trinity

DYNAMIC TASK PLANNING & WORK RE-ORGANIZATION TUTORIAL

Laboratory of Manufacturing Systems and Automation (LMS)

www.trinityrobotics.eu

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Pre-requisites

- Operating system: Linux Ubuntu 16.04
- Software components required:
  - ROS Kinetic.
  - Gazebo simulation engine 10.
  - Development environment JDK 13.
  - Apache Tomcat 9.
  - Docker Engine for Linux Ubuntu 16.04.
  - Web browser (Firefox, Chrome etc.).
  - Selected robots ROS controllers for simulated motions' execution.
  - Gradle build tool for Ubuntu Linux 16.04.
  - GZWeb software for GAZEBO simulation visualization in a Web browser tab.
- Minimum desktop related hardware requirements:
  - CPU: Intel Core i7 10th Generation.
  - Disk: SSD 250 GB.
  - RAM: 32 GB.
  - GPU: NVIDIA GTX 1050.

trinity ENGAGE WITH AGILE MANUFACTURING

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Overview of the module features

Task planner module provides a User Interface for production manager's interaction with the task planner in order to:

- ✓ Initialize task plans creation and evaluation parameters.
- ✓ Visually check the top 3 task plan alternatives generated by the task planner.
- ✓ Select the best alternative and save the task plan for execution in the physical environment.

trinity ENGAGE WITH AGILE MANUFACTURING

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Pre-installation Tasks

- Check ROS 1 Kinetic and Gazebo simulation engine 10 installation.
- Create the GAZEBO world for the selected use case layout.
- Launch GAZEBO world file and robot resources with the corresponding ROS controllers.
- Add the "Pick", "Place" and "Navigation" frames in ROS TF tree to be used for objects' manipulation in the simulated environment.

trinity ENGAGE WITH AGILE MANUFACTURING

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Installation Procedure

1. Receive Task Planner module docker image project from LMS.
2. Set your account cridentials to build the docker image as received by LMS under the main gradle.properties file.
3. Place Task Planner docker image project in linux home folder.
4. Connect to internet.
5. Build received project for Docker. The commands that should be executed in a linux terminal to build the task planner module are presented in the next slide.

trinity ENGAGE WITH AGILE MANUFACTURING

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Installation Procedure

Step	User	Command to execute	Remarks
1	Linux user	cd task_planner_parent	
2	Linux user	sudo ./gradlew clean	
3	Linux user	sudo ./gradlew war	
4	Linux user	sudo ./gradlew installDist	
5	Linux user	sudo ./gradlew docker_system_trinity:prepareForDockerImage	In case of building errors try to execute again commands 3,4 and 5. In case that the errors still exist, contact product provider for support.
6	Linux user	sudo ./gradlew copyInstallToExternalDirectory	

trinity ENGAGE WITH AGILE MANUFACTURING

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Database

- Edit an excel file about:
  - The available resources for tasks' allocation to be used by the task planner.
  - Which resources are capable to execute each task and how many time the operator need to execute these tasks in the current manual assembly operation.
  - The "Pick", "Place" and "Navigation" frames to be used by the task planner for tasks' simulated execution and validation.
- Edit a Java file by adding the actions for each human and robot task to be used during the task planning process. In each action, the "Pick", "Place" or "Navigation" frame to be used as reference for mobile robots' navigation or fixed robots' motion is defined.

trinity ENGAGE WITH AGILE MANUFACTURING

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Systems

Installation done by user administrator.

Configuration

Configure task planner ROS action servers based on the MoveIt configuration files used and the "Pick", "Place" and "Navigate" frame defined in the excel and json files by the user.

trinity ENGAGE WITH AGILE MANUFACTURING

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

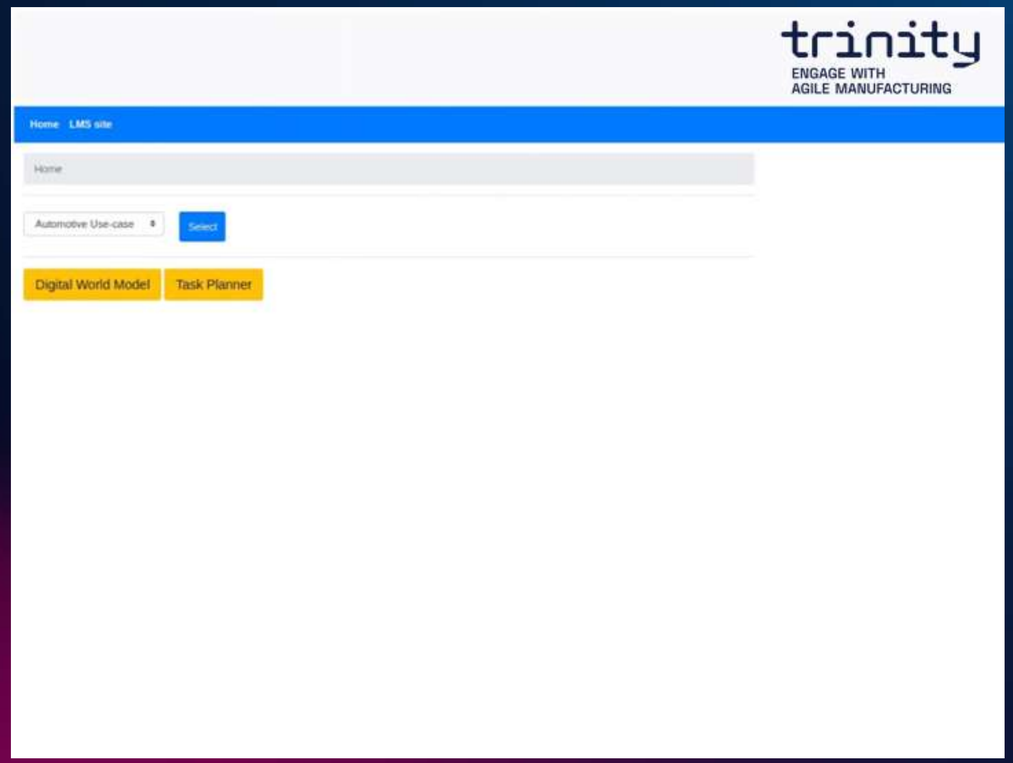
Execution

1. Prepare ROS environment for the task planner.
    i. Launch GAZEBO simulator with the required .world file and resources (Human, Robots).
    ii. Launch robots' ROS controllers and MoveIt for robots' motion planning.
    iii. Launch a list of action servers for communication between the GAZEBO simulator and the Task Planner module.
    iv. Launch ROS nodes for assembly actions' execution time duration calculation.
    v. Launch GZWeb on http://127.0.0.1:65200.

