the user(s) of the solutions developed within WP6 – BUILD: AGILEHAND Agile, Flexible and Rapid Reconfigurable SUITE of the **AGILEHAND** project.		

Disclaimer

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1. Introduction

1.1. Purpose and Scope

The WP6 of **AGILEHAND** is designed to provide automated AI-powered Digital Twin system for modelling, simulating, and optimising the behaviour of soft and deformable food products within industrial processing lines. This User Manual describes how to operate the system across its two supported use cases, Marelec and Sant'Orsola. The manual covers day-to-day system usage, including workflow execution, simulation management, and interpretation of the generated production and performance results.

1.2. Target Audience

This User Manual is intended for operators, and supervisors who will interact with the **AGILEHAND** Digital Twin system during routine production activities. It assumes no prior knowledge of simulation technologies or optimisation algorithms and focuses on practical instructions for using the system effectively. Technical staff responsible for installation, maintenance, system configuration, or model management should refer to the dedicated Installation Manual, provided as a separate document.

2. System Overview

The **AGILEHAND** Digital Twin system combines hardware and software components to simulate, analyse, and optimise production processes in real industrial environments. It leverages advanced data processing, modelling, and AI-driven optimisation algorithms to support decision-making, improve efficiency, and enhance overall production planning.

3. Use cases

3.1. Marelec

3.1.1. Project Management

Another important page in the dashboard is the Project Management section. This area allows users to create and maintain a project repository, where different working projects can be stored and managed.

- Top box
  - ID: the project identifier
  - Name: a field that can be set by the user
  - Description: an optional short description
- Available actions
  - Save Changes: saves the configuration
  - Discard: cancels the configuration
  - If saved, the system stores the project information so it can be reloaded whenever needed

3.1.1.1. Search and Project browsing

- Search Table: used to browse across saved projects
- Filters available: ID, Name, Description
- Reset Button: clears the search fields if the parameters are incorrect

3.1.1.2. Search and Project browsing

Within the project Table, each saved project includes an Actions column with three key options:

- Link button: opens the main solution page created under that project name
- Copy command: duplicates the project configuration for reuse or modification
- Delete button: permanently removes the project from the repository

3.1.2. Production Optimisation Tool

This section presents the interface dedicated to production optimisation, accessible from the "**Production Line Optimisation**" tab.
The module enables the distribution of production demand across the available lines and identifies the most efficient configuration based on warehouse stock and customer orders.

Data Upload
The initial section allows the user to import data relating to both warehouse and orders using one of the two available methods:

Upload from Excel File

- The "*Choose File*" button allows the user to select an Excel file containing the data to be processed.

Upload from Company Database

- The user can select a date from the calendar and press "*Query on DB*" to automatically retrieve information from the company database.

Once the data has been successfully loaded, the user can start the optimisation process by clicking "**Process Data**".

Starting the Optimisation Process
After loading the data, the user can run the algorithm by clicking "**Process Data**".
The system analyses:

- the orders to be fulfilled,
- the availability of raw material,
- the current configuration of the production lines,
- the setup of the Marelec units.

The objective is to generate a feasible and efficient production plan, selecting the most suitable combination of raw material and line configuration based on real operating conditions.

Optimisation Results

Once processing is complete, the interface displays three main tables, representing the output of the optimisation algorithm.

Raw Material Assignment Table Orders

The first table shows the association between each customer order and the most suitable raw material batch to fulfil it.

For each order, the following information is displayed:

- **Chicken Type** – the product type requested (whether to separate inner and fillet).
- **Completed Orders** – percentage indicating the completion level of each order.
- **Customer** – customer associated with the order.
- **Line** – assigned production line (line 1–2 or line 3–4).
- **Supplier Used** – supplier of the selected raw material.
- **Used Chickens** – number of chickens required to fulfil the order.
- **Weight Average** – average fillet weight of the assigned raw material.
- **Weight Max** – maximum fillet weight.
- **Weight Min** – minimum fillet weight.

This table represents the most efficient match between warehouse availability and the specific requirements of each order.

Splitter Configuration – Lines 1–2 and Lines 3–4

The second and third tables show the required splitter configuration respectively for:

- Lines 1–2,
- Lines 3–4.

Each table includes the following fields:

- **Class Low** – lower limit of the weight class.
- **Class High** – upper limit of the weight class.
- **Batch Weight** – target batch weight.
- **N° Batch** – number of batches required.

- **Customer** – customer associated with the batches.

These tables provide the operational instructions required to configure the Marelec splitters so that the system can automatically generate batches that match customer specifications.

