



**CRISIS - Project Main Output O.T2.1**

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**Output Title: ICT platform for monitoring and hazardous materials' transportation**

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12/2023





Summary

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## 1 INTRODUCTION

The main output of the CRISIS project is an ICT Platform for monitoring and supporting decision-making regarding hazardous materials' transportation in the area. The system developed, considers weather conditions (waves and wind), quay and ship structure, protected marine areas and traffic conditions when assigning berths and the shortest navigation route. This innovative solution takes safety into account not only in the definition of the applied algorithms, but also in the implementation of the best solution and during the execution of operations. The platform assists stakeholders in allocating ships to berths and routing shipments, minimizing transport risks, ensuring environmental sustainability (safety in marine protected areas) and worker safety, using real-time numerical simulations for all procedures.

## 2 CRISIS: User Interface

The URL for accessing the CRISIS project platform is: <https://crisis.innovativeprojects.eu:30001/>

Username: test

Password: test

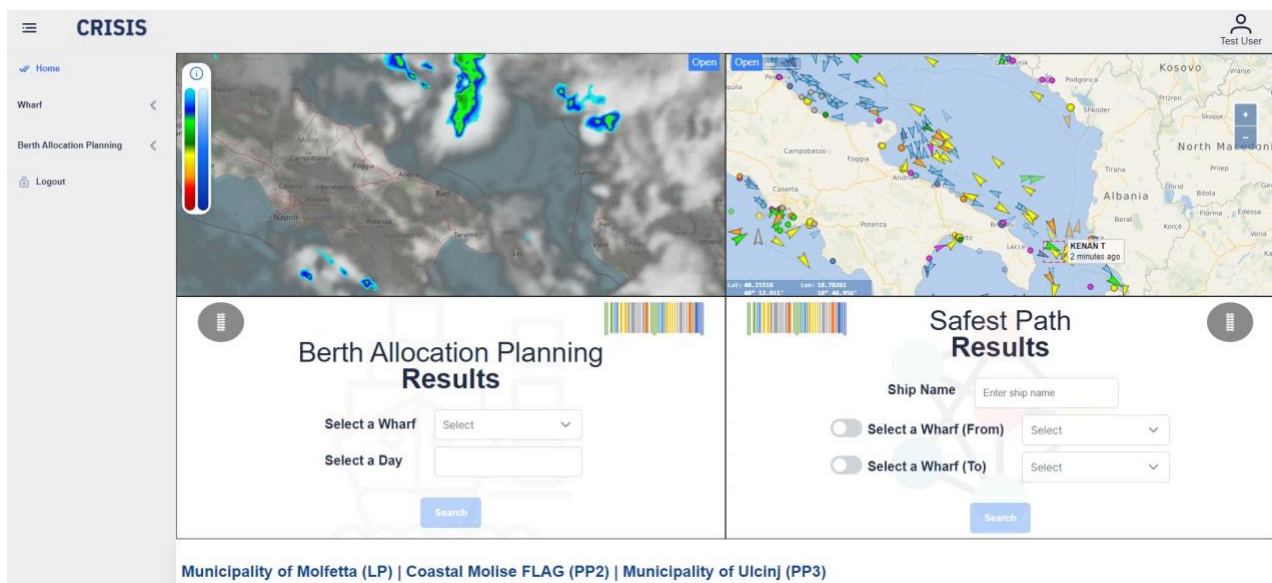
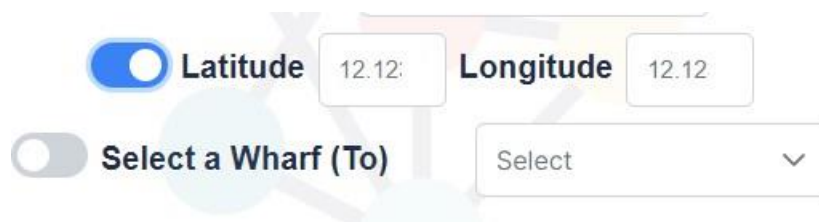


Figure 1: Home page

The online platform home page contains a dashboard with four panels, useful to have a global insights on the maritime traffic and ports.

- The top left quadrant contains information about the current weather, centered on the domain of interest
- The top right quadrant shows the current maritime traffic in the desired area. Clicking on a ship in this quadrant there is the possibility to show the real-time track of the selected ship until the current time.
- The bottom left quadrant allows the user to quick search for a specific Berth Allocation planning for a wharf
- Finally, the bottom right quadrant allows a user to query the suggested safest path given the starting and ending points. These points may be a specific wharf from those registered on the platform or a coordinate. It is possible to select the point type by toggling the switch.



*Figure 2: Toggling switch to change point type*

After a short time since the path planning request, a toast will appear in the lower-right part of the screen to alert the user that results are available. Clicking on the toast, the following pop up appears:

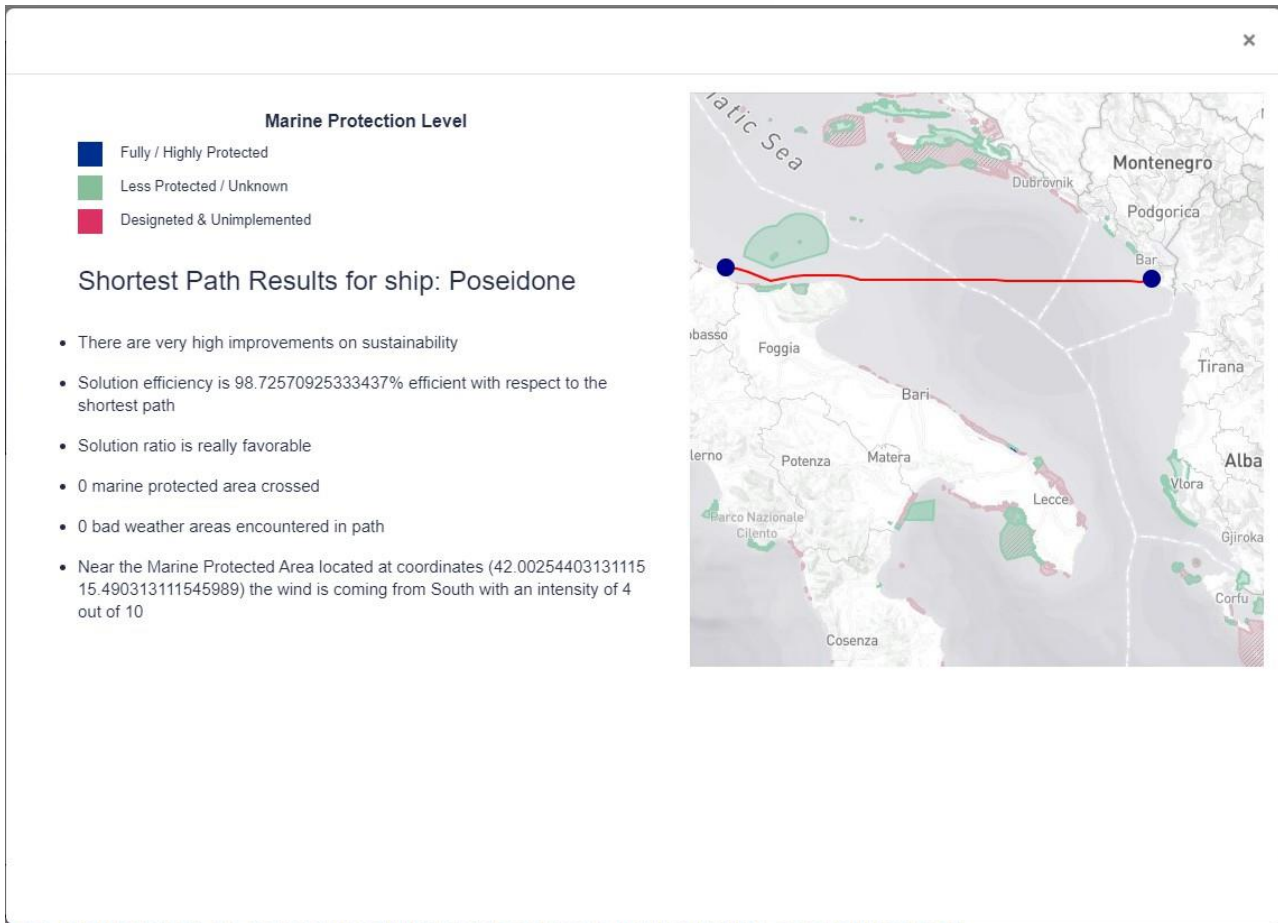


Figure 3: Ship safest path results interface

The previous interface sums up the results from shortest safe path algorithm. The core of the result is the map showing the trajectory a ship should follow to reduce the risk of encountering bad weather or marine protected areas. The shown map has colored zones, which indicate marine protected areas, whose color corresponds to the legend shown on the top-left of the window. Just below the legend there are annotations produced by the DSS, indicating how the suggested path improves sustainability (reducing pollution risks, especially in marine protected areas), as well as the percentage of efficiency with respect to a time-optimal solution.