trinity ENGAGE WITH AGILE MANUFACTURING
The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Execution

1. Start the task planner with running the following commands in linux terminal:
    1. cd task_planner_parent/docker_system_trinity/build/docker
    2. sudo docker-compose up --build --remove-orphans --force-recreate
2. Fill the database of the task planner module with the required data for planning.
    1. cd ~/task_planner_parent
    2. ./gradlew data_entry_trinity:run
3. CONTROL + C to close the data entry script.
4. Open a web browser (Chrome, Firefox etc.) and go to: http://127.0.0.1:8081/taskPlanner



The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Execution

5. Go to "Digital World Model" tab to check the loaded data of the Digital World model.

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

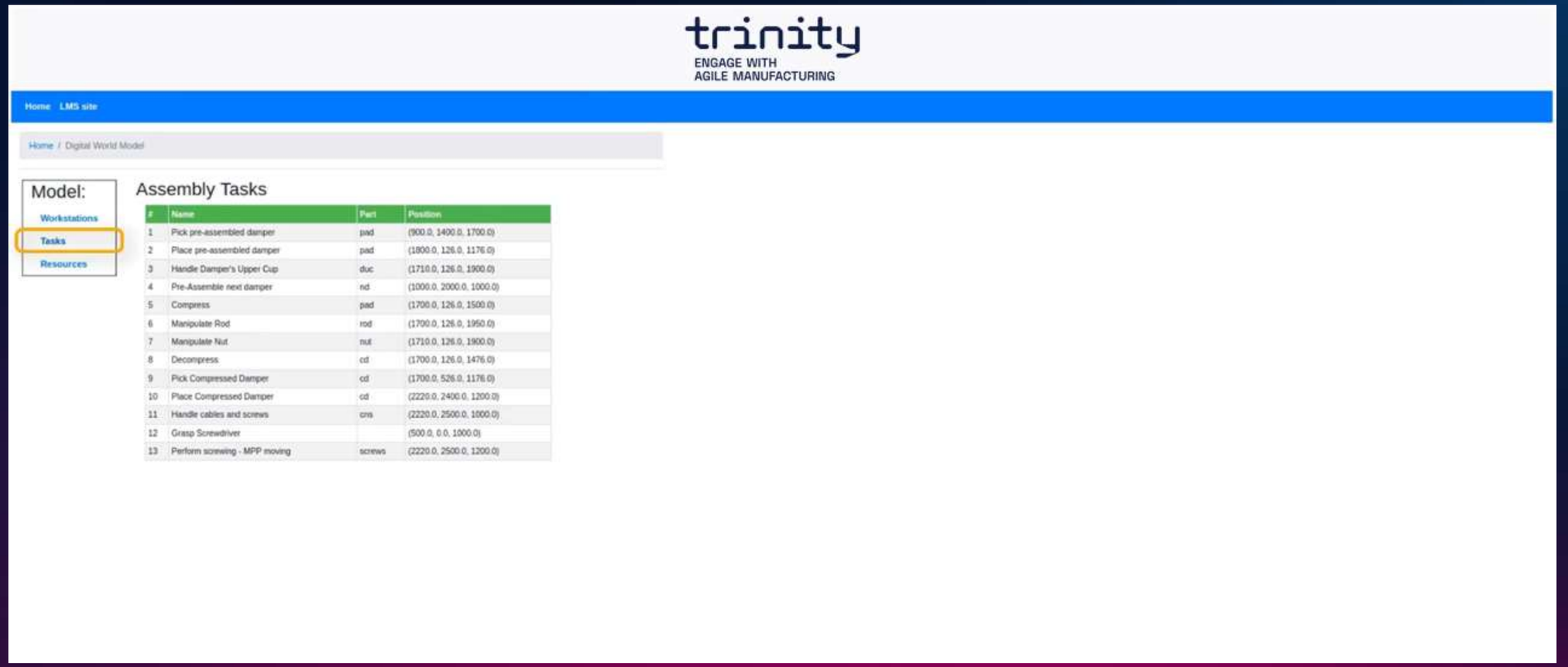
Execution