Customisable Operator Tables

In addition to the three tables automatically generated by the optimiser, the interface displays three additional tables, identical in structure but fully editable by the operator.

The operator can:

- modify any cell,
- add new rows,
- delete existing rows,
- create a personalised configuration as an alternative to the automatically generated one.

This allows production plans to be adapted to specific needs, operational exceptions, or plant preferences.

Saving the Results

Once the analysis or manual adjustments are complete, the user can save the configuration by choosing one of two options:

- **Save Optimised** – saves the configuration generated automatically by the algorithm.
- **Save Customised** – saves the manually customised configuration created by the operator.

Before saving, the user can select the processing mode:

- **FAST** – prioritises speed for quicker results.
- **SLOW** – prioritises accuracy for more detailed optimisation.

Both options allow the user to export a complete, production-ready plan.

3.1.3. The Simulation Configuration Parameters Tool

This section displays the **Configurations Parameters** interface, where users can define or view the structure of each production line. At the top, a dropdown menu labelled "**Select Production line**" allows the user to choose a specific line to configure.

Once a line is selected, the interface is divided into two areas:

- **Production line components**: a panel listing all stations that make up the selected production line. If no line is selected or no configuration exists yet, this panel remains empty.
- **Details**: a section that displays information related to the selected station, such as name and processing time.
- At the bottom, a button labelled "**Send Stations data**" allows the user to confirm and save the current configuration.

This interface is used to define the layout and behaviour of each line before running simulations or optimisations.
When hovering over a station, a tooltip appears with a useful description.
These contextual tooltips help users understand the role of each station, improving configuration accuracy and usability. The Details panel is ready to display more in-depth parameters when a component is selected.

Once a component is selected, the right-hand **Details** section is populated with editable fields. Users can specify the component name and its processing time, either as a fixed value or using statistical parameters.
If statistical mode is enabled, a help section appears showing how to define processing times using random distributions, such as ***np.random.uniform(), np.random.lognormal(), or np.random.poisson()***, making simulations more realistic.
After configuring the station, users can confirm and save the data using the **Send Stations data** button, ensuring the configuration is included in the upcoming simulation or optimisation process.

3.1.4. The Simulator

This section illustrates the initial interface of the **Simulator** tab. The green highlight in the top menu indicates that the user is currently in the simulation environment of the application. The interface includes the following main elements:

- A toggle switch labelled View, which enables or disables the graphical representation of the simulation.
- A Play button (green arrow) to start the simulation and a Stop button (green square) to halt it.
- A numeric input labelled Repetitions, which defines how many times the simulation should run.

At this point, no simulation has started yet, and the controls are ready for user interaction.

Multiple Simulations for Statistical Results

After pressing the Play button with the number of repetitions set to 50. A list of simulation instances is displayed on the left, labelled from *Sim 0* to *Sim 49*. Each simulation has a progress bar showing its execution status. This layout allows users to monitor the progress of multiple runs in real time, which is essential for analysing statistical variability and different production scenarios.

Graphical Simulation View

After enabling the **View** toggle to activate graphical simulation mode. Once enabled, two additional buttons appear: **Connect** (middle button) and **Disconnect** (right button). To start the simulation in this mode, the user must first click **Connect** to establish communication with the simulation engine. Before closing the application, it's important to click **Disconnect** to safely terminate the connection and preserve simulation data integrity.

The simulation layout includes detailed representations of the production lines. Visual symbols for operators are also shown, helping users understand the allocation of resources and the physical layout of each line. This graphical mode provides an intuitive and realistic visualization of the process, useful for validating the configuration and identifying potential inefficiencies.

The graphic shows the simulator in action with the **View** mode enabled. The simulation is actively running, as shown by the playback controls and animation across the production lines. Coloured markers (e.g., red, yellow, blue) represent the state of products and operations at different stages. Controls at the top allow users to adjust simulation scale and speed, providing flexibility for observing detailed operations or speeding up the process for analysis. This dynamic visualization supports a clearer understanding of process performance in real time.

3.1.5. Result

This image shows the initial interface of the **Results** tab. The section highlighted in green at the top confirms that the user is currently in the part dedicated to analysing the simulation results. In this section, the operator can compare the expected demand with the production capacity, analyse the performance of operators and stations, and assess the order fulfilment times based on customers.