Moving on the left part of the screen, a sidebar menu on the home page allows the user to seamlessly navigate into detailed features of the platform.



Figure 4: Wharf submenu

By clicking on the wharf label, a submenu opens showing two features. The first one is the creation of a wharf, allowing the user to insert wharf information such as its name, specific safety entrance times ( in minutes, based on the wharf regulation), its coordinate and its structure (berthing points and safety scores assigned to them)

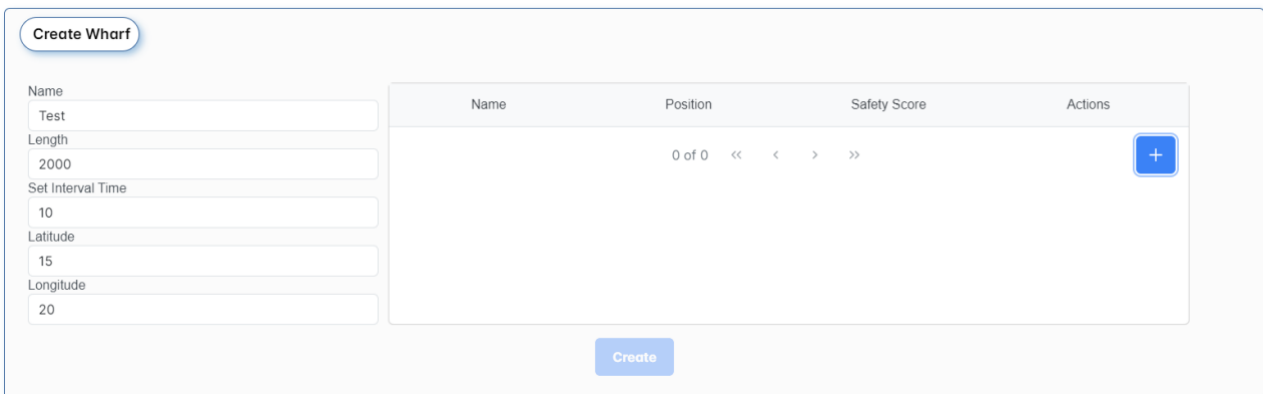


Figure 5: Wharf creation interface

Once fields on the left are populated, the blue “+” button become available, allowing the user to insert berthing points inside the specific pop up. Berth position is based on the position (in meters) from the entrance of the wharf, while the safety score is based on a wharf’s structure assessment, including protection from both strong winds, waves and/or extreme weather conditions.

### Create Berth Point ×

Name

Position

Safety Score

Add

Figure 6: Berthing Point pop-up form

Upon successful creation, the wharf will be available in the wharf list interface. Here the user is able to immediately see wharf generic information:

Wharf List <span style="float: right; border: 1px solid #ccc; border-radius: 15px; padding: 2px 5px;">Search keyword</span>				
Name	Length (meters)	Interval Time (minutes)	Berth Points	Actions
Bari	2000	30	👁️	✎️ 🗑️
Ulcinj	1500	10	👁️	✎️ 🗑️
Termoli	1500	10	👁️	✎️ 🗑️
Molfetta	2000	30	👁️	✎️ 🗑️

Showing 1 to 4 of 4 entries << < 1 > >> 10 ▾

Figure 7: Wharf List Interface

By clicking on the eye symbol in the Berth points column it is possible to see the list of berthing points for the corresponding wharf, whereas by selecting the pencil icon it is possible to modify wharf information previously inserted into the systems. Finally, the bin icon allows you to delete a wharf.

**Edit Wharf** x

Name  
Bari

Length  
2000

Set Interval Time  
30

Latitude  
41,13628262298635

Longitude  
16,85865432488174

Name	Position	Safety Score	Actions
A	0	5	<a href="#">✎</a> <a href="#">✕</a>
B	500	3	<a href="#">✎</a> <a href="#">✕</a>
C	1000	8	<a href="#">✎</a> <a href="#">✕</a>

1 of 2 << < 1 2 > >> +

Figure 8: Wharf modification interface.



By clicking on the “Berth Allocation Planning” label on the side menu, instead, the BAP submenu opens:

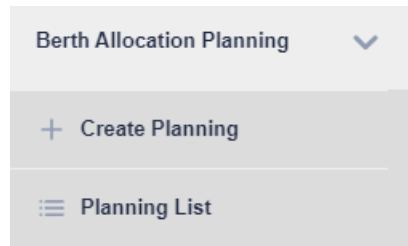
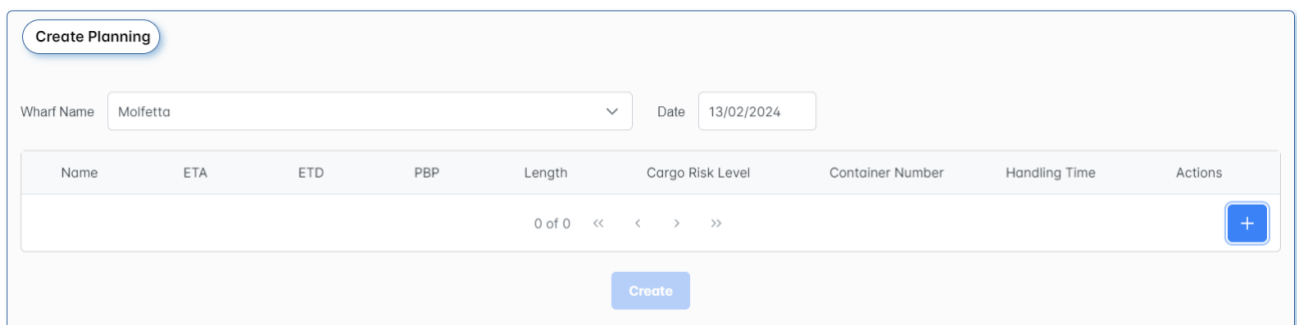


Figure 9: BAP Submenu

By clicking on “Create Planning” the planning interface opens:



The screenshot shows the "Create Planning" interface with the following elements:

- A "Create Planning" button at the top left.
- Input fields for "Wharf Name" (set to "Molfetta") and "Date" (set to "13/02/2024").
- A table with columns: Name, ETA, ETD, PBP, Length, Cargo Risk Level, Container Number, Handling Time, and Actions.
- A pagination bar showing "0 of 0" and navigation arrows.
- A blue "+" button in the bottom right corner of the table area.
- A "Create" button at the bottom center.

Figure 10: BAP planning creation interface

This interface requires the user to select an existing wharf and a date, starting from the current day. After selecting the two information, the blue “+” button becomes available, allowing the user to insert the list of ships that will berth at the selected wharf for the selected day.