6. Go to "Workstations" tab to check the loaded data about the available workstations.

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Execution

7. Go to "Tasks" tab to check the loaded data about the assembly tasks.



trinity ENGAGE WITH AGILE MANUFACTURING

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Execution

8. Go to "Resources" tab to check the loaded data about the available resources.

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

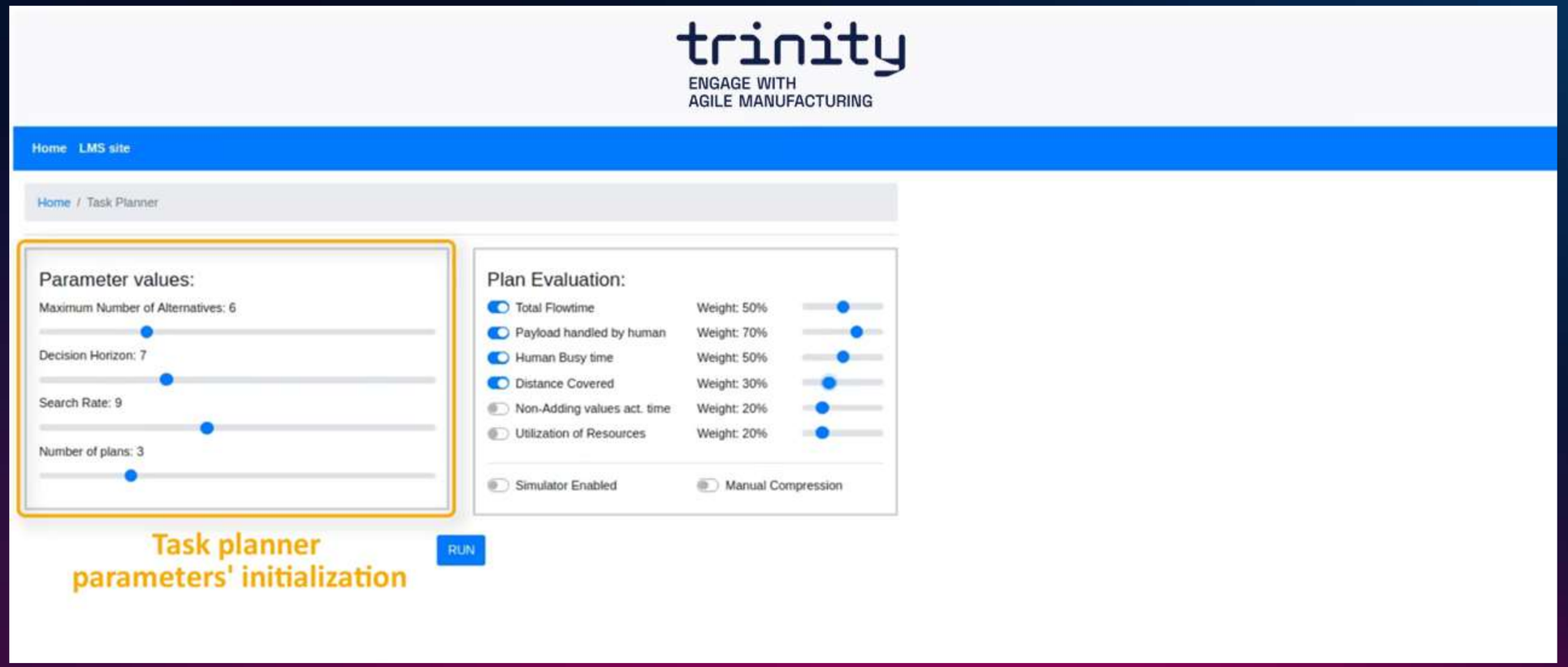
Execution

9. Go to back to the starting page and navigate to "Task Planner" tab to initialize the task planner module and check the planning results.

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Execution

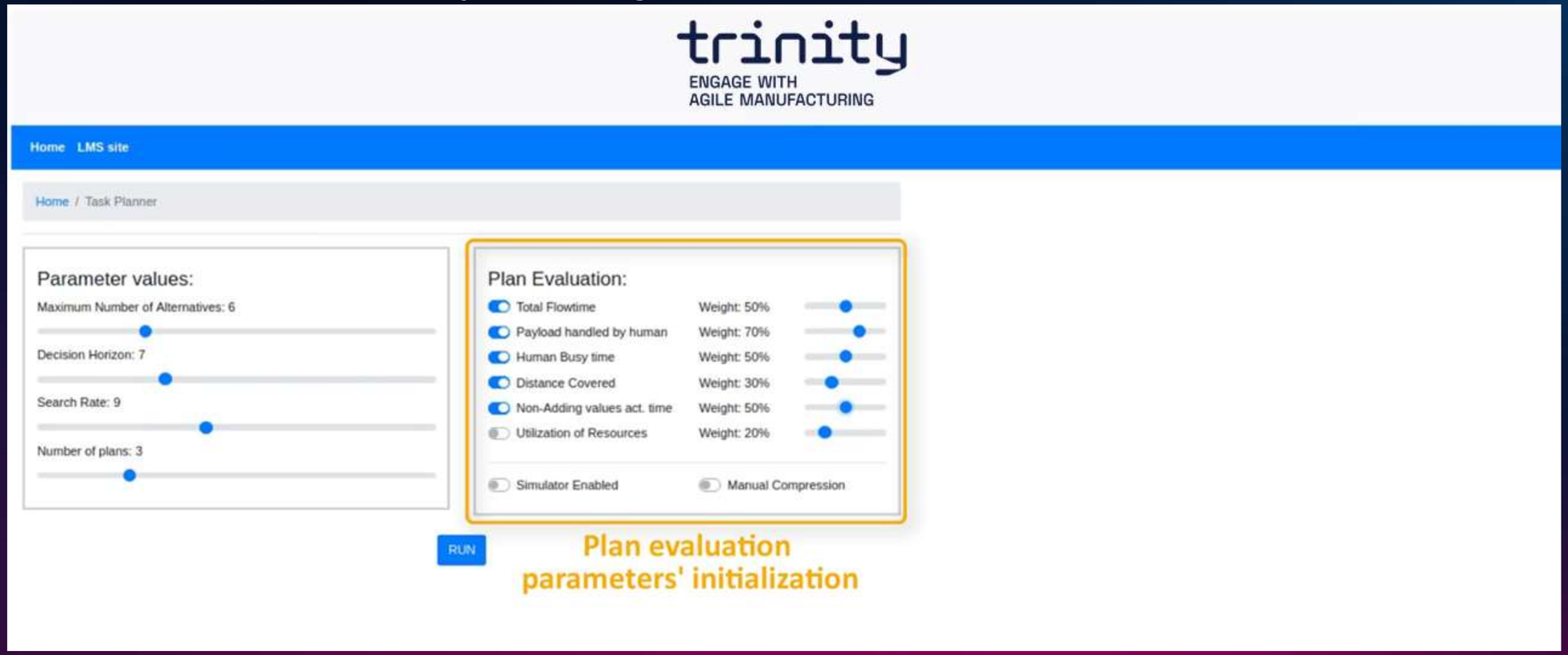
10. Initialize the task planning parameters' values. More infromation for each parameter will be provided by LMS together with the Task Planner module.