- **Save Data** - Save the obtained results for future analysis.
- **Don't Save** - Discard the results.
- **Save Data to the Cloud** - Save the obtained results on Cloud for future analysis.
- **Selection line** - Select the production line from the available ones.
- **Select Operator** - Choose an operator or select "All" to include all operators.
- **Select Customer** - Choose the expected order arrival time for a specific customer.
- **Plot Productivity** - Generate a chart that compares the simulated productivity with the requested demand.
- **Analyse Operators** - Display a bar chart of the operators' workload.
- **Generate ETA** - Show the order fulfilment times based on customers.
- **Select Station** - Select a station assigned to the selected line or choose "All".
- **Station Stats** - Display a table with station statistics.
- **Interarrival** - Show the interarrival times of products at the station.
- **Productivity** - Display an hourly productivity bar chart for the station.

Productivity Analysis

The “Plot Productivity” button opens the “Production vs Orders Demand” chart, which provides a combined visualisation of production performance against confirmed demand. The chart includes the following elements:

- Simulated Production

Represent the mean value of simulated production for each time interval.

- Confirmed Orders

Indicate the number of pieces that must be available in each time interval to satisfy confirmed orders.

- Net Available Production

Calculated as cumulative production minus order requirements. This measure ensures that the resulting value remains non-negative, thereby verifying the feasibility of the production plan.

- Cumulative Production Line

A line chart is superimposed on the bar chart to represent the total amount of products realised step by step in a cumulative manner.

By clicking the Save PDF button, the user can export the graph as a PDF document. In contrast, clicking the Clear Graph button, the displayed graph is deleted, and the interface returns to the initial screen of the Results tab.

Operator Analysis
To view the operators' workload, select the desired line and operator first. Only then will the **Analyse Operators** button become enabled.

- Single Operator Selection

The bar charts (average in green, minimum in red, and maximum in blue) show the operator's workload percentage at the assigned stations. Hovering over a bar shows the workload percentage for that station.

- Selecting "All"

In this case, selecting the All option in the operator dropdown shows the total workload percentages for each operator. Hovering over a bar shows the total workload percentage for that operator on the line.

By clicking the **Clear Graph** button, the user can return to the initial screen of the **Results** tab.

ETA Analysis
To view order fulfilment times, first select the line and then the customer. Only then will the **Generate ETA** button become enabled.

- Single Customer Selection

It shows an analysis of the Estimated Time of Arrival (ETA) for a specific customer. The lines show the order completion progress, indicating how production evolves over time to reach the customer's requested quantity. The lines represent ETA values (minimum in red, maximum in blue, and average in green).

- Selecting "All"

The All option was selected in the customer dropdown. In this case, the average end-of-line arrival time for each product is shown, classified by customer.

By clicking the **Clear Graph** button, the user can return to the initial screen of the **Results** tab.

Station Analysis
The second area of the page allows you to select a line and a station. Only then will the Station Stats, Interarrival, and Productivity buttons become enabled.

Station Statistics
The report provides operational performance data for the station, including processing time, wait time in, wait time out, and the number of pieces processed per hour.
Interarrival
It shows the Interarrival analysis, monitoring the time between the arrival of one piece and the next.

Hourly Productivity
This section monitors the number of pieces produced per hour by the station, evaluating overall efficiency. The chart represents maximum, minimum, and average productivity values.

3.1.6. Monitoring

The interface shown is the Production Monitoring screen of the AgileHand platform. At the top of the page, the user finds three main controls:

- A Dropdown menu used to select the project to analyse;
- A green button that activates the production monitoring view;
- A time selector that defines the start time of the production shift.

On the upper-right side, alert notifications appear whenever the system detects delays in the workflow, generated in real time to help the operator to immediately identify orders that are falling behind schedule:

- Yellow messages indicate minor delays
- Red notification signal indicates more severe issues.

At the centre of the page, the title clearly indicates that the user is viewing the Production Monitoring section. Just below, a detailed table provides an overview of the production status for each customer. It displays:

- Ordered quantity
- The number of units produced so far
- Any delay accumulated relative to the planned schedule
- The estimated completion time
- A progress bar showing the percentage of work completed

The table also uses colour coding to help the operator quickly interpret the situation:

- Orange rows highlight orders experiencing moderate delays or still in progess
- Red rows indicate severe delays or critical issues
- Neutral colours represent orders that have not yet started or for which data is not available

This interface offers a clear, immediate view of the production flow, allowing operators to monitor performance and react promptly to any emerging issues.