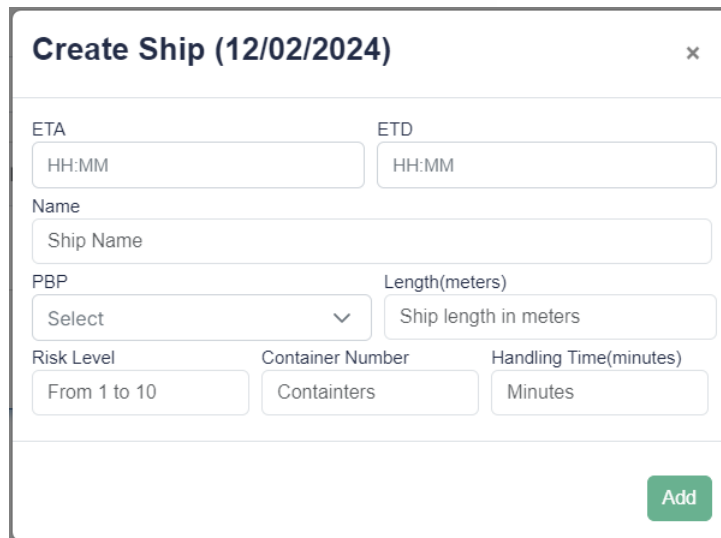
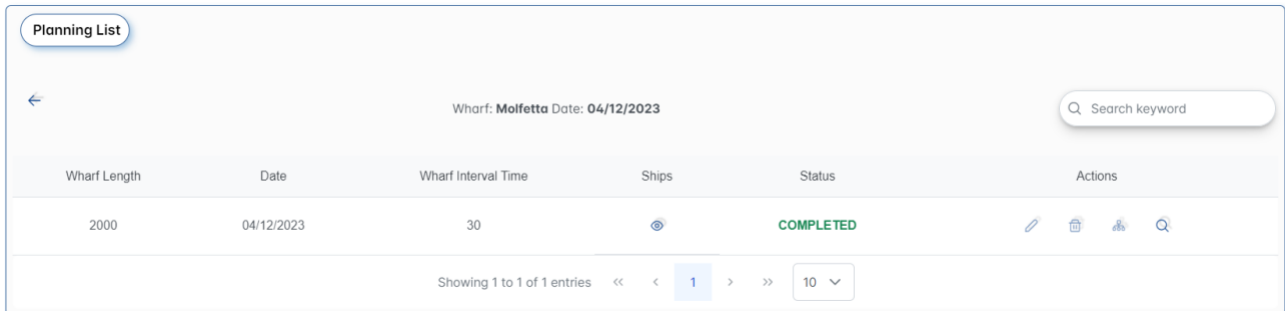


Figure 11: Pop-up form for ship insertion

For each inserted ship, the following information are required:

- **ETA:** Expected Time of Arrival, meaning the estimated arrival time for the ship. ETA should be greater than current time
- **ETD:** Expected Departure Time, meaning its estimated departure time. ETD should be greater than ETA
- **Ship Name**
- **PBP:** Preferred Berthing Point, from the list of Berthing points available at the wharf
- **Length:** length of the ship, in meters
- **Risk Level:** from 1 to 10, an assessment of risk based on type of cargo loaded on that ship. It included a series of metrics based on pollution risk, danger to marine ecosystem, environmental impact of cargo dispersion etc.
- **Container Number**
- **Handling Time (minutes):** Expected handling time for that ship, based on previously-happened bargaining between the incoming ship and the host wharf.

Once the planning request is complete, it is possible to access the planning list by selecting a specific wharf and date. The following interface will show a series of plannings for the selected wharf and date:



Wharf Length	Date	Wharf Interval Time	Ships	Status	Actions
2000	04/12/2023	30		COMPLETED	

Showing 1 to 1 of 1 entries << < 1 > >> 10 ▾

Figure 12: Planning list interface for specific wharf and date

In this interface it is possible to notice, apart from general information, a status code. It includes the following possibilities:

- **STANDBY:** The planning request is created and it is ready to be launched. While in the standby phase, the planning could be modified by clicking the pencil icon. When in standby status, it is possible to launch the DSS computing by clicking the diagram icon next to the bin one.
- **PENDING:** The planning request is delivered to DSS and the platform is waiting for results. While in pending status, all icons are disabled. When the DSS answer with a planning, a toast will appear in the bottom right part of the browser to notice the user of the results availability. By clicking the toast it is possible to check
- **COMPLETE:** The planning is complete and it is possible to browse the results by clicking the magnifying glass icon.



Figure 13: Planning Complete toast

When checking BAP results, the following plot is shown to the user:

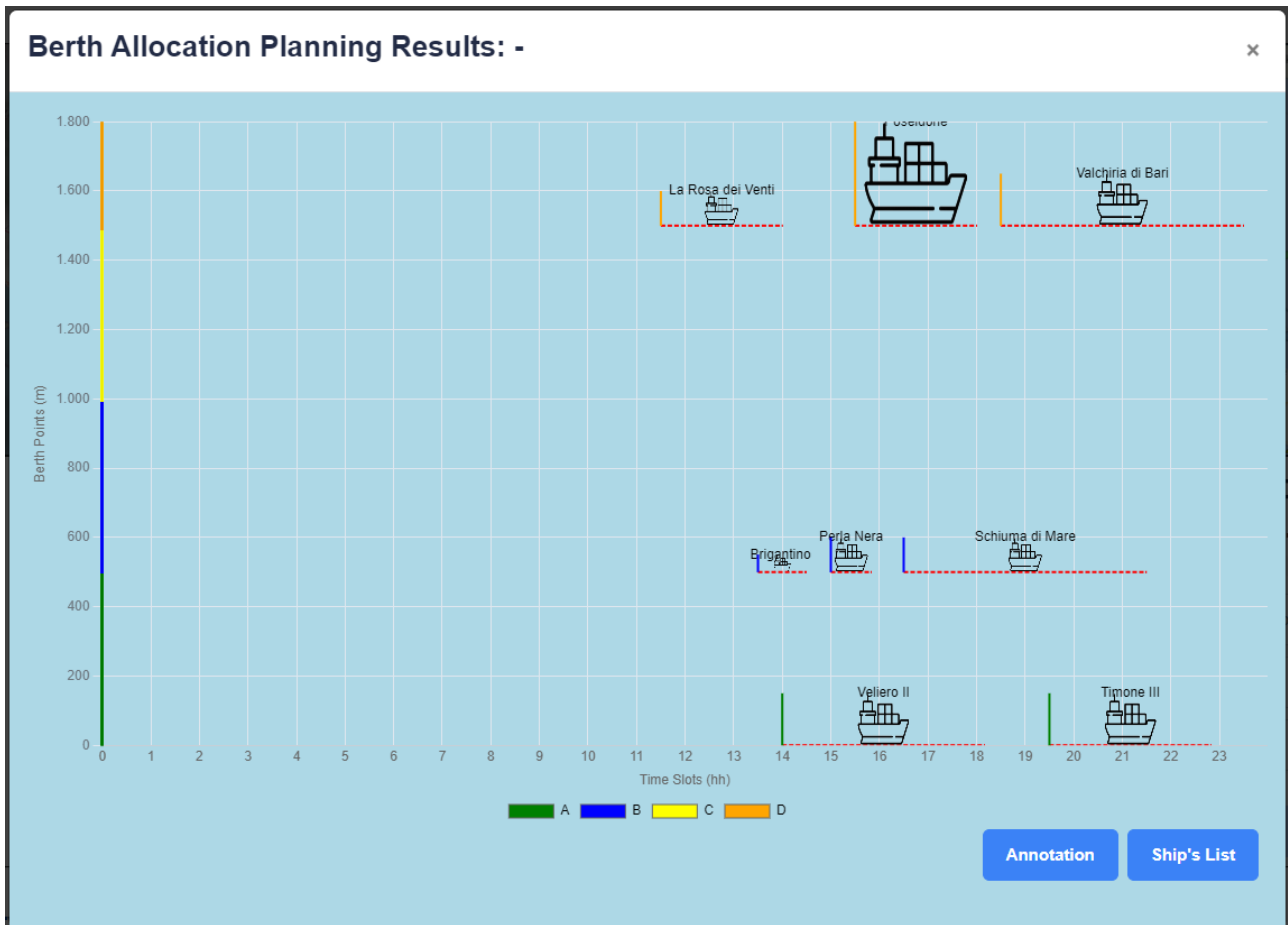


Figure 14: Planning Results for Berth Allocation

The plot shows, on the x-axis, the day hour, while in the y-axis the length of the wharf. A ship is contained in a box indicating, from the y-axis length, the space occupied in the wharf, while in the x-axis the time in which the previous space is occupied.

By clicking the ship's list button it is possible to see the planning request that produced the shown result.

Name	ETA	ETD	PBP	Length	Cargo Risk Level	Container Number	Handling Time
La Rosa del Venti	11:22	17:18	A	100	10	30	150
Perla Nera	13:21	18:21	B	100	5	10	50
Vellero II	13:54	20:20	C	150	1	50	250
Schiuma di Mare	15:20	20:20	D	100	7	40	300
Brigantino	13:21	17:21	B	50	10	5	60
Valchiria di Bari	12:22	20:22	B	150	7	60	300

Figure 15: Ship List for planning

Instead, clicking the Annotation button, it is possible to access additional information and insights about the proposed planning.