The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Execution

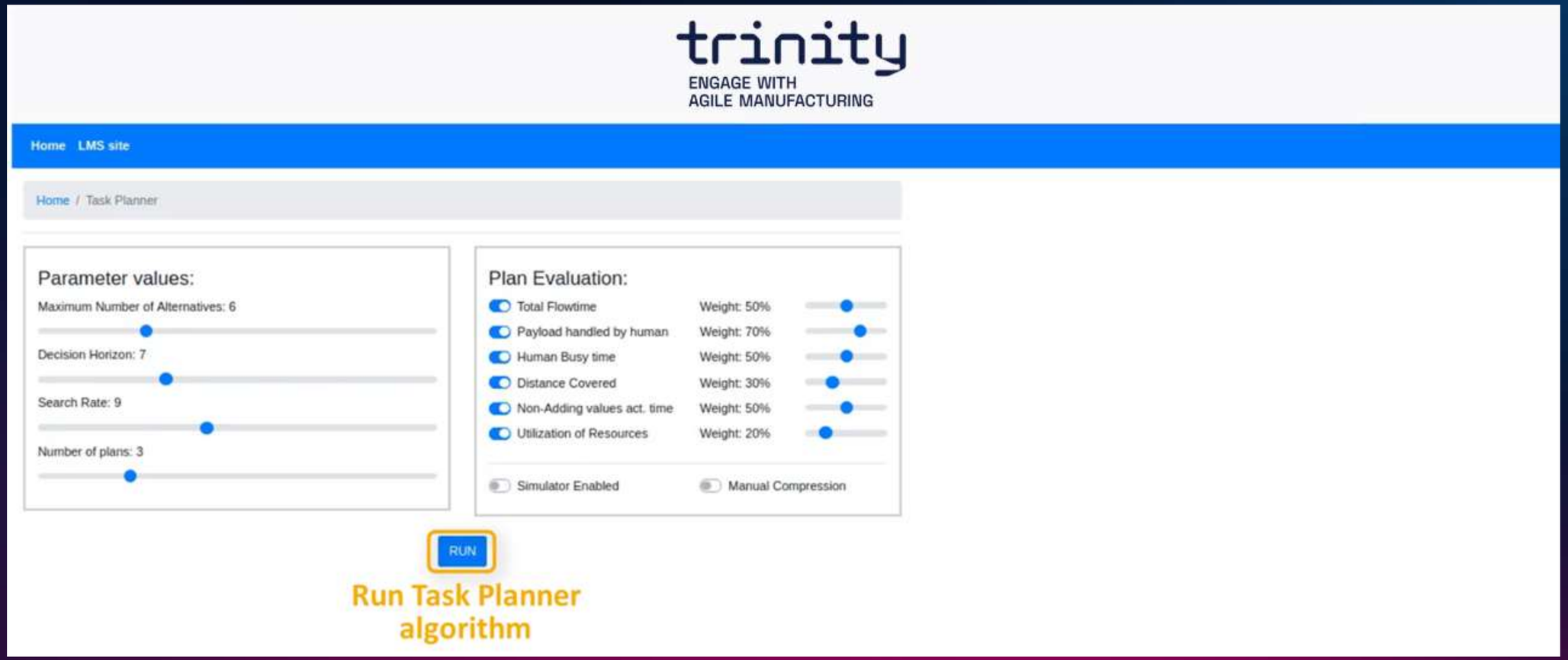
11. Initialize the task planning evaluation parameters' values. More infromation for each parameter to be provided by LMS together with the Task Planner module.



The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Execution

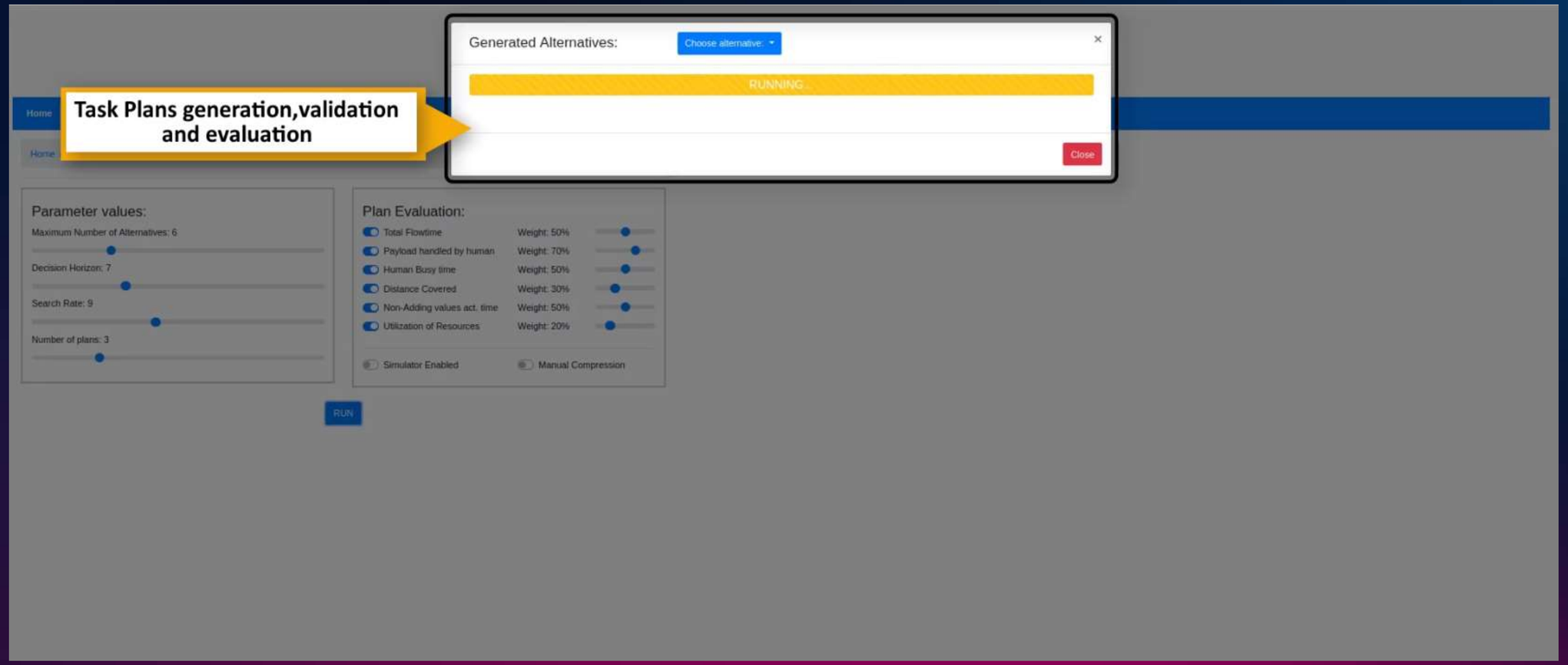
12. Start the task planner algorithm using the "Run" button.