3.1.7. Result Analysis

From the main screen of the **AgileHand** dashboard, click on DT Marelec in the left sidebar to open the dropdown menu. Select **Results Analysis** to access the analysis screen for previously saved simulations. In this section, click **Load Project** to upload the desired project. Once uploaded, compare the forecasted demand with the production capacity, analyse the performance of operators and stations, and evaluate order fulfilment times based on customer data. After clicking Load Project, a selection panel opens. It allows browsing through saved simulation folders. Select a folder to load the project into the platform for analysis.

Once loaded, the production line configuration will appear in the **Input Parameters** section. At the top of this section, the label "**Input parameters – cust – SLOW**" (or the corresponding variation) is displayed. This label indicates:

- whether the input data used for the simulation is **customised(cust)** or **optimised (opt)**, and
- whether the production line is set to operate at **SLOW** speed or **FAST** speed.

Below this header, the table provides the following information for each line:

- **Completed Orders** – percentage indicating the completion level of each order.
- **Customer** – customer associated with the order.
- **Line** – assigned production line (line 1–2 or line 3–4).
- **Supplier Used** – supplier of the selected raw material.
- **Used Chickens** – number of chickens required to fulfil the order.
- **Weight Average** – average fillet weight of the assigned raw material.
- **Weight Max** – maximum fillet weight.
- **Weight Min** – minimum fillet weight.

With the simulation loaded and the line configuration visible, proceed to visualize all available results, as described in Section 5. Results. The operator can now analyze operator and station performance, compare demand and production capacity, and evaluate order fulfillment times for each customer.

3.1.8. Result Comparison

From the main screen of the **AgileHand** dashboard, click on DT Marelec in the left sidebar to open the dropdown menu. Select **Result Comparison** to access the interface used to compare two previously saved simulations.

In this section, two dropdown selectors are available at the top of the screen:

- **Select a project to analyse** – used to load the first simulation (Project 1).
- **Select a project to compare** – used to load the second simulation (Project 2).

After choosing both projects, the platform automatically loads their configuration and displays the corresponding input parameters side by side.

Project Input Parameters Overview

For each loaded simulation, a dedicated panel appears (or any other variation, depending on the selected simulations):

Each header follows the format “Input parameters – [cust/opt] – [SLOW/FAST]”, indicating:

whether the simulation inputs were customised (cust) or optimised (opt);

whether the production line was configured to run at SLOW speed or FAST speed.

Input Parameters Table

For both Project 1 and Project 2, the platform displays a table containing the configuration used for each line.

Each table includes the following fields:

- **Chicken Type** – the requested product type (e.g., WITH or WITHOUT inner fillet separation).
- **Completed Orders** – percentage showing the progress or completion of the order.
- **Customer** – customer associated with each order.
- **Line** – assigned production line (1–2 or 3–4).
- **Supplier Used** – raw material supplier selected in the simulation.
- **Used Chickens** – number of chickens required to satisfy the order.
- **Weight Average** – average fillet weight of the supplied raw material.
- **Weight Max** – maximum fillet weight observed.
- **Weight Min** – minimum fillet weight observed.

Both tables include pagination to navigate through all lines of the configuration.

Available Comparison Tools

After loading the two simulations, the comparison screen enables a set of tools for deeper evaluation:

- **Plot Productivity** – allows comparing productivity metrics between Project 1 and Project 2 based on selected line, operator, and customer.
- **Analyse Operators** – evaluates operator performance across the two simulations.
- **Generate ETA** – provides an estimation of completion time for the selected customer, allowing direct comparison between the two scenarios.
- **Station Stats** – displays statistics for a selected station across both projects.
- **Interarrival** – shows interarrival time distributions.

- **Productivity** – compares productivity at station level.

Purpose of the Comparison Module

This module allows operators and supervisors to directly evaluate two simulations side by side, the user can:

- compare line performance under different strategies,
- evaluate the effect of supplier changes or weight distributions,
- assess how demand or customer mix impacts throughput,
- identify which setup is more efficient for a given production objective.

3.2. Sant'Orsola

3.2.1. Project Management

Another important page in the dashboard is the Project Management section. This area allows users to create and maintain a project repository, where different working projects can be stored and managed.