**Note**

There are exceptional improvements on sustainability

The planning preserves 29.67% efficiency compared to a time optimal solution

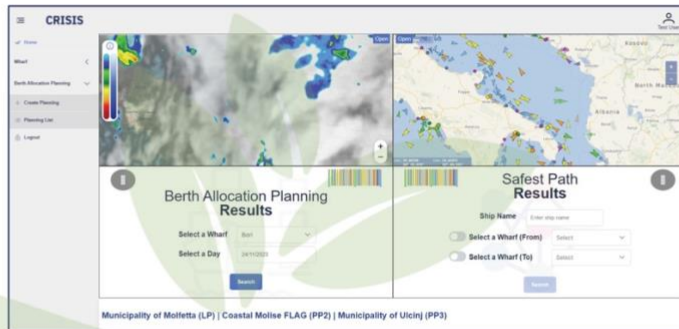
The ratio between sustainability and efficiency is exceptionally favorable

1 of 1 << < 1 > >>



### **3 ANNEX**

#### CRISIS Technological Platform Overview



Municipality of Molfetta



Coastal Molise FLAG



Municipality of Ulcinj

**CRISIS**

**Cross-border RISK management of hazardous material transportation**

<https://crisis.italy-albania-montenegro.eu>



Municipality of Molfetta



Coastal Molise FLAG



Municipality of Ulcinj



Cross-border RISK management of hazardous material transportation

Authentication & Authorization Controls

Project Platform Design & Development

WP-T1 'Data Collection and Algorithm Design'  
WP-T2 'Platform Design & Development'







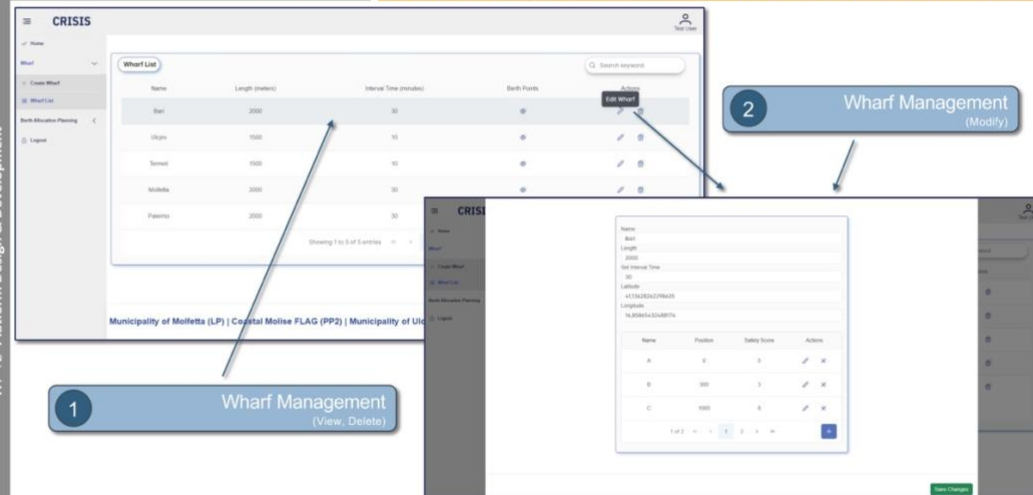
Cross-border **RISk** management of hazardous material tranSportation

**Wharfs & Berthing Points Management**

Project Platform Design & Development

WP-T1 'Data Collection and Algorithm Design'

WP-T2 'Platform Design & Development'



**1** Wharf Management (View, Delete)

**2** Wharf Management (Modify)

Name	Length (meters)	Internal Time (minutes)	Berth Points	Actions
Barb	2000	30		View, Delete, Edit Wharf
Ugento	1500	15		View, Delete, Edit Wharf
Terni	1500	15		View, Delete, Edit Wharf
Molfetta	2000	30		View, Delete, Edit Wharf
Papiano	2000	30		View, Delete, Edit Wharf



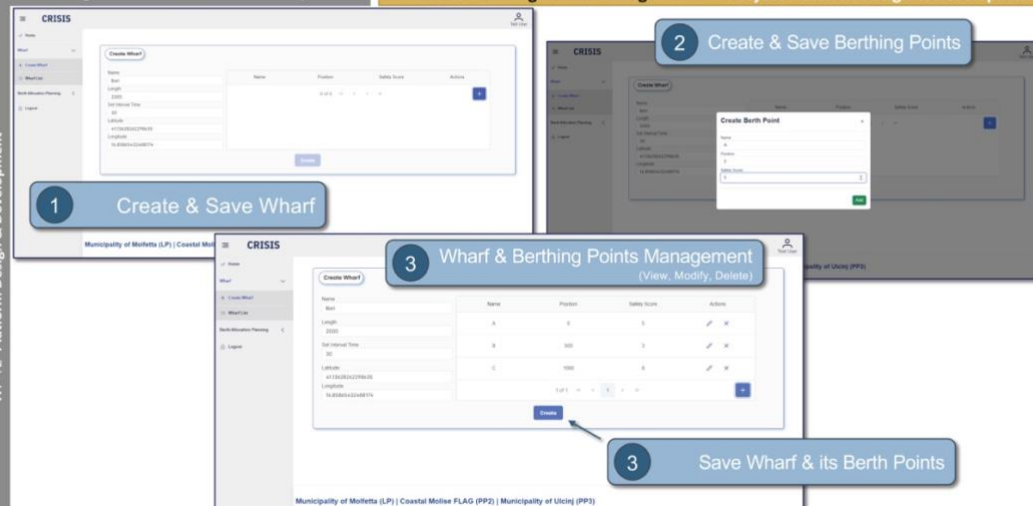
Cross-border **RISk** management of hazardous material tranSportation

**Wharfs & Berthing Points Management**

Project Platform Design & Development

WP-T1 'Data Collection and Algorithm Design'

WP-T2 'Platform Design & Development'



**1** Create & Save Wharf

**2** Create & Save Berthing Points

**3** Wharf & Berthing Points Management (View, Modify, Delete)

**3** Save Wharf & its Berth Points

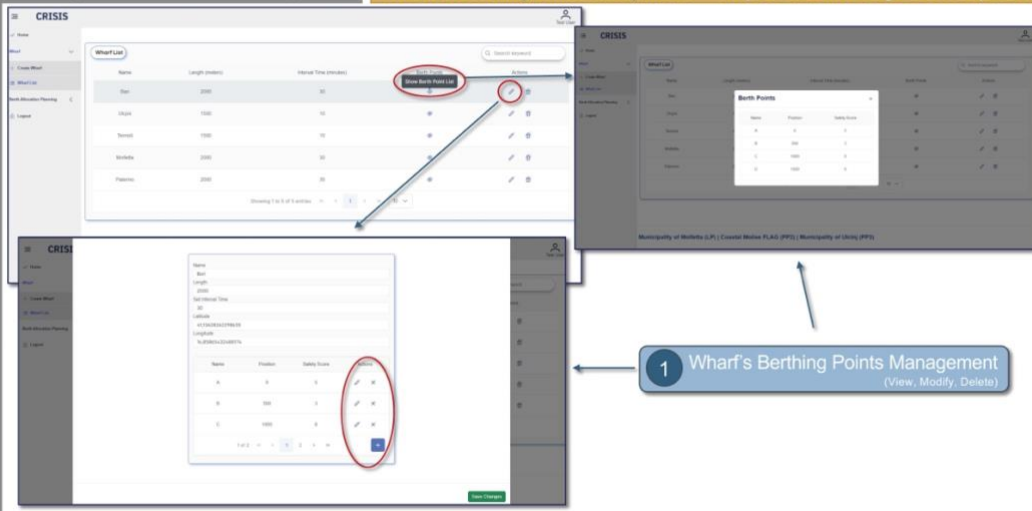


Cross-border Risk management of hazardous material transportation

Wharfs & Berthing Points Management

Project Platform Design & Development

WP-T1 'Data Collection and Algorithm Design'  
WP-T2 'Platform Design & Development'