The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Execution

13. Wait for task plans generation, validation and evaluation.

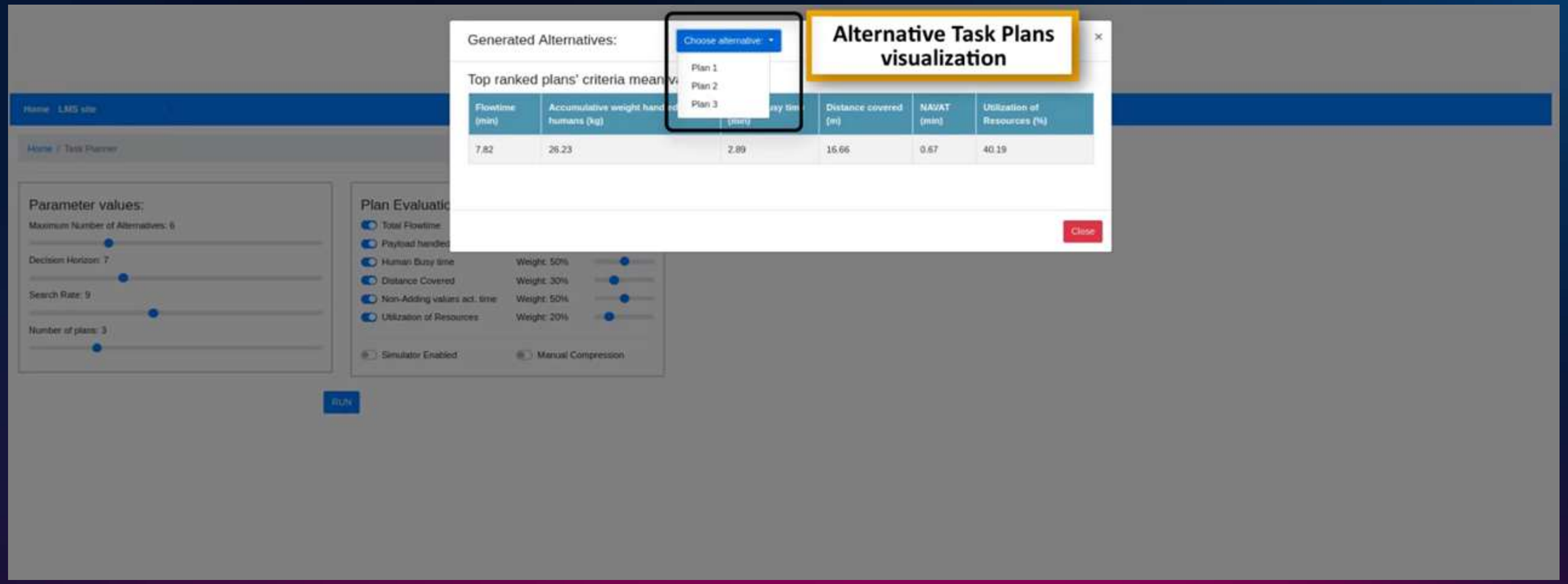


trinity ENGAGE WITH AGILE MANUFACTURING

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Execution

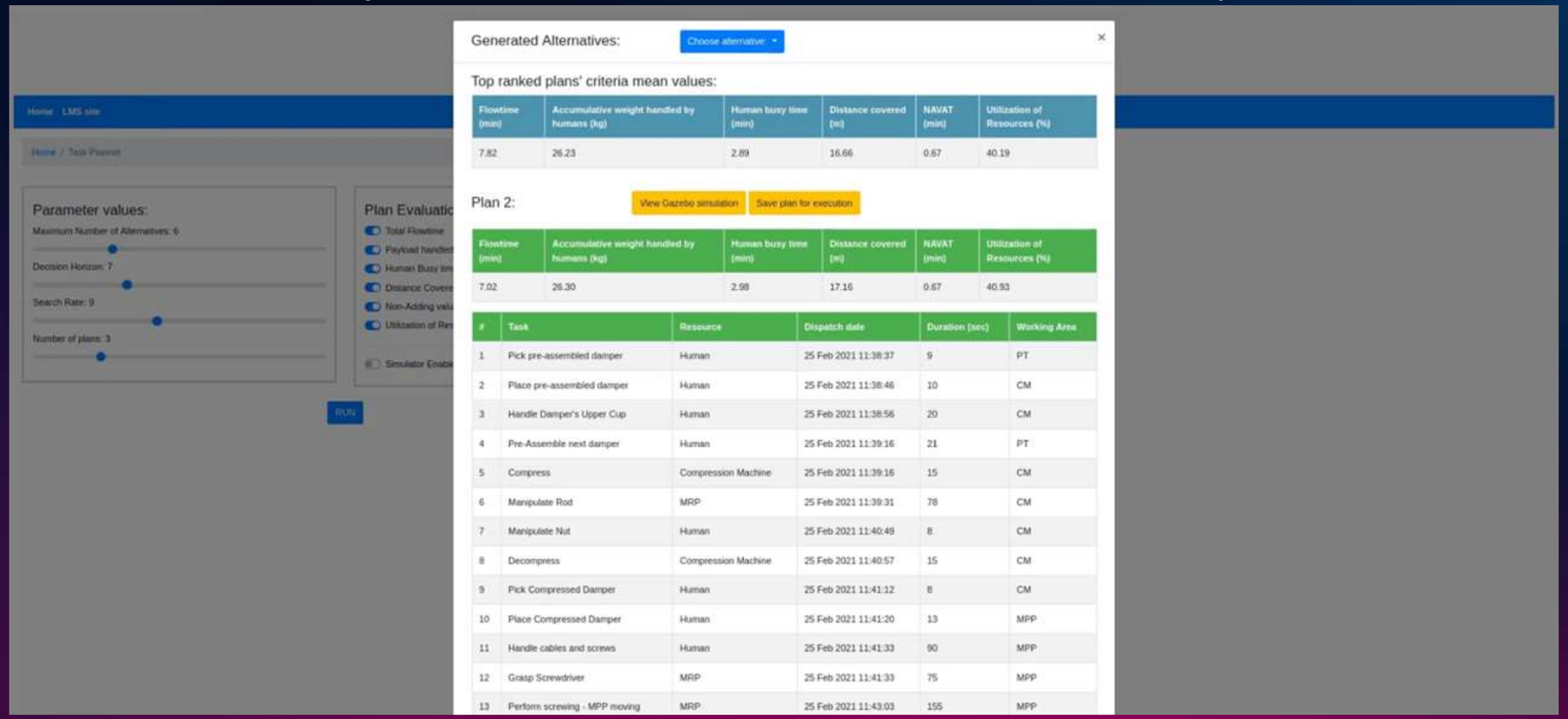
14. Use "Choose alternative" tab to view the top 3 generated alternatives.



The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Execution

15. Choose an alternative task plan to check usefull information (Flowtime, Human busy time, Distance covered by each resource, Resource Utilization etc.)