Top box:

    - **Name:** a field that can be set by the user
    - **ID:** the project identifier
    - **Description:** an optional short description
- Available actions
    - **Save Changes:** saves the configuration
    - **Discard:** cancels the configuration
    - If saved, the system stores the project information so it can be reloaded whenever needed

3.2.1.1. Search and Project browsing

- **Search Table:** used to browse across saved projects
- **Filters available:** ID, Name, Description
- **Reset Button:** clears the search fields if the parameters are incorrect

3.2.1.2. Search and Project browsing

Within the project Table, each saved project includes an Actions column with three key options:

- **Link button:** opens the main solution page created under that project name
- **Copy command:** duplicates the project configuration for reuse or modification
- **Delete button:** permanently removes the project from the repository

3.2.2. Demand Forecasting

3.2.2.1. Forecast Demand for Tomorrow Production

This tool allows users to forecast the next day production demand based on historical data. Follow the steps below to upload input data, generate a forecast and visualise historical trends in an interactive chart.

- Enter tomorrow date in the "*Tomorrow Date*" field;
- Select the product species and format from the available menus.
- Once the date, product species and format are provided, the system will execute a query to the company Database.
- The query processes the relevant information stored in the database.
- The prediction is generated, with the predicted value automatically displayed in the "Tomorrow forecast" box.
- After the prediction, a chart displaying all historical forecasts will appear in the "Forecast Analysis" section.
  - The chart ends with the most recent forecasted date.
  - Use the available menus to filter and focus on a specific analysis period.

3.2.2.2. Alternative access to forecast history

Instead of generating a new forecast, it is possible to choose the "Upload historical prediction" button to view past demand forecasts for the selected product spieces and format. This allows exploration of the prediction chart without computing a new forecast.

3.2.3. The Optimiser Tool

This section presents the Production Lines Optimisation interface, accessible under the "Production lines optimisation" tab. The module, titled OPTIMISATION MODULE, includes:

- **Forecasted Demand Input Field**

  Users can manually enter or load the forecasted demand value. This field is directly connected to the Forecasted Demand Tool but also allows the insertion of custom values.

- **Date and Demand Input Field**

Users must specify tomorrow date in relation to the one selected in the Forecasted Demand Tool, including the workday start hour.

- **Product Specied and Format Selection**

Once the product species and format are defined, the system automatically executes a query to the company Database. This query retrieves the all confirmed orders up to the current moment and deducts their quantities from the forecasted demand.

- **Confirmed Orders Requirements Section**

Confirmed orders are logged within the designated evasion time interval under the "Confirmed Orders Requirements" section. Within this section, each time slot displays the product quantities that must be produced in order to fulfil the corresponding orders.

3.2.3.1. Optimised Result Section

The Optimised Result section presents the outcomes of the production line optimisation process. It is organised as follows:

- **Configuration Table**

- The table includes a "Line" column, which indicates the identification number of each plant line. It is divided into two halves, corresponding to the two production shifts.

  - **Shift 1 (left half):** contains the "Combination" (operator configuration), "Work Time" (allocated duration) and "Crates" (workload value expressed as the number of crates).

  - **Shift 2 (right half):** reports the same columns ("Combination", "Work Time", "Crates") with values corresponding to the second shift.

- **Difference Box**

Positioned below the table, this box displays in red the overproduction resulting from the selected configuration, calculated by comparing the optimised configuration against the exact forecasted demand. Whether there is no overproduction, the Difference Box will display the "0" value in green.

- **Save Optimisation Button**

The "Save Optimisation" button allows users to store the selected configuration, making it available for subsequent steps in the optimisation workflow.

3.2.3.2. Customised Result Section

The Customised Result section provides an alternative to the automated optimisation process. It includes the same comparison table as presented in the Optimised Result section, with identical values for each production line and shift. However, in this case the values can be manually adjusted by the user to define a customised configuration.

- **Comparison Table**

Displays the same structure as the optimised result, including columns for “Line”, “Combination”, “Work Time” and “Crates” across both shifts. Users may directly modify these values to reflect preferred configurations.

- **Difference Box**

Unlike the optimised result, this section does not include a difference box.

- **Save Optimisation Button**

The “Save Customised” button enables users to store the manually defined configuration, making it available for subsequent steps in the workflow.

3.2.4. The Simulation Configuration Parameters Tool

This section displays the **Configurations Parameters** interface, where users can define or view the structure of each production line. At the top, a dropdown menu labelled "**Select Production line**" allows the user to choose a specific line to configure.

Once a line is selected, the interface is divided into two areas:

- **Production line components**: a panel listing all stations that make up the selected production line. If no line is selected or no configuration exists yet, this panel remains empty.
- **Details:** a section that displays information related to the selected station, such as name and processing time.
- At the bottom, a button labelled "**Send Stations data**" allows the user to confirm and save the current configuration.

This interface is used to define the layout and behaviour of each line before running simulations or optimisations.
When hovering over a station, a tooltip appears with a useful description.
These contextual tooltips help users understand the role of each station, improving configuration accuracy and usability. The Details panel is ready to display more in-depth parameters when a component is selected.