1 Wharfs Berthing Points Management  
(View, Modify, Delete)

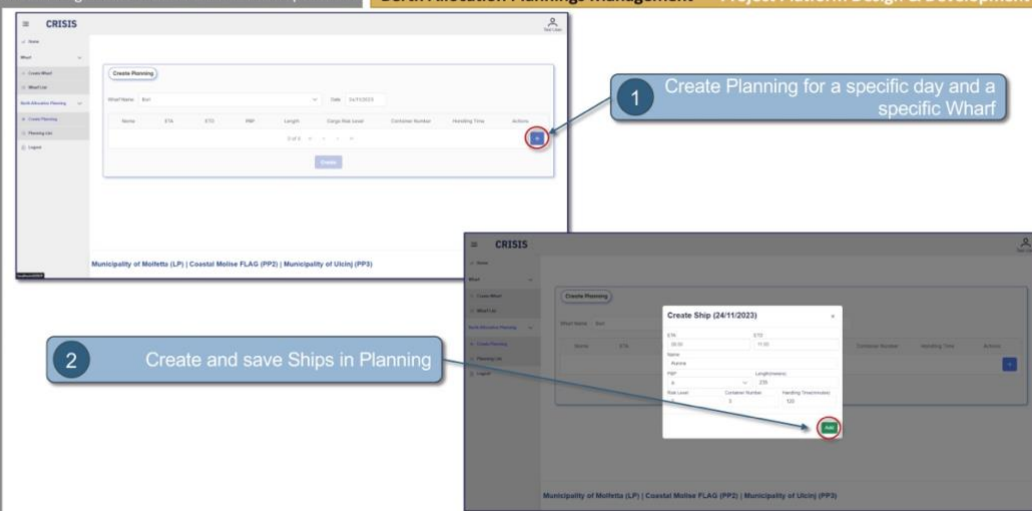


Cross-border Risk management of hazardous material transportation

Berth Allocation Plannings Management

Project Platform Design & Development

WP-T1 'Data Collection and Algorithm Design'  
WP-T2 'Platform Design & Development'



1 Create Planning for a specific day and a specific Wharf

2 Create and save Ships in Planning

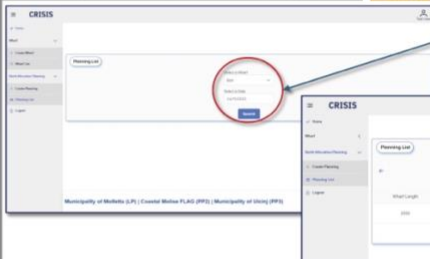


Cross-border Risk management of hazardous material transportation


Berth Allocation Plannings Management

Project Platform Design & Development

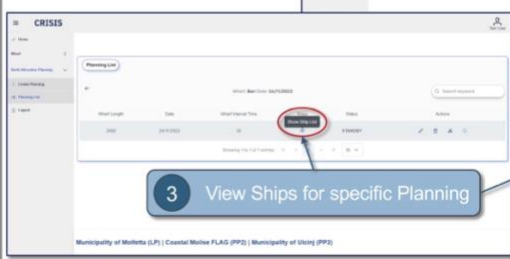
WP-T1 'Data Collection and Algorithm Design'  
WP-T2 'Platform Design & Development'



1 Search a Planning by Wharf and Date



2 View Results List



3 View Ships for specific Planning

Wharf	Date	Wharf Name	Status	Address
000	2019-03-01	00	00	00000000

Ships	Name	ETA	ETD	Size	Length	Weight	Customer Number	Handling Time
000	0000	00:00	00:00	0	000	0	0	000
000	0000	00:00	00:00	0	000	0	0	000
000	0000	00:00	00:00	0	000	0	0	000

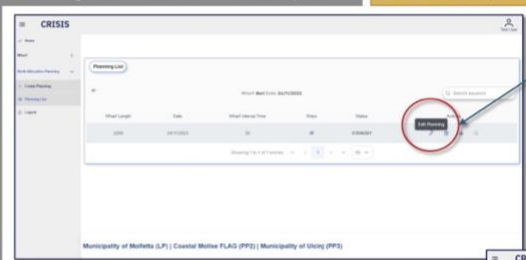


Cross-border Risk management of hazardous material transportation


Berth Allocation Plannings Management

Project Platform Design & Development

WP-T1 'Data Collection and Algorithm Design'  
WP-T2 'Platform Design & Development'

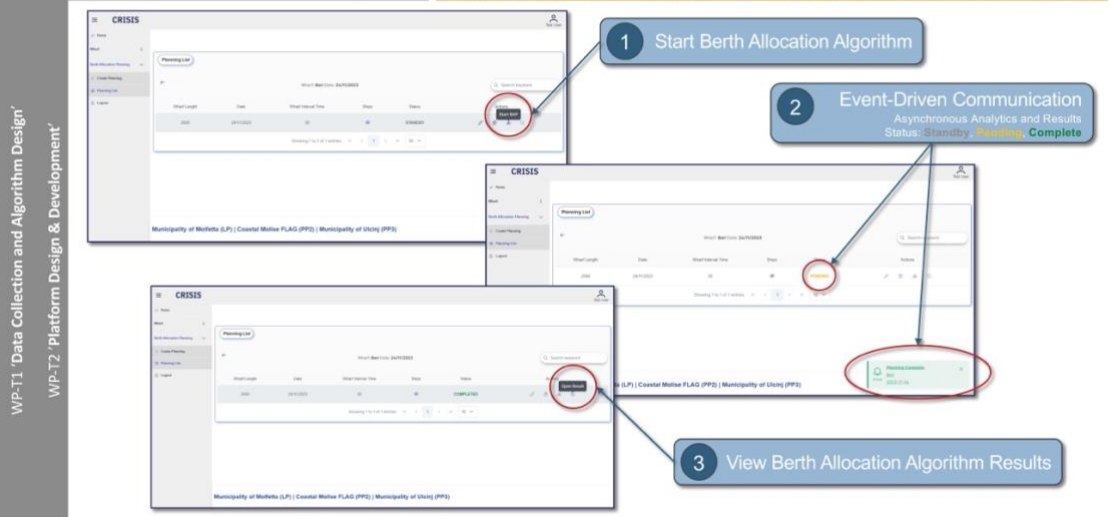


1 Edit a Planning



2 Delete a Planning

WP-T1 'Data Collection and Algorithm Design' | WP-T2 'Platform Design & Development'

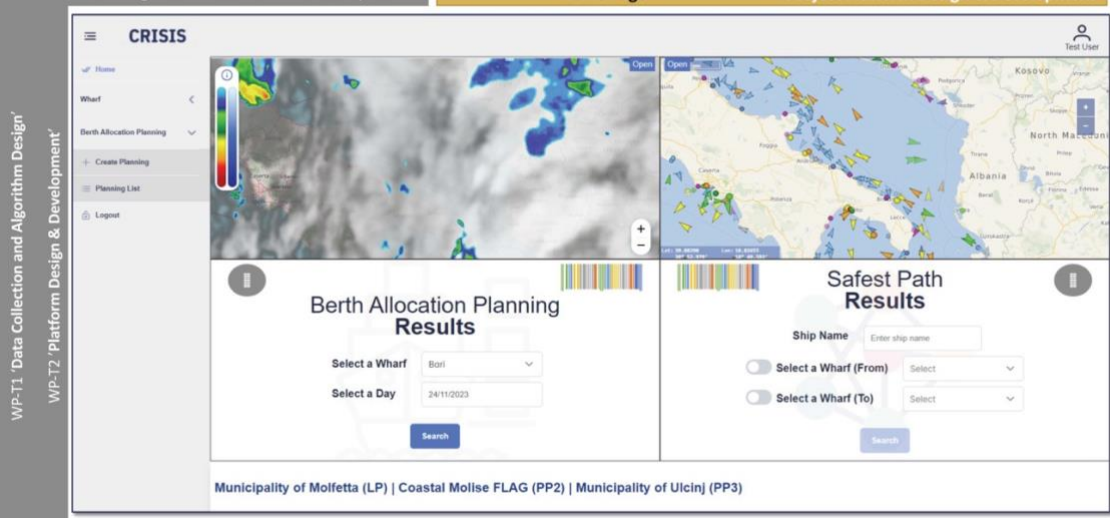


1 Start Berth Allocation Algorithm

2 Event-Driven Communication  
Asynchronous Analytics and Results  
Status: Standby, Planning, Complete

3 View Berth Allocation Algorithm Results

WP-T1 'Data Collection and Algorithm Design' | WP-T2 'Platform Design & Development'