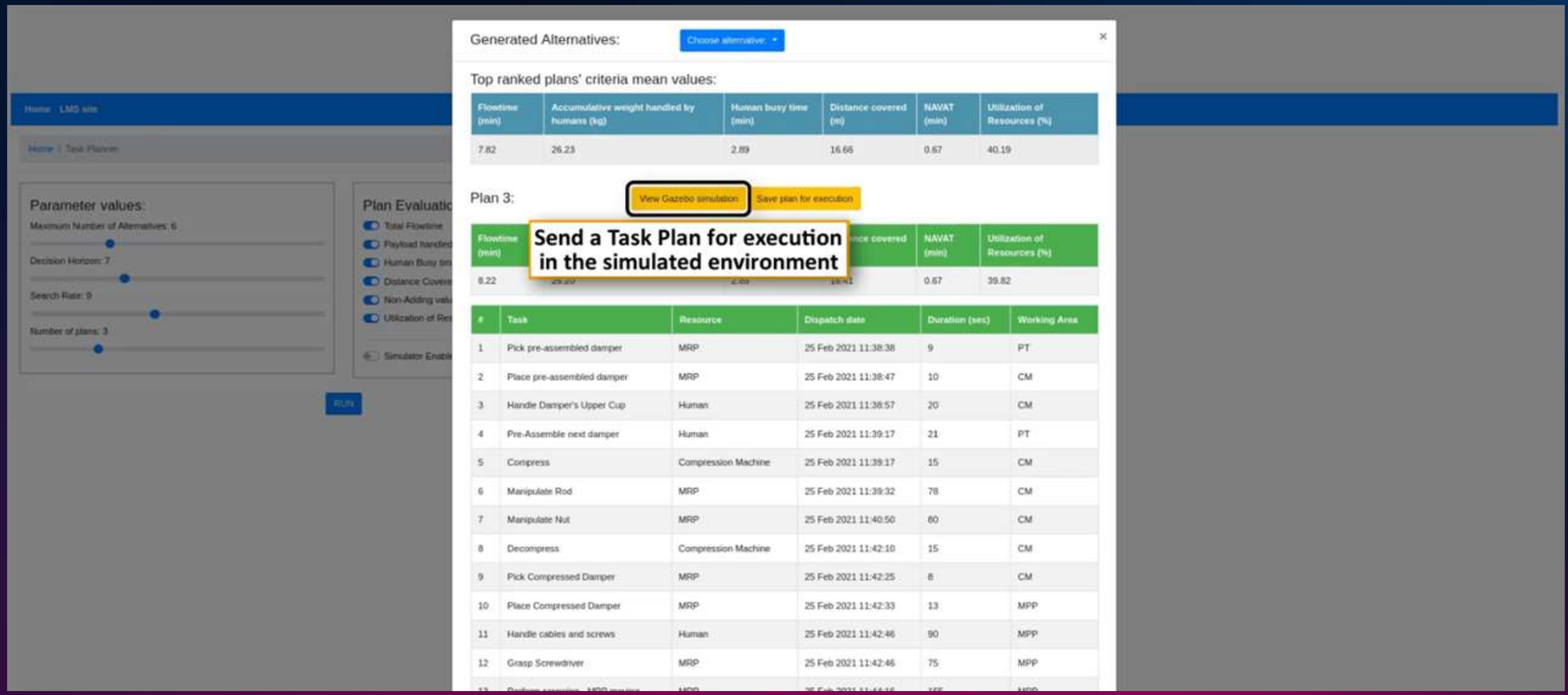


trinity ENGAGE WITH AGILE MANUFACTURING

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Execution

16. Use the "View Gazebo simulation" tab to visually check a generated task plan.

