DigLogs

5.1.3 DelPlan Functional Specification

Activity title: Pilot functional specification

Responsible partner: PP6 Polo Inoltra Involved partners: PP5 Actual IT			
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Notes:			

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Table of Contents

1. Introduction

The Functional Specs document aims at pointing out all the aspects related to the DelPlan Pilot, the Deliveries Planning System pilot action taken forward by Polo Inoltra and Actual IT within the DigLogs project.

The document will provide a description of the pilot action, the creation of a multimodal route planner for intermodal freight traffic, on a three-modality base (road, rail, sea), capable of making simpler the operational management of intermodal services, and the functional requirements for the pilot action, connected to the various project details.

Once set all the functional requirements, the document will highlight the design details agreed with the IT development team, and the related data model on which the main system algorithm will base its calculations.

Finally the document will evaluate the pilot constraints and limitations that the pilot action may find.

2. Pilot description

Deliveries Planning is an innovative IT solution, based on Big Data and PCS automation, aimed at better planning multimodal deliveries, based on real-time and predicted traffic conditions, service prices, transit times, schedules & ITU requirements comparisons, automatically suggesting or enabling selection of best travel routes before or during the trip. This tool is a specialized Decision Support System that calculates and suggests routes by processing normalized real-time data coming from external sources and systems used by the port community. Deliveries planning solution can be easily connected to the existing Port and Maritime information systems both as sources and as targets of the Delivery Planning Solution.

The pilot solution has been named DELPLAN, and structured in 2 main phases.

The first phase is concerning the multimodal route planning, which consist in setting up a shipment, selecting a place of departure (any Italian or Croatian provinces), a place of delivery (any Italian or Croatian provinces), an ETD and an ETA, and the state of the cargo (e.g. solid

palletized or not palletized, bulk, liquid, gas, etc.). The system is then asking the user to indicate which ITUs can be considered for the shipment (e.g. a standard 40' or a 45' container, a semitrailer or a bulk or tank container, etc.), and the user can indicate just one ITU for the service or multiple ITUs for the price comparison. Once selected the ITUs, the system will compare, considering road, sea and rail routes available on the market, several routing options, and sort them by three main criteria: Transit Times, Prices and Emissions.

The second phase of the DELPLAN specs, is related to the re-routing functions, where a confirmed shipment can be monitored and, in case of non-compliances on the selected route, replan it using the re-routing options.

Pilot definition

	Information	Description
1.	**Problem to be addressed or improvement desired**	- Lack of information on available intermodal routes; - Difficulties in determine the route compatibility with available ITUs; - Operational problems in re-routing an intermodal shipment in due course.
2.	**Goal(s) of the pilot project**	- Map some of the key routes in rail and sea freight transport; - Map some of the key intermodal hubs in Italy and Croatia; - Offer a direct tool for shipment planning, with indications of prices, transit times and emissions; - Follow up the shipments in each step of the multimodal chain, adding the re-routing tool as an option for shipments' non-compliance.
3.	**Technology to pilot**	- A web based, user-friendly interface which interconnects all the aspects, ITUs, hubs, routes, conditions, and groups them into an algorithm capable of giving the routing options.
4.	**Pilot project description**	- Multimodal route planner on 3 modalities, rail, sea, road;

	- Comparison of routes based on ITUs and ranking available on price, transit times and emissions; - Rerouting option, based on the journey non-compliance, and re-route from that point onwards, with rankings on price, transit times and emissions.
5. Resources needed	- System algorithm; - Web based interface; - Simulated data info about traffic and weather; - Simulated data info about multimodal routes with detailed service conditions.
6. Cost/benefits analysis (if any)	- The pilot benefits are well beyond any costs, as the digitalization process would be based on a web-based user interface, easy to create and not expensive, while the benefits would be potentially huge, as they would impact almost any multimodal shipment interesting Italy and Croatia.

3. Functional requirements

The project functional requirements are directly connected to each function of the pilot system.

The functions of the system will be the following:

a. Bookings and transport orders;

b. Travel sections and nodes;

c. ITUs;

d. Trains, stations & rail terminals;

e. Vessels;

f. Ports & terminals;

g. System Output;

h. Track&Trace and Re-Routing;

i. Reporting.