Once a component is selected, the right-hand **Details** section is populated with editable fields. Users can specify the component name and its processing time, either as a fixed value or using statistical parameters.
If statistical mode is enabled, a help section appears showing how to define processing times using random distributions , such as ***np.random.uniform(), np.random.lognormal(), or np.random.poisson()***, making simulations more realistic.
After configuring the station, users can confirm and save the data using the **Send Stations data** button, ensuring the configuration is included in the upcoming simulation or optimisation process.

3.2.5. The Simulator

This section illustrates the initial interface of the **Simulator** tab. The green highlight in the top menu indicates that the user is currently in the simulation environment of the application. The interface includes the following main elements:

- A toggle switch labelled View, which enables or disables the graphical representation of the simulation.
- A Play button (green arrow) to start the simulation and a Stop button (green square) to halt it.
- A numeric input labelled Repetitions, which defines how many times the simulation should run.

At this point, no simulation has started yet, and the controls are ready for user interaction.

Multiple Simulations for Statistical Results

After pressing the Play button with the number of repetitions set to 50. A list of simulation instances is displayed on the left, labelled from *Sim 0* to *Sim 49*. Each simulation has a progress bar showing its execution status. This layout allows users to monitor the progress of multiple runs in real time, which is essential for analysing statistical variability and different production scenarios.

Graphical Simulation View

After enabling the **View** toggle to activate graphical simulation mode. Once enabled, two additional buttons appear: **Connect** (middle button) and **Disconnect** (right button). To start the simulation in this mode, the user must first click **Connect** to establish communication with the simulation engine. Before closing the application, it's important to click **Disconnect** to safely terminate the connection and preserve simulation data integrity.

The simulation layout includes detailed representations of the production lines. Visual symbols for operators are also shown, helping users understand the allocation of resources and the physical layout of each line. This graphical mode provides an intuitive and realistic visualization of the process, useful for validating the configuration and identifying potential inefficiencies.

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3.2.6. Results

This image shows the initial interface of the **Results** tab. The section highlighted in green at the top confirms that the user is currently in the part dedicated to analysing the simulation results. In this section, the operator can compare the expected demand with the production capacity, analyse the performance of operators and stations, and assess the order fulfilment times based on customers.

- **Save Data** - Save the obtained results for future analysis.
- **Don't Save** - Discard the results.
- **Save Data to the Cloud** - Save the obtained results on Cloud for future analysis.
- **Selection line** - Select the production line from the available ones.
- **Select Operator** - Choose an operator or select "All" to include all operators.
- **Select Customer** - Choose the expected order arrival time for a specific customer.
- **Plot Productivity** - Generate a chart that compares the simulated productivity with the requested demand.
- **Analyse Operators** - Display a bar chart of the operators' workload.
- **Generate ETA** - Show the order fulfilment times based on customers.
- **Select Station** - Select a station assigned to the selected line or choose "All".
- **Station Stats** - Display a table with station statistics.
- **Interarrival** - Show the interarrival times of products at the station.
- **Productivity** - Display an hourly productivity bar chart for the station.

Productivity Analysis

The “Plot Productivity” button opens the “Production vs Orders Demand” chart, which provides a combined visualisation of production performance against confirmed demand. The chart includes the following elements:

- **Simulated Production**

Represent the mean value of simulated production for each time interval.

- **Confirmed Orders**

Indicate the number of pieces that must be available in each time interval to satisfy confirmed orders.

- **Net Available Production**

Calculated as cumulative production minus order requirements. This measure ensures that the resulting value remains non-negative, thereby verifying the feasibility of the production plan.

- **Cumulative Production Line**

A line chart is superimposed on the bar chart to represent the total amount of products realised step by step in a cumulative manner.

By clicking the Save PDF button, the user can export the graph as a PDF document. In contrast, clicking the Clear Graph button, the displayed graph is deleted, and the interface returns to the initial screen of the Results tab.

Operator Analysis
To view the operators' workload, the user must first select the desired **line** and the **shift** to analyse (Shift 1 or Shift 2). Only after these selections can the operator be chosen, at which point the *Analyse Operators* button becomes enabled.

- **Single Operator Selection**

The bar charts (average in green, minimum in red, and maximum in blue) show the operator's workload percentage at the assigned stations. Hovering over a bar shows the workload percentage for that station.