CRISIS

Home

Wharf

Berth Allocation Planning

+ Create Planning

Planning List

Login

Test User

Berth Allocation Planning Results

Select a Wharf: Bori

Select a Day: 24/11/2023

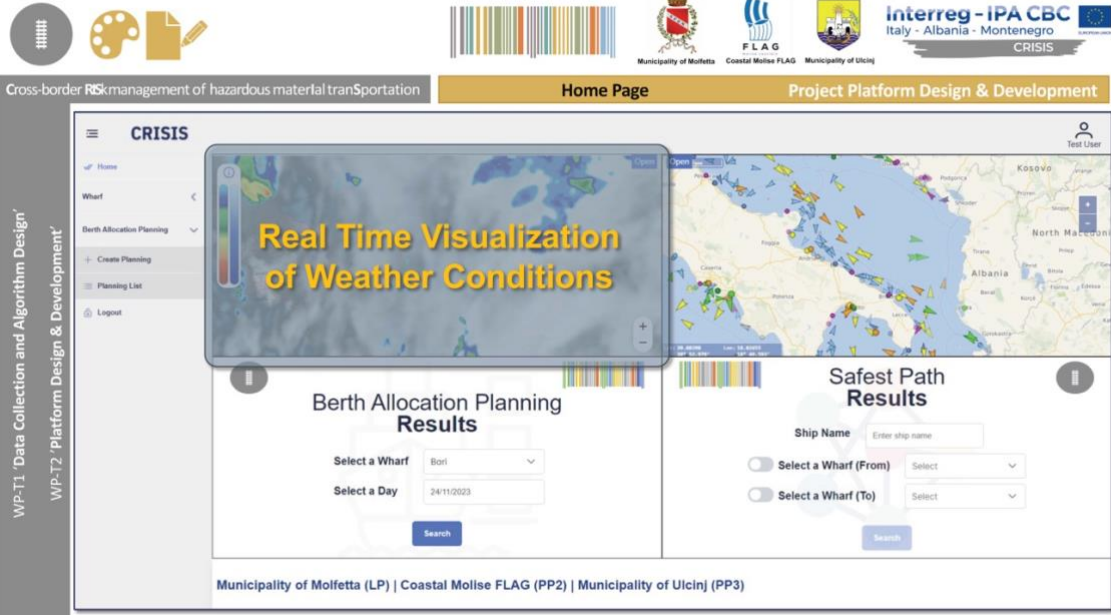
Safest Path Results

Ship Name: Enter ship name

Select a Wharf (From): Select

Select a Wharf (To): Select

Municipality of Molfetta (LP) | Coastal Molise FLAG (PP2) | Municipality of Ucinj (PP3)



Cross-border **Risk** management of hazardous material transportation | Home Page | Project Platform Design & Development

WP-T1 'Data Collection and Algorithm Design' | WP-T2 'Platform Design & Development'

### CRISIS

Real Time Visualization of Weather Conditions

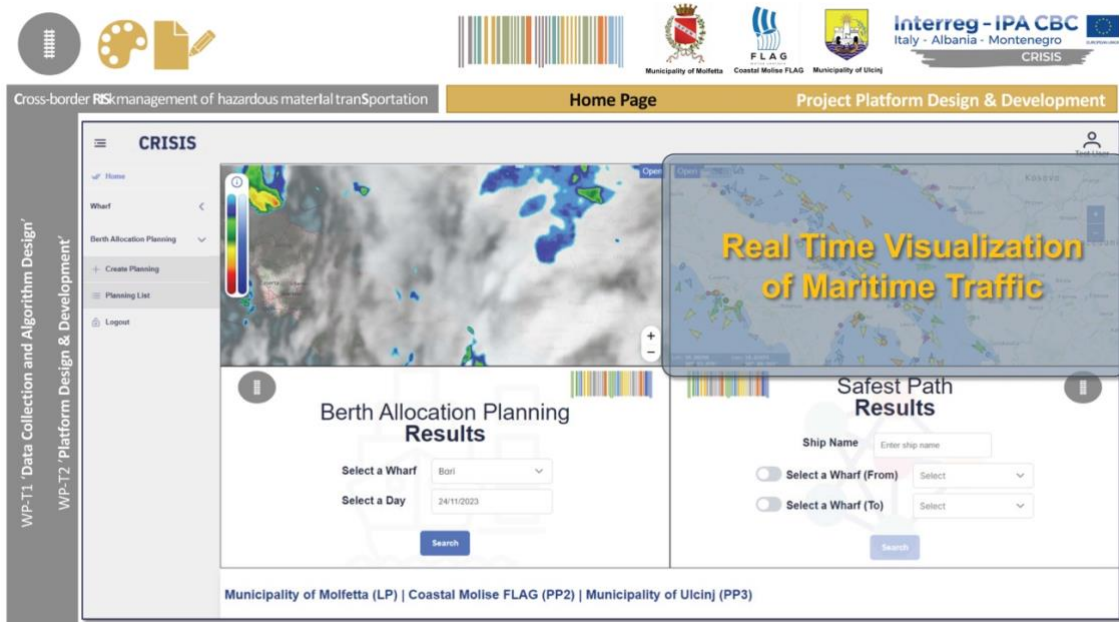
#### Berth Allocation Planning Results

Select a Wharf: Bori  
Select a Day: 24/11/2023  
Search

#### Safest Path Results

Ship Name: Enter ship name  
Select a Wharf (From): Select  
Select a Wharf (To): Select  
Search

Municipality of Molfetta (LP) | Coastal Molise FLAG (PP2) | Municipality of Ucinj (PP3)



Cross-border **Risk** management of hazardous material transportation | Home Page | Project Platform Design & Development

WP-T1 'Data Collection and Algorithm Design' | WP-T2 'Platform Design & Development'

### CRISIS

Real Time Visualization of Maritime Traffic

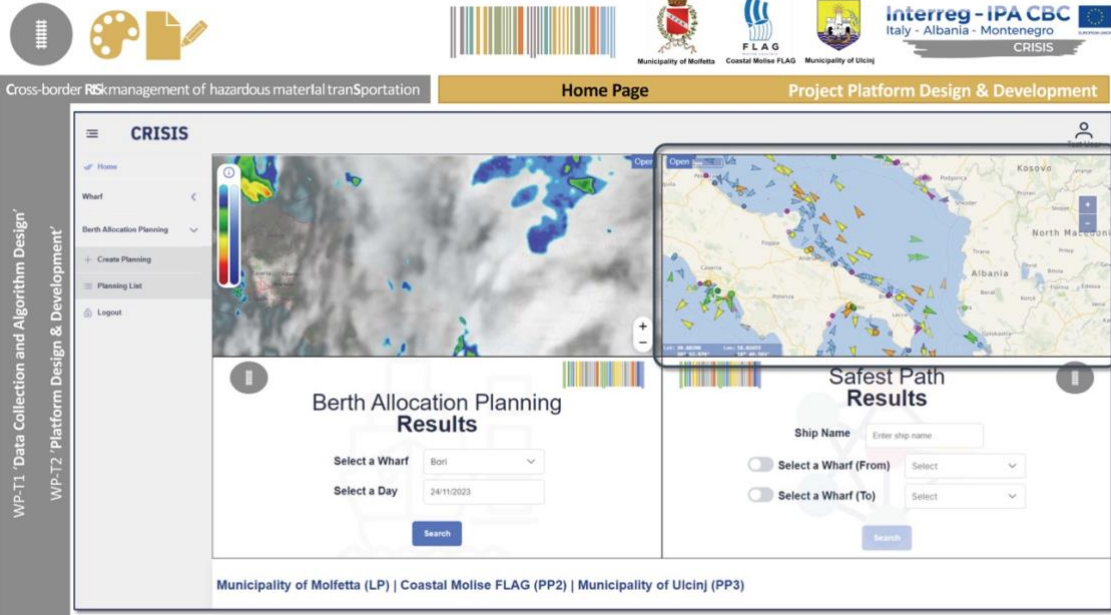
#### Berth Allocation Planning Results

Select a Wharf: Bori  
Select a Day: 24/11/2023  
Search

#### Safest Path Results

Ship Name: Enter ship name  
Select a Wharf (From): Select  
Select a Wharf (To): Select  
Search

Municipality of Molfetta (LP) | Coastal Molise FLAG (PP2) | Municipality of Ucinj (PP3)



CRISIS

Home Page Project Platform Design & Development

WP-T1 'Data Collection and Algorithm Design'  
WP-T2 'Platform Design & Development'