3.a Booking and Transport Orders input function

The first function of the Deliveries Planning system is being able to handle the booking processes of multimodal freight services. For this particular function the system will need to be able to recognize the various aspects of a service booking, considering the starting and the ending point of the service, the kinds of goods shipped, the frequency of the service, the volumes of goods to be shipped, the timescale, the characteristic of the eventual ITU to be used for the service and eventual restrictions. The system will place each piece of information into an algorithm, in order to feed the other system functions, this way it is possible to consider the Booking and Transport Order as an input function.

Within the booking, the DelPlan pilot will allow the user to indicate a place of departure (any Italian or Croatian provinces), a place of delivery (any Italian or Croatian provinces), an ETD and

an ETA, and the state of the cargo (e.g. solid palletized or not palletized, bulk, liquid, gas, etc.). The system is then asking the user to indicate which ITUs can be considered for the shipment (e.g. a standard 40' or a 45' container, a semitrailer or a bulk or tank container, etc.), and the user can indicate just one ITU for the service or multiple ITUs for the price comparison. Once selected the ITUs, the system will compare, considering road, sea and rail routes available on the market, several routing options, and sort them by three main criteria: Transit Times, Prices and Emissions.

3.b Travel Sections & Nodes

The second function of the Deliveries Planning system is to arrange, similar to a travel planner, the routes of the goods by providing several available options, after studying the three different modalities of transport available for the system: Road, Rail and Sea freight transport. In the process of calculating the different options and transport modalities, the system will break down the main journey from the loading point A to the unloading point Z into sub-sections. Each travel section will be either a road, a rail or a sea travel section, connected to specific infrastructure nodes, either ports or freight terminals where the transport modality will be switched. Once done that, each travel section will be used to obtain a different travel option, that will contribute to generating the system outputs, which will be represented by the alternative routes that will have to be chosen by the transport operator using the system.

The following nodes have been added to the system functionalities:

- Rail nodes: Interporto di Novara, Interporto d'Abruzzo, Interporto Marche, Scalo Merci Saletti, Interporto di Bologna, Sisak Terminal, Port of Sibenik, Port of Split, Port of La Spezia;

- Sea nodes: Port of Ortona, Port of Vasto, Port of Ancona, Port of Sibenik, Port of Split;

- Road nodes: Any physical point in any Italian or Croatia provinces.

The indicated nodes have been linked to travel sections (legs):

- Rail sections: Interporto Novara <> Interporto d'Abruzzo, Scalo Merci Saletti <> Interporto Bologna, Interporto Marche <> Port of La Spezia, Sisak Station <> Sibenik Port, Sisak Station <> Split Port;

- Sea sections: Sibenik Port <> Ortona Port, Sibenik Port <> Vasto Port, Split Port <> Ortona Port.

- Road sections: from any province to any province or from any province to any specific node.

Per each node and section, limitations were set in order to evaluate the ITU compatibility with a specific journey, dangerous goods restrictions, opening hours, route timetable and gabarits.

3.c ITUs

Once the system will have calculated the plan, it will also be able to recommend the ITUs for the service, for example a craneable semitrailer, a swap body or a container. In order to do so, the system will consider restrictions and limitations for travel sections and nodes. If the transport of goods is already set with a given service ITU, the system will integrate the information when selecting the suitable travel section and relative nodes. At the same time, for multimodal services involving road transport in connection with rail and/or sea transport, there will also be the availability of road tractors for semitrailers, flat-container semitrailers and infrastructure requirements checks.

The ITU fleet considered has been divided into separate sections: ITU type, cargo typology, EN13044 Profile, Support Stand Height and Pocket Wagon Compatible codes.

For the ITU type, three main categories were considered: Containers, Swap Bodies and Semitrailers.

For the ITU cargo typology, samples were considered: bulk, tank, normal box, high cube, cranable semitrailer.

For the EN13044 Profile, swap bodies were marked from C20 to C45, while semitrailers were marked from p385 to p402.

For the EN13044 Support Stand Height, semitrailers were marked 85, 88, 98 or 113;

For the EN13044 Pocket Wagon Compatible codes, semitrailers were marked P, Pa, Pb, Pc, Pd, Pe, Pf, Pg, Ph.