- **Selecting "All"**

In this case, selecting the All option in the operator dropdown shows the total workload percentages for each operator. Hovering over a bar shows the total workload percentage for that operator on the line.

By clicking the Save PDF button, the user can export the graph as a PDF document. In contrast, clicking the Clear Graph button, the displayed graph is deleted, and the interface returns to the initial screen of the Results tab.

ETA Analysis
To view order fulfilment times, first select the line and then the customer. Only then will the **Generate ETA** button become enabled.

- **Single Customer Selection**

It shows an analysis of the Estimated Time of Arrival (ETA) for a specific customer. The lines show the order completion progress, indicating how production evolves over time to reach the customer's requested quantity. The lines represent ETA values (minimum in red, maximum in blue, and average in green).

- **Selecting "All"**

The All option was selected in the customer dropdown. In this case, the average end-of-line arrival time for each product is shown, classified by customer.

By clicking the Save PDF button, the user can export the graph as a PDF document. In contrast, clicking the Clear Graph button, the displayed graph is deleted, and the interface returns to the initial screen of the Results tab.

Station Analysis
The second area of the page allows you to select a line and a station. Only then will the Station Stats, Interarrival, and Productivity buttons become enabled.

By clicking the Save PDF button, the user can export the graph as a PDF document. In contrast, clicking the Clear Graph button, the displayed graph is deleted, and the interface returns to the initial screen of the Results tab.

Station Statistics
The report provides operational performance data for the station, including processing time, wait time in, wait time out, and the number of pieces processed per hour.

Interarrival
It shows the Interarrival analysis, monitoring the time between the arrival of one piece and the next.

By clicking the Save PDF button, the user can export the graph as a PDF document. In contrast, clicking the Clear Graph button, the displayed graph is deleted, and the interface returns to the initial screen of the Results tab.

Hourly Productivity
This section monitors the number of pieces produced per hour by the station, evaluating overall efficiency. The chart represents maximum, minimum, and average productivity values.

By clicking the Save PDF button, the user can export the graph as a PDF document. In contrast, clicking the Clear Graph button, the displayed graph is deleted, and the interface returns to the initial screen of the Results tab.

3.2.7. Monitoring

The monitoring activity is based on the comparison between real-time information from the plant and the simulated production conducted during the previous day. To begin, the user must upload the relevant simulation through a dropdown menu, which allows the selection among previously conducted simulations.

- **Orders Requirements Section**

Once the simulation is chosen, the system displays the scenario and configuration in terms of confirmed orders from the previous day. These are presented in a table, organised by time intervals , each specifying the hour and the required product quantities.

- **Loaded Configuration Section**

Alongside the order requirements, the configuration selected for that scenario is shown. This configuration serves ad the starting point for the current workday. It is presented in a table divided into two shifts. Each one reports the operator combination, allocated work time and workload in crates.

- Monitoring Controls

After reviewing the configuration, the monitoring activity can be managed through three main buttons:

- **Start Monitor:** initiates the monitoring activity;
- **Stop Monitor:** temporarily halts monitoring, preventing updates for the moment.
- **Quit Monitor:** exits the monitoring phase and clears the page of visualised insights.

Before monitoring begins, the Total Plant Monitor section is already visible, serving as the host for the monitoring chart. Next to the controls, the Production Variance box indicates the gap between simulated and real data, highlighting delays in terms of pieces produced at that time.

- Monitoring Charts

Once monitoring is started, the chart becomes active and displays two combined line charts:

- **Expected Production (red line):** represents the real production values.
- **Simulated Production (blue line):** represents the simulated values. In addition, below the Total Plant Monitor, individual line monitoring charts are shown for each line activated in the real plant.

- **Anomaly Detection and Reconfiguration**

The monitoring process focuses on two main aspects to detect anomalies:

- **Delays:** highlighted in the Production Variance box in red, indicating that the current configuration is no longer suitable.
- **Changes in Order Requirements:** a pop-up message is displayed to inform the user that the order requirements have changed since the last update check.

If either of these conditions (or both) occur, the system calculates a new optimised configuration to recover the delay. This updated configuration is displayed in a table with the same structure as the Loaded Configuration, but with revised values.

- **Confirmation Process**

The new configuration must be either confirmed or discarded manually:

- **If confirmed:** the system sends a correction notification to the real plant, adjusts the configuration and resumes monitoring by comparing real data with the updated simulated data from the implementation time onward.
- **If discarded:** no adjustment is made to the real plant and the system continues to detect and report the delay.