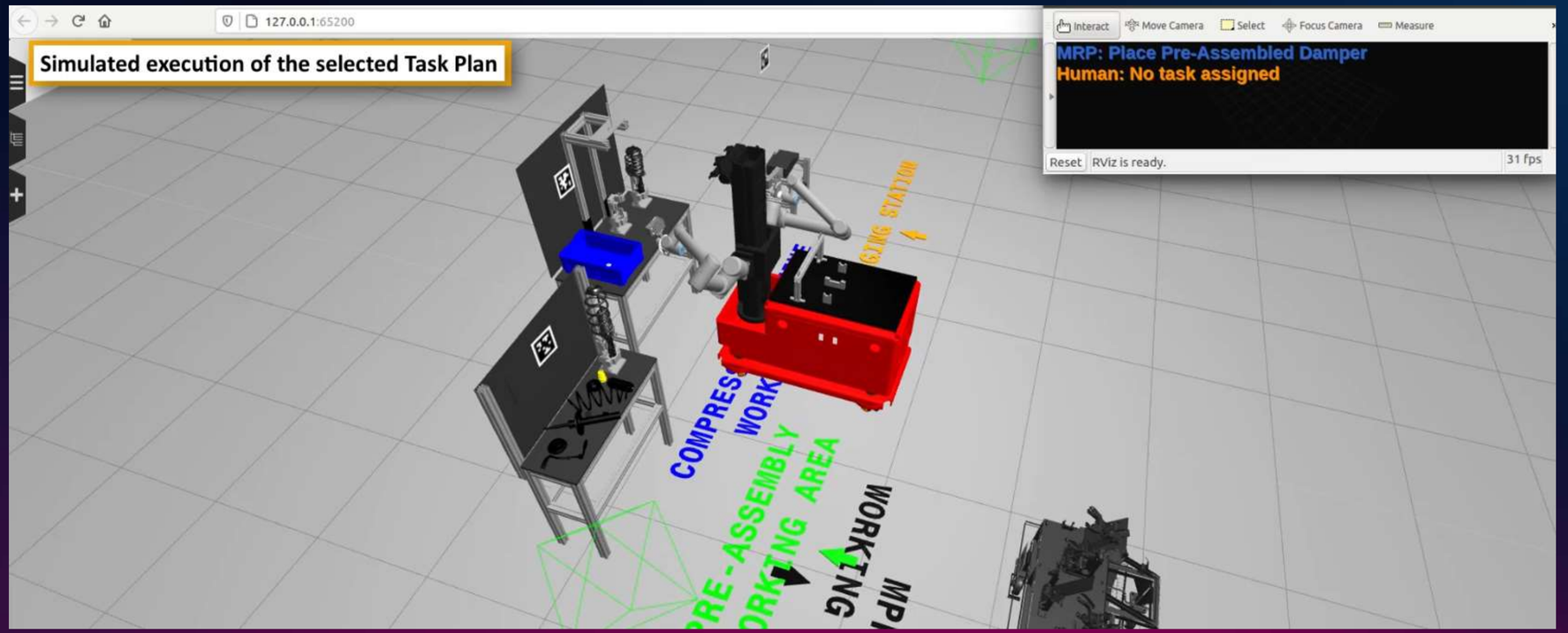


trinity ENGAGE WITH AGILE MANUFACTURING

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Execution

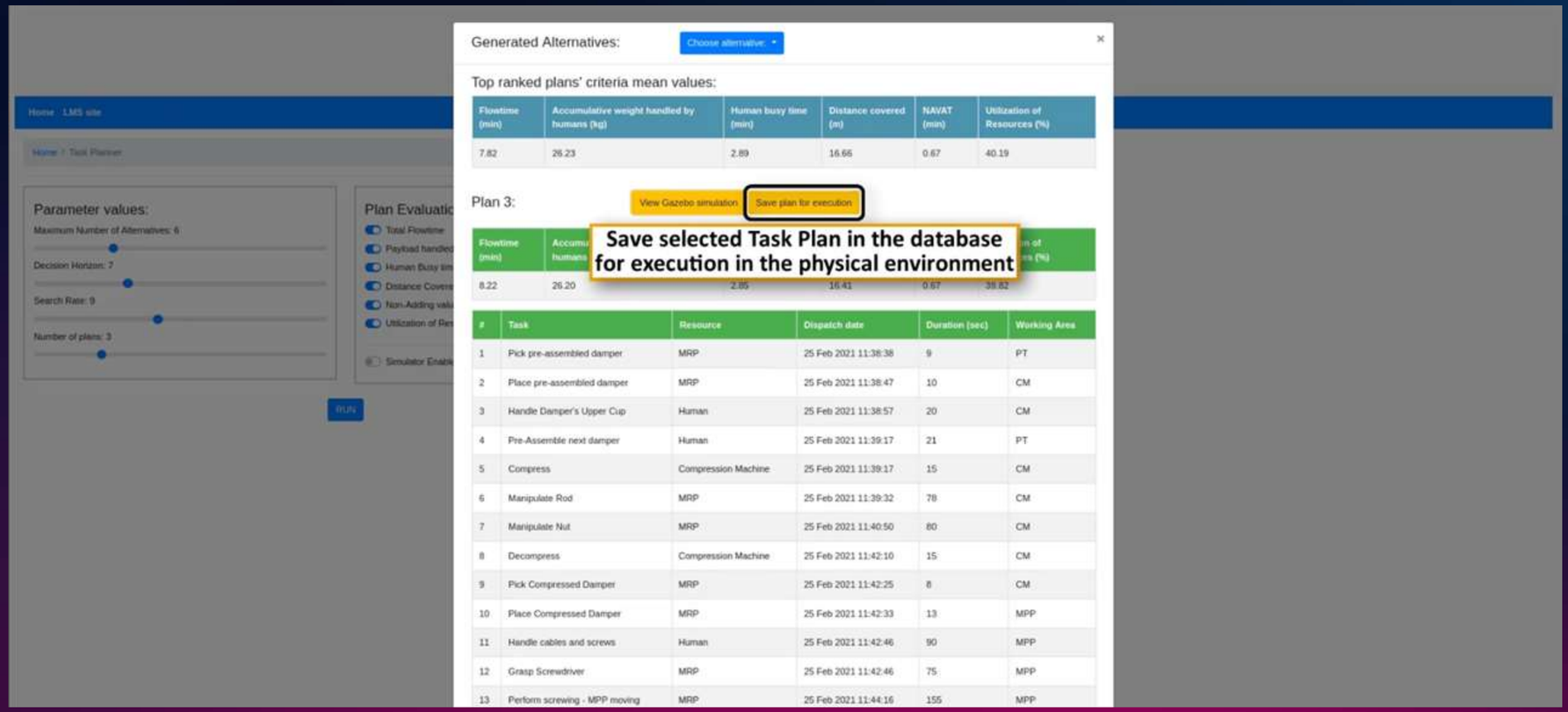
17. Visually check a generated task plan using GZWeb software.