3.d Trains, Stations & Rail Terminals

The system, while comparing potential journey options using different transport modalities, will also calculate multimodal and conventional rail connections and their relative service conditions. By doing so, it will be possible to integrate into the journey planner the rail services, adding the rail modality to the road and sea ones. When comparing the MTOs services connecting two or more rail terminals, the system will evaluate the variables and the compatibility of the ITUs with the sets of wagons available. Once cleared the compatibility check, the next step will be to add transit times, prices and restrictions for the system output. The system will also need to consider Freight Villages and Rail Terminals procedures, restrictions, working hours and access restrictions for the route planner.

The following types of wagons were assigned to sample wagons' sets per each rail node: 90' flat container wagon, MF lower bed container wagon, 60' flat container wagon, T2000 double pocket wagon, TWIN megatrailer pocket wagon, 80' flat container wagon.

Per each wagon, an ITU compatibility rule was assigned, marking the potential assignment ITU for a specific route.

3.e Vessels

Similar to what was done for the sea freight services, the system will evaluate the vessels used to connect the Adriatic ports, checking their typology, the capacity, the ITUs requirements and eventual restrictions. Once cleared the compatibility check, the following point will be to add transit times, prices and restrictions for the system output.

In order to evaluate the ITU compatibility, specific vessels were assigned to sea travel nodes.

In particular, the following vessels were assigned: Burak Bayrajtar (Container Ship), Havin Hawk (Bulk Carrier), Zlad Junior (General Cargo Ship), Luebeck (Container Ship), Pergamon Seaways (RoRo Cargo Ship), Goutamaru (Refrigerated Cargo Ship), Alondra (Livestock Carrier), Valle di Granada (Chemical/Oil Tanker), Syn Zaura (LPG Tanker), Seavoyager (Crude Oil Tanker), Marko Polo (RoRo Cargo Ship), SNAV Adriatico (RoRo Cargo Ship).

Per each ship the following details were identified: Vessel IMO, Vessel GT, Vessel DWT, Vessel Size, Vessel Draught, Emission Class.

3.f Ports & Terminal

Once cleared the vessels' compatibility, it will also be important to consider Ports and Terminal procedures, working hours and access or similar restrictions for the route planner. Eventual hidden costs, including ITUs storage fees, will be included in the final comparison, if applicable.

Per each port and terminal, a booking requirement was set, storage and THC fees were determined, terminal opening hours, reach stacker working hours and DG restrictions.

3.g System Output

The system will structure all the information obtained in the previous points, process it and generate an output, which will consist of several routing options for a particular service. The comparison will be based on a pre-defined set of variables, leaving to the user the manual decision to proceed with a determined option. Once the user will have made a choice, the system will consider valid the chosen option and guide the user to the various booking procedures of the service. At the pilot stage, the system will not be able to automatically complete all the required bookings for the service, this functionality may be included though in the future development of the system.

Depending on the user choice, for the selected route, the system will indicate the options available, the costs, the transit times and emissions per each ITU selected. By clicking on each solution, the user will be able to check how many legs will be used, the relative modality (eg 2 rail legs and 1 sea leg plus first and last road mile).

By clicking on booking button, the user will be able to select the intermodal route and pass it to "Current Services" page.

3.h Track&Trace and Re-Routing

Even if the system may have given a particular set of outputs and the user may have selected one option among the ones given, there may be the possibility for that particular selected service to have been delayed by unexpected events or to have been affected by service disruptions, cancellations, etc.. The system, being capable of Track&Trace the shipment, will be able to calculate the consequences that the unexpected events may have on the route, estimating the

delays and the interconnections among different transport modalities being affected by these delays. Once calculated these consequences, the system will be able, given a pre-defined set of variables, to alert the user of the disruptions in place, allowing the user to re-route the service by comparing the re-routing options to the original route, if that option is still available. If the original route that was selected is not anymore available due to the disruptions, the system will consider a compulsory re-routing task. The re-routing options, similar to what happened to the selection of the original plan, will be displayed for the user to select. Following that moment, once selected a re-routed plan, the system will readapt the track&trace function to follow the shipment into the new selected journey.

The service tracking and update will be based in the pilot action with a checkpoint system, with the system admin updating the status of a shipment in progress. In case of non-compliance, the system will generate an alert, recommending or guiding the user to the shipment re-routing.