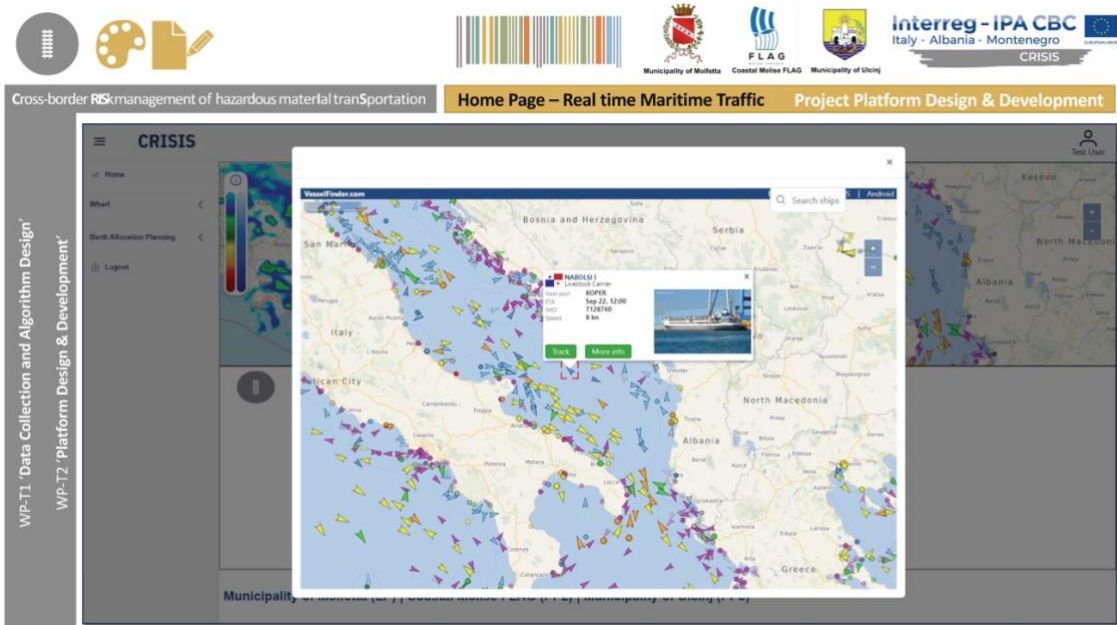
**Berth Allocation Planning Results**

Select a Wharf: Bori  
Select a Day: 24/11/2023  
Search

**Safest Path Results**

Ship Name: Enter ship name  
Select a Wharf (From): Select  
Select a Wharf (To): Select  
Search

Municipality of Molfetta (LP) | Coastal Molise FLAG (PP2) | Municipality of Ucinj (PP3)



CRISIS

Home Page - Real time Maritime Traffic Project Platform Design & Development

WP-T1 'Data Collection and Algorithm Design'  
WP-T2 'Platform Design & Development'

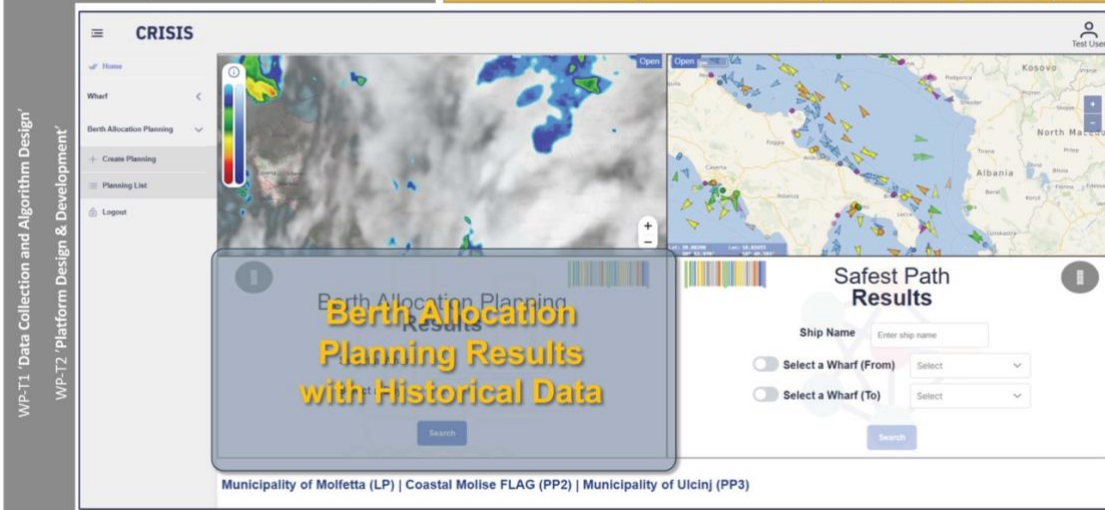
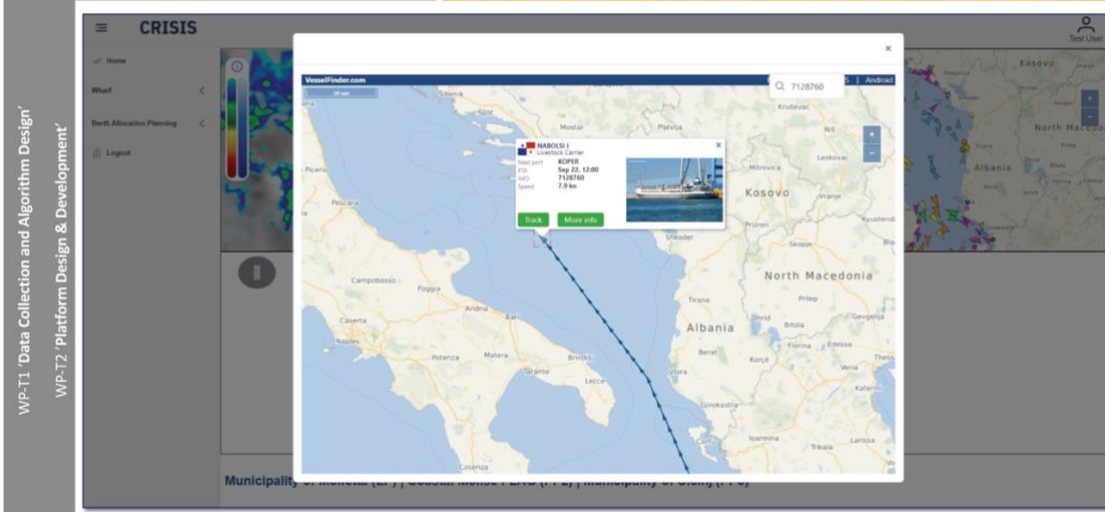
**Home Page - Real time Maritime Traffic**

VesselFinder.com

Search ships

NABOULI  
Liveslock Center  
KOPER  
Sep 22, 12:00  
718760  
8 km

Track More info






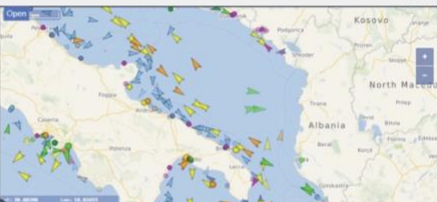
WP-T1 'Data Collection and Algorithm Design'

WP-T2 'Platform Design & Development'

CRISIS

- Home
- Wharf
- Berth Allocation Planning
  - Create Planning
  - Planning List
- Logout





### Berth Allocation Planning Results

Select a Wharf:

Select a Day:


### Safest Path Results


Ship Name:


Select a Wharf (From):

Select a Wharf (To):


Municipality of Molfetta (LP) | Coastal Molise FLAG (PP2) | Municipality of Ucinj (PP3)








Municipality of Molfetta



Coastal Molise FLAG



Municipality of Ucinj

Interreg - IPA CBC  
Italy - Albania - Montenegro  
CRISIS

Cross-border **Risk** management of hazardous material transportation

Home Page – BAP Results

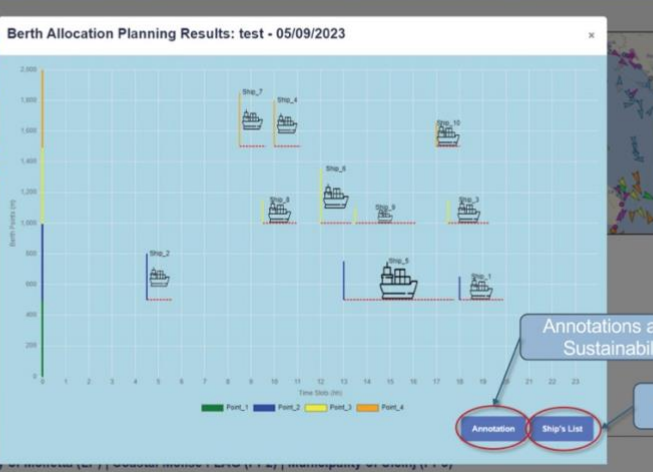
Project Platform Design & Development

WP-T1 'Data Collection and Algorithm Design'