3.2.8. Results Analysis

From the main screen of the **AgileHand** dashboard, click on DT Sant'Orsola in the left sidebar to open the dropdown menu. Select **Results Analysis** to access the analysis screen for previously saved simulations. In this section, click **Load Project** to upload the desired project. It is possible to recognise if the simulation has been optimally configured or customised thanks to the project title. Once uploaded, compare the forecasted demand with the production capacity, analyse the performance of operators and stations, and evaluate order fulfilment times based on customer data. After clicking Load Project, a selection panel opens. It allows browsing through saved simulation folders. Select a folder to load the project into the platform for analysis. Once the project is uploaded, the relative configuration used in the loaded simulation is displayed in a table.

The table includes a "Line" column, which indicates the identification number of each plant line. It is divided into two halves, corresponding to the two production shifts:

- **Shift 1 (left half):** contains the Combination (operators configuration), Work Time (allocated duration) and Crates (workload value expressed as the number of crates).
- **Shift 2 (right half):** reports the same columns (Combination, Work Time, Crates) with values corresponding to the second shift.

With the simulation loaded and the line configuration visible, proceed to visualize all available results, as described in Section 5. Results. The operator can now analyze operator and station performance, compare demand and production capacity, and evaluate order fulfillment times for each customer.

3.2.9. Simulation Comparison

From the main screen of the **AgileHand** dashboard, click on DT Sant'Orsola in the left sidebar to open the dropdown menu. Select **Result Comparison** to access the interface used to compare two previously saved simulations.

In this section, two dropdown selectors are available at the top of the screen:

- **Select a project to analyse** – used to load the first simulation (Project 1).
- **Select a project to compare** – used to load the second simulation (Project 2).

It is possible to recognise if the simulation has been optimally configured or customised thanks to the project title. After choosing both projects, the platform automatically loads their configuration and displays the corresponding input parameters side by side.

Project Input Parameters Overview

Once the simulations to be compared are selected, the corresponding input parameters tables are displayed at the beginning of the pages. Each table appears under the Input Parameters section and is accompanied by the simulation date and time, as well as an indication of whether the configuration was generated through the optimised process or defined as customised.

Input Parameters Table

For both Project 1 and Project 2, the platform displays a table containing the configuration used for each line.

Each table includes a "Line" column, which specifies the identification number of each plant line and is divided into two halves corresponding to the two production shifts. The left half refers to Shift 1, showing the Combination (operator configuration), Work Time (allocated duration) and Crates (workload expressed as the number of crates). The right half refers to Shift 2, reporting the same columns (Combination, Work Time, Crates) with values associated with the second shift.

Available Comparison Tools

After loading the two simulations, the comparison screen enables a set of tools for deeper evaluation:

- **Plot Productivity** – allows comparing productivity metrics between Project 1 and Project 2 based on selected line, operator, and customer.
- **Analyse Operators** – evaluates operator performance across the two simulations.
- **Generate ETA** – provides an estimation of completion time for the selected customer, allowing direct comparison between the two scenarios.
- **Station Stats** – displays statistics for a selected station across both projects.
- **Interarrival** – shows interarrival time distributions.
- **Productivity** – compares productivity at station level.

Purpose of the Comparison Module

This module allows operators and supervisors to directly evaluate two simulations side by side, the user can:

- compare line performance under different strategies,
- evaluate the effect of supplier changes or weight distributions,
- assess how demand or customer mix impacts throughput,
- identify which setup is more efficient for a given production objective.

4. Troubleshooting

4.1. Common Issues and Solutions

Issue	PossibleCause	Suggested Action
Dependencies not installing	Outdated pip, incompatible OS or Python version	Upgrade pip (pip install --upgrade pip); verify compatibility in requirements
Script crashes at launch	Incorrect script or missing files	Ensure you're running the correct script and that all models and configs are present

4.2. When to Contact Technical Support

Contact technical support if:

- The system does not respond to restarts or commands.
- Software errors or crashes occur repeatedly.
- Model performance appears degraded.
- You require assistance with advanced configuration or maintenance.

Include details such as system logs, error messages, and a description of steps taken when reporting issues.

5. Frequently Asked Questions (FAQs)

Q1: Do I need to train or retrain the AI model before using the system?
A: No. All models are pre-trained for the supported use cases. No manual training or annotation is required by the user

Q2: Can I use the system in other manufacturing process?
A: No. The current version supports only these specified use cases. Extending the system to

other products would require additional data collection, annotation, and AI model development.

Q3: Is internet access required for using the system?

A: No. Once installed the local version, the system runs locally and does not require an internet connection.