3.i Reporting

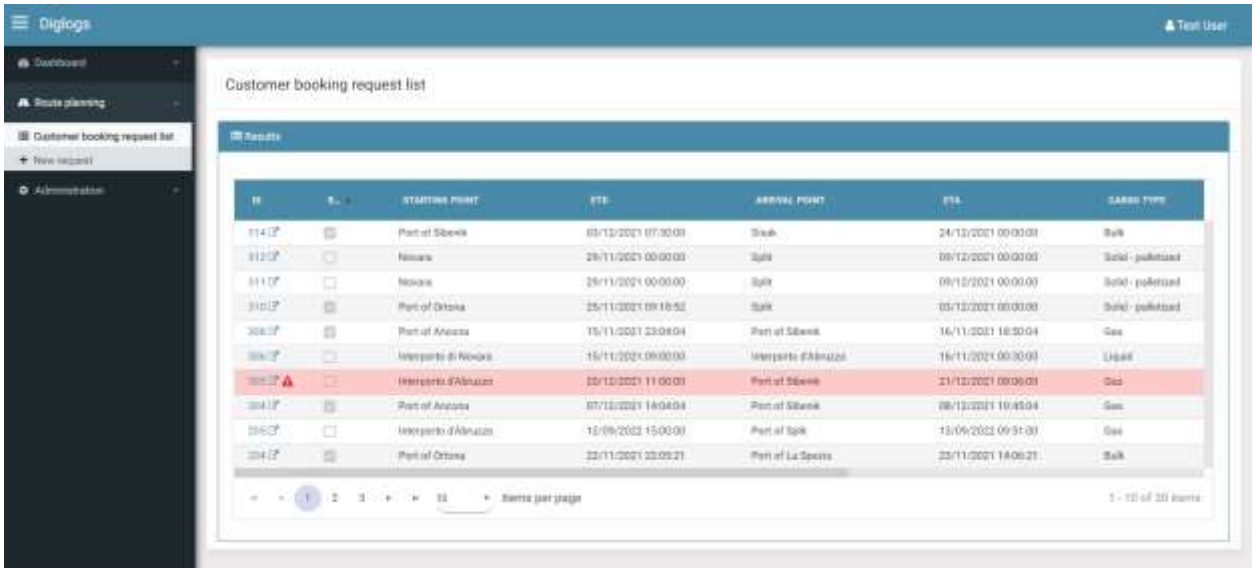
After the completion of the service, the system will be able to provide a report of the actual travel route in terms of differences to the originally selected one (if the route has been re-routed), the actual vs planned transit times, costs and emissions.

4. Design Details

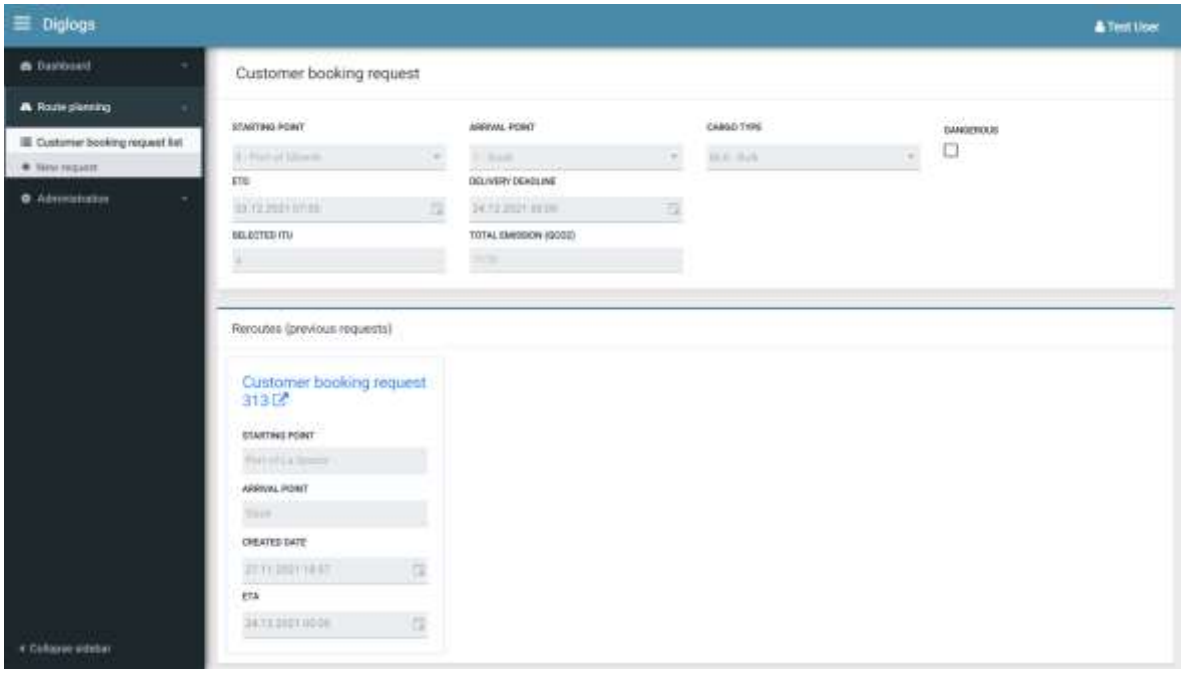
Here are the GUI screens from DEPLAN, implementing the required functionalities:

General overview:

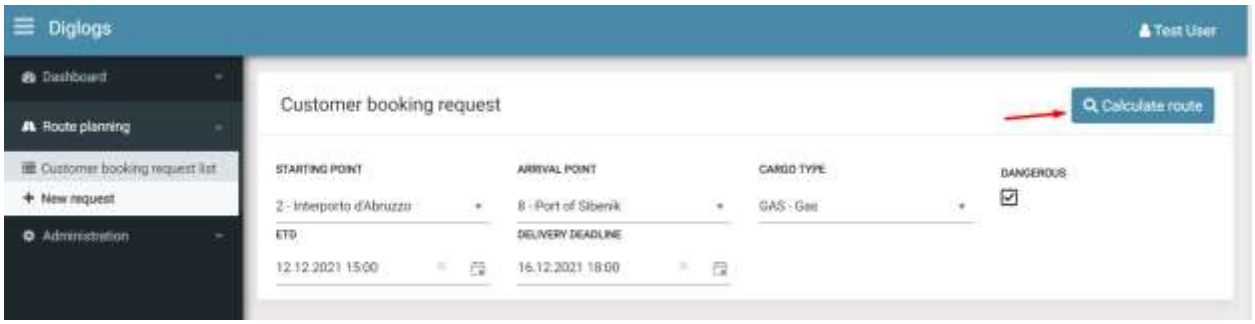
The list of booking requests.



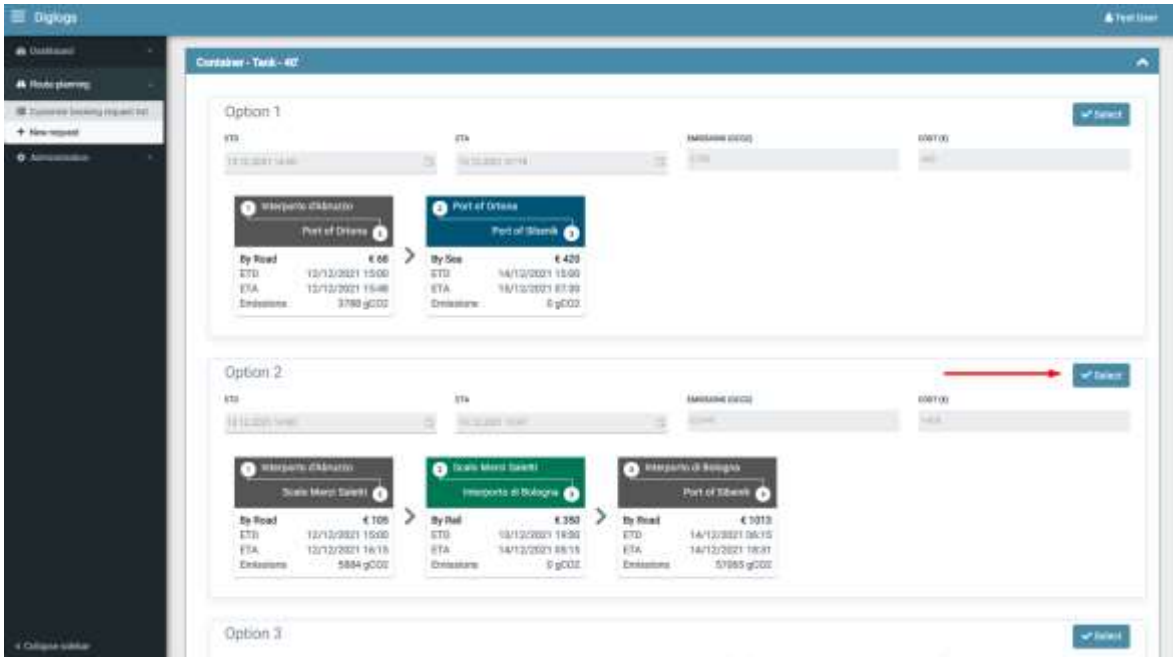
The booking request details:



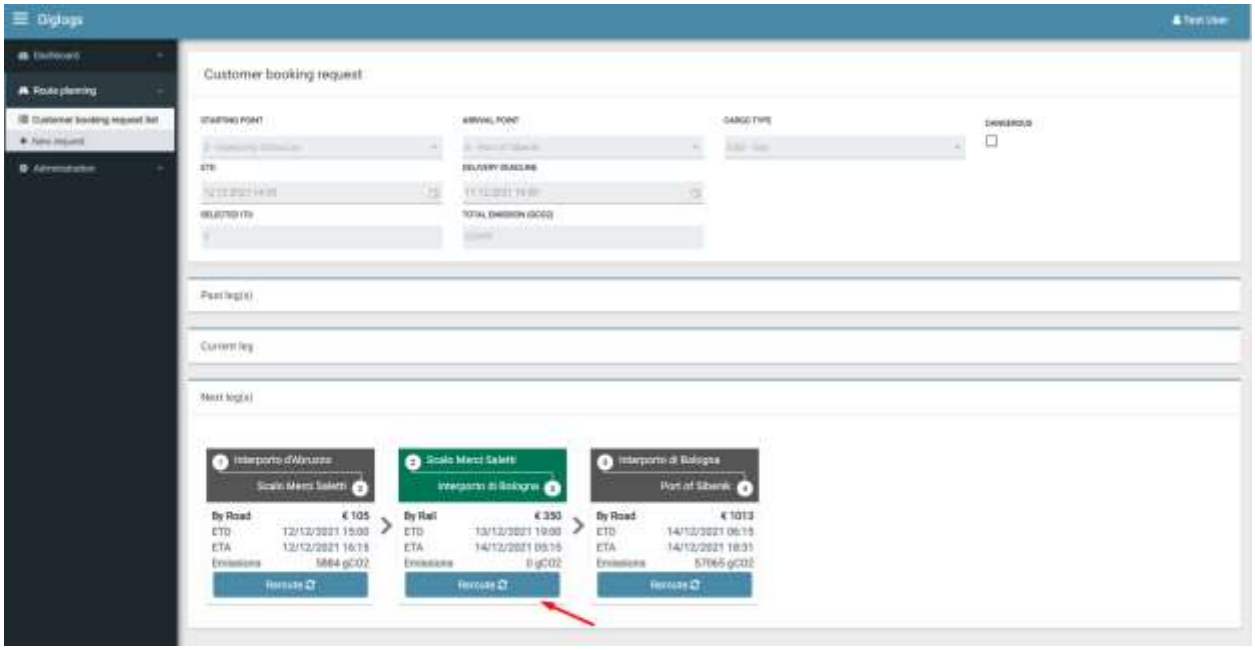
Creating new booking request:



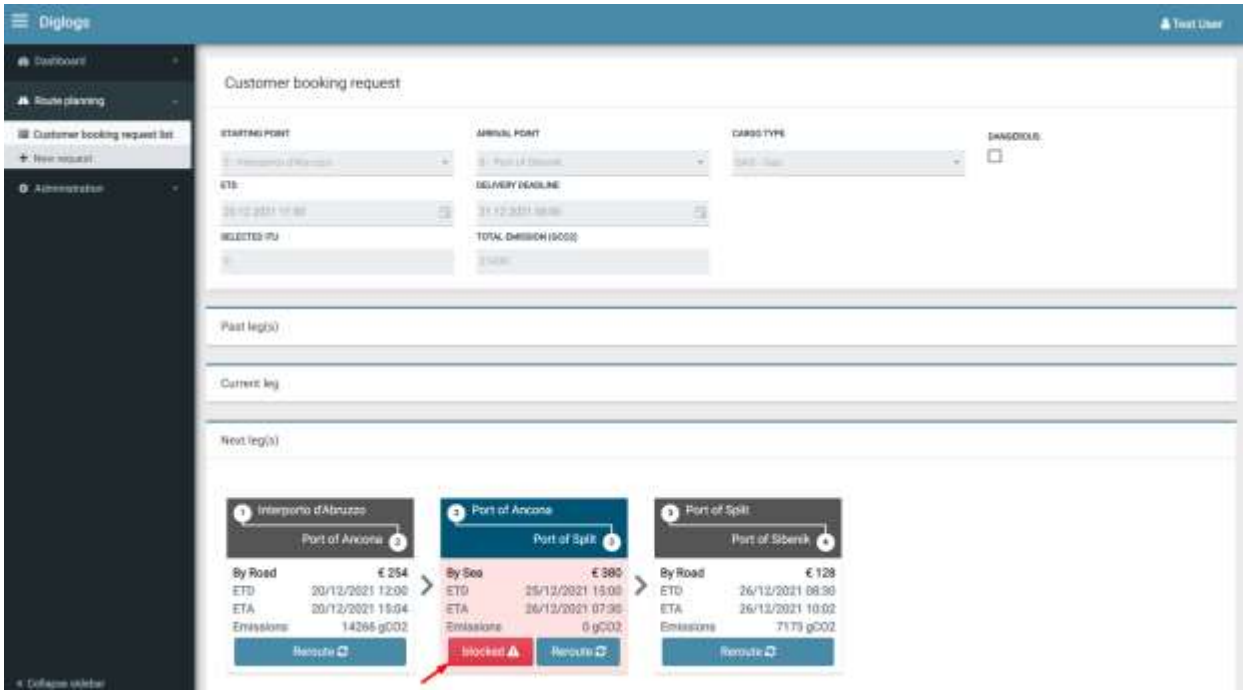
Calculated results with options selection:

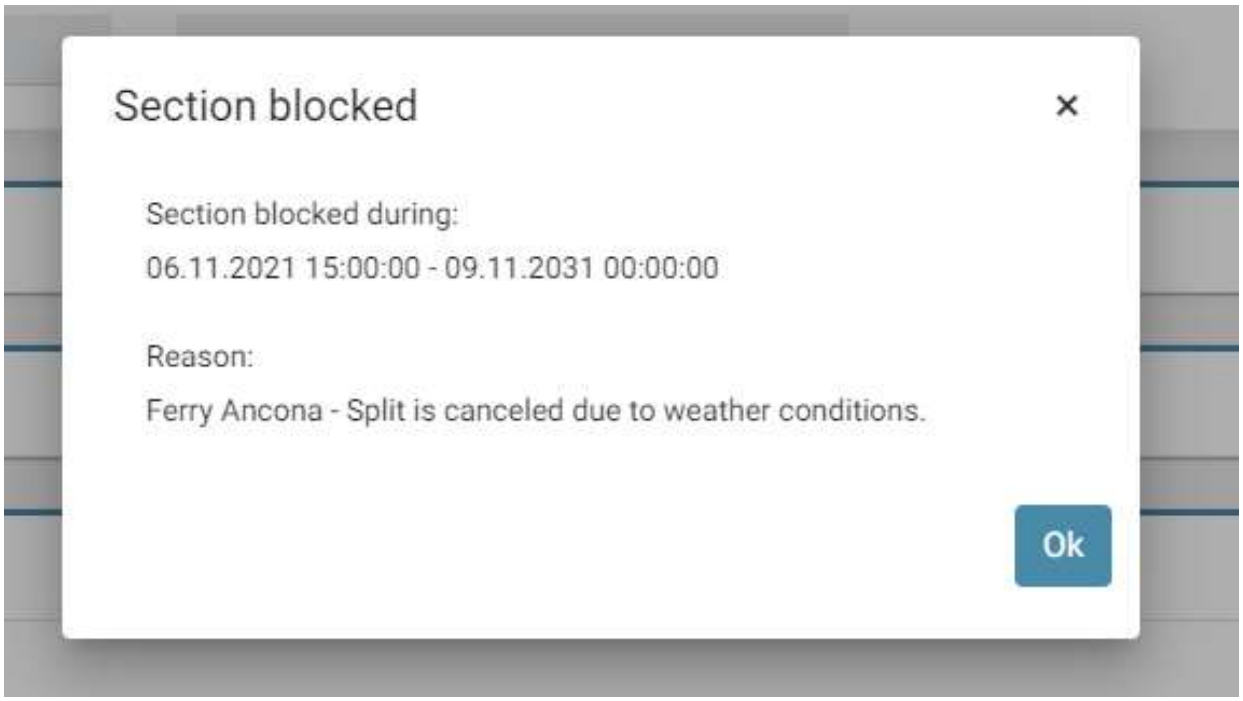


Rerouting options:


Diglogs
Customer booking request
Route planning
Administration
Interporto d'Abruzzo
Scalo Merci Saletti
Interporto di Bologna
Port of Sibenik
By Road
By Rail
ETD
ETA
Reroute

Alerts:


Diglogs
Test User
Dashboard
Route planning
Customer booking request list
New request
Administration
Collapse sidebar
Customer booking request
STARTING POINT
ARRIVAL POINT
CARGO TYPE
DANGEROUS
ETD
DELIVERY DEADLINE
SELECTED ITU
TOTAL EMISSION (GCO2)
Past leg(s)
Current leg
Next leg(s)
1 Interporto d'Abruzzo
Port of Ancona 2
By Road € 254
ETD 20/12/2021 12:00
ETA 20/12/2021 15:04
Emissions 14266 gCO2
Reroute
2 Port of Ancona
Port of Split 3
By Sea € 380
ETD 25/12/2021 15:00
ETA 26/12/2021 07:30
Emissions 0 gCO2
blocked
Reroute
3 Port of Split
Port of Sibenik 4
By Road € 128
ETD 26/12/2021 08:30
ETA 26/12/2021 10:02
Emissions 7179 gCO2
Reroute


Section blocked
Section blocked during:
06.11.2021 15:00:00 - 09.11.2031 00:00:00
Reason:
Ferry Ancona - Split is canceled due to weather conditions.
Ok

The DEPLAN full solution with all the screens developed is described in the User manual.

5. Constraints and limitations

The main pilot constraints and limitations are related to the usage of lab-based data for the system testing. First of all, due to the limited amount of sea routes connecting the mid-Adriatic area, new potential routes will be simulated, in order to make the algorithm more effective in the route comparison.

The necessity of creating simulated routes within the pilot action represent a limitation to the usability of the platform in the short term. Same simulations have been made for open trains in intermodal routes, as some of the trains that connect the mid-Adriatic terminals are block-trains, used by one or two main operators only.

In order to make the multimodal route planner more effective, existing block-trains have been lab-converted to open trains, in order to represent, at least for the algorithm calculations, an alternative to the main existing routes.

The second main limitation is connected to the necessity of having a checkpoint system for the shipment monitoring and re-routing. In real life, the GPS coordinates of a shipment would allow to establish an actual arrival or departure of an ITU in a specific travel leg, while in the pilot action, due to the simulations specified above, in order to arrange shipments taking simulated travel legs, will be modified, using a user validated checkpoint system, so to have a confirmation of the end of specific travel leg and the start of the next one.

The checkpoint system, while on the testing phase will still be effective for the monitoring and re-routing activities, still represent an obstacle to the full automatization of the system, therefore making it a big constraint.

The last limitation is concerning the number of routes available and the geographical area of coverage. Due to the role of the pilot, only shipments to/from Italy and/or Croatia were considered with point of departure and arrival of shipments in any of Italian and Croatian provinces. Outside the pilot action, for the long term planning of the system, it will be essential

to consider not only shipments arriving or departing to/from Italian and Croatian provinces, but also shipment crossing the area, for a longer service (for example, a shipment from Barcellona to Bucharest may be directed by the system to use the multimodal services in Italy and Croatia for part of the service).

As the aim of the pilot is to validate an algorithm capable of comparing routing options, only sample routes have been considered, but in the long run further intermodal nodes and travel legs may be added, in order to make the system more effective.