WP-T2 'Platform Design & Development'

CRISIS

- Home
- Wharf
- Berth Allocation Planning
- Logout



Municipality of Molfetta (LP) | Coastal Molise FLAG (PP2) | Municipality of Ucinj (PP3)

CRISIS - Project Main Output O.T2.1

24





Cross-border Risk management of hazardous material transportation

Home Page – BAP Results

Project Platform Design & Development

WP-T1 'Data Collection and Algorithm Design'  
WP-T2 'Platform Design & Development'



**Berth Allocation Planning Results: test - 05/09/2023**

Ship's List inserted in Planning definition

Name	ETA	ETD	PBP	Length	Cargo Risk Level	Container Number	Handling Time
Ship_1	05/09/2023	05/09/2023	Point_2	150	3	7	112
Ship_2	05/09/2023	05/09/2023	Point_3	300	5	9	66
Ship_3	05/09/2023	05/09/2023	Point_2	150	9	8	108
Ship_4	05/09/2023	05/09/2023	Point_3	300	8	12	67
Ship_5	05/09/2023	05/09/2023	Point_1	250	4	3	285
Ship_6	05/09/2023	05/09/2023	Point_1	350	8	13	79



Cross-border Risk management of hazardous material transportation

Home Page – BAP Results

Project Platform Design & Development

WP-T1 'Data Collection and Algorithm Design'  
WP-T2 'Platform Design & Development'



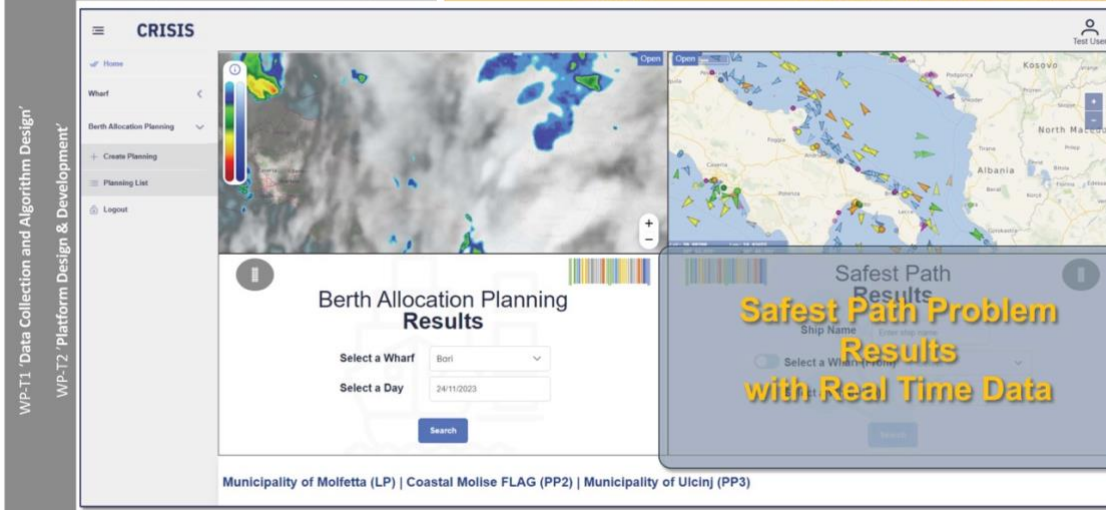
**Berth Allocation Planning Results: test - 05/09/2023**

Sustainability Annotations and Results

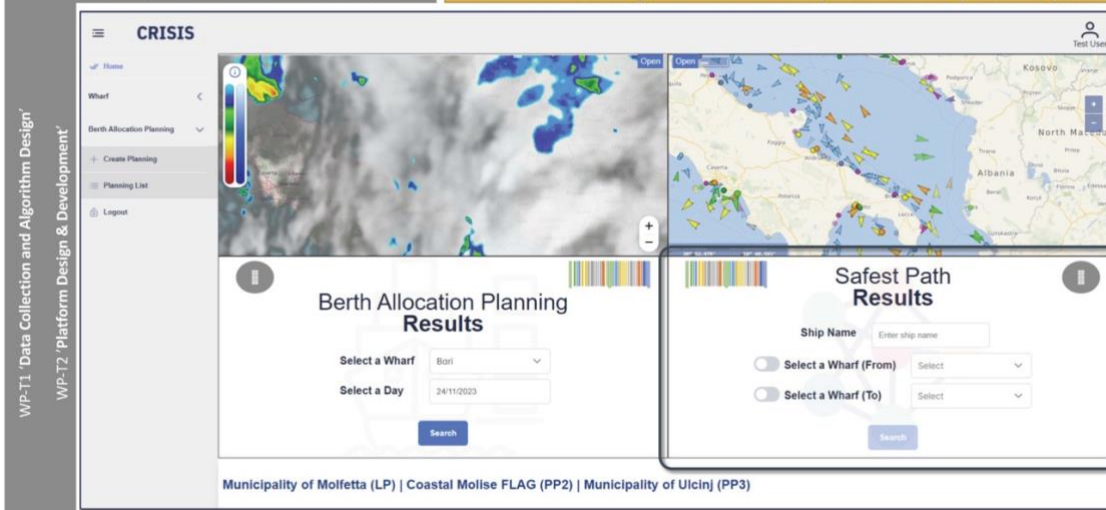
**Note**

There are significant improvements on sustainability  
The planning preserves 100% efficiency compared to a time optimal solution  
The ratio between sustainability and efficiency is favorable

1 of 1



The screenshot displays the CRISIS web application interface. On the left, a sidebar contains navigation options: Home, Wharf, Berth Allocation Planning (with sub-options for Create Planning and Planning List), and Logout. The main content area is split into two panels. The left panel, titled 'Berth Allocation Planning Results', features a map of the Adriatic coast and a form with 'Select a Wharf' (set to 'Bori') and 'Select a Day' (set to '24/11/2023'). The right panel, titled 'Safest Path Results', shows a map with a highlighted path and a large yellow text overlay that reads 'Safest Path Problem Results with Real Time Data'. At the bottom of the interface, a footer identifies the participating municipalities: 'Municipality of Molfetta (LP) | Coastal Molise FLAG (PP2) | Municipality of Ucinj (PP3)'.



This screenshot shows the same CRISIS web application interface as above, but with the 'Safest Path Results' panel expanded to show its input fields. The 'Ship Name' field is labeled 'Enter ship name'. Below it, there are two radio buttons: 'Select a Wharf (From)' and 'Select a Wharf (To)', each followed by a 'Select' dropdown menu. The 'Search' button is visible at the bottom of this panel. The rest of the interface, including the sidebar and the 'Berth Allocation Planning Results' panel, remains identical to the previous screenshot.



WP-T1 'Data Collection and Algorithm Design'  
WP-T2 'Platform Design & Development'


### Safest Path Algorithm Results

**Marine Protection Level**

- Fully / Highly Protected
- Less Protected / Unknown
- Designated & Unimplemented

**Shortest Path Results for ship: Test**

- There are very high improvements on sustainability
- Solution efficiency is 98.72570925333437% efficient with respect to the shortest path
- Solution ratio is really favorable
- 0 marine protected area crossed
- 0 bad weather areas encountered in path
- Near the Marine Protected Area located at coordinates (42.00254403131115 15.490313111545989) the wind is coming from South with an intensity of 4 out of 10





**Berth Allocation Planning Results**

Select a Wharf:

Select a Day:

**Safest Path Results**

Ship Name:

Select a Wharf (From):

Select a Wharf (To):

Municipality of Molfetta (LP) | Coastal Molise FLAG (PP2) | Municipality of Ucinj (PP3)



Municipality of Molfetta



Coastal Molise FLAG



Municipality of Ucinj

## CRISIS

Cross-border **RISk** management of hazardous material tranSportation

<https://crisis.italy-albania-montenegro.eu>

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## Contacts



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