The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Execution

18. Use the "Save plan for execution" button to save selected task plan in the database for execution in the physical environment.

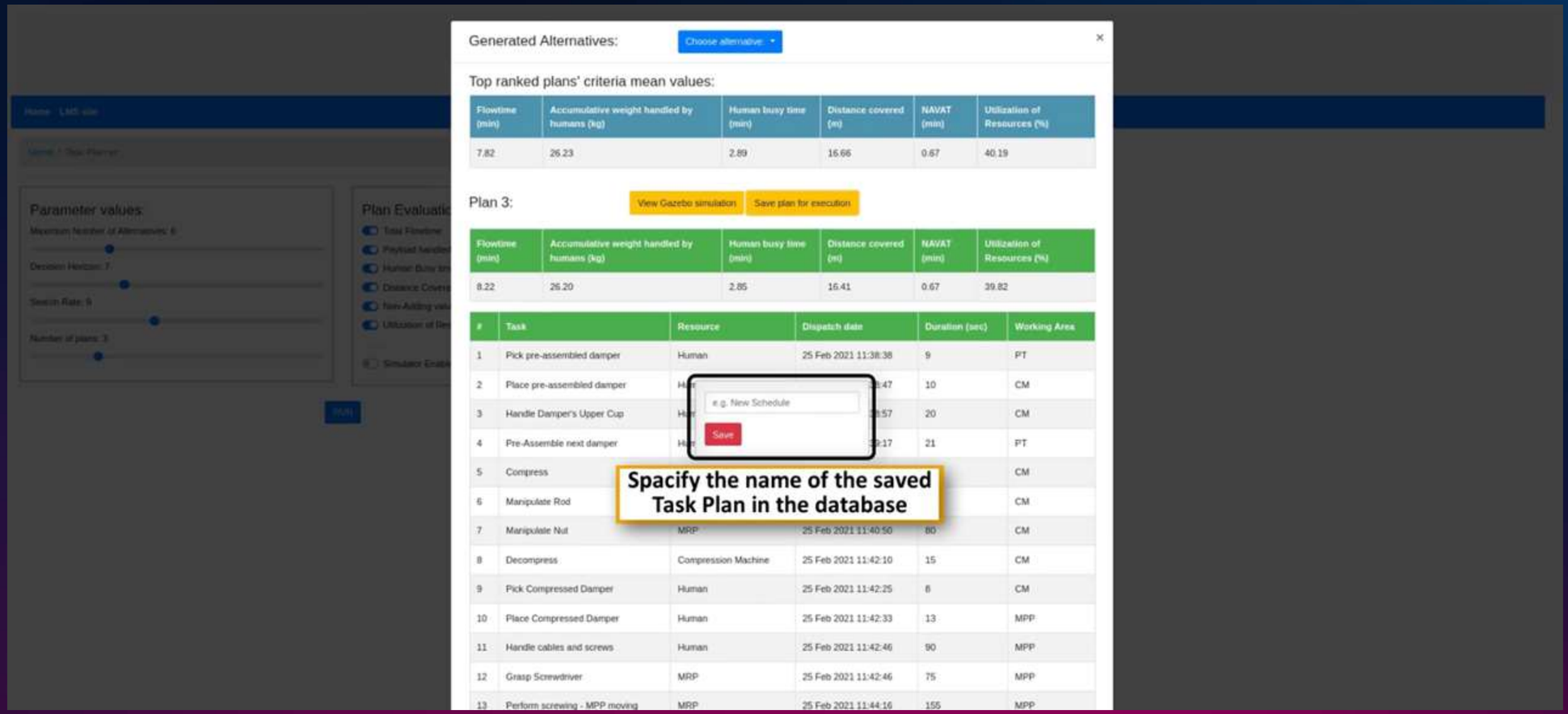


trinity ENGAGE WITH AGILE MANUFACTURING

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Execution

19. Specify the name of the saved task plan in the database.



trinity ENGAGE WITH AGILE MANUFACTURING

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

Maintenance and Error Messages and Troubleshooting

In order to restart the Task Planner module, it is required to stop and remove any previous docker images and start again the Task Planner.

trinity ENGAGE WITH AGILE MANUFACTURING

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196

www.trinityrobotics.eu

@eu_trinity

@TRINITY Robotics DIHs

trinity

Thank you!

Sotiris Aivaliotis (LMS)
saival@lms.mech.upatras.gr

info@trinityrobotics.eu

The TRINITY project has received funding from the European Union's Horizon 2020 research and innovation programme under the GA 825196