DigLogs

Pilot Project Plan PP6, PP5

Deliverable D5.1.1

PCS Automation - Deliveries Planning

Responsible partner: Polo Inoltra
Involved partners: All

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Introduction: PCS Automation - Deliveries Planning

The PCS Automation - Deliveries Planning pilot aims at creating and testing a Deliveries Planning module, which could in the future extend the PCS systems. The **Deliveries Planning** Technology aims at providing an improved knowledge for operators in the decision making process for the shipment routing through comparison of multimodal services in terms of prices, transit times and schedules, matching ITUs requirements/compatibility with the vessel, shipment requirements and Dangerous Goods limitations, while providing re-routing options based on traffic & weather conditions. The full scope of the Deliveries Planning innovation system aims at guiding the operator with an automatic booking process (including Custom Declarations and Dangerous Goods processing), then follows the shipment through a Track&Trace system, giving a real-time updated ETA, and finally provides emission certificates at the end of the journey. The pilot application is going to focus its scope on the route selection algorithm, exploring all the parameters that might affect the selection and establishing the criteria for prioritizing optimal route selection. It will then examine the circumstances and parameters that might cause rerouting at each node along the chosen route. Finally, it will examine KPIs for calculating route performance and provide comparison reports among different available options, as well as comparison between planned (nominated) and completed (travelled) route performance. Pilot application is going to limit its scope to the nominal booking, Track&Trace simulation and calculated approximated ETA and CO2 emission, as well as defining the interface data structures towards potential future system integrations. If proven feasible, the fully scoped system in the future will aim at automated booking, real time Track&Trace system with real time ETA and CO2 emission calculations, and integrations with external systems, which is all beyond the pilot scope.

1. Pilot project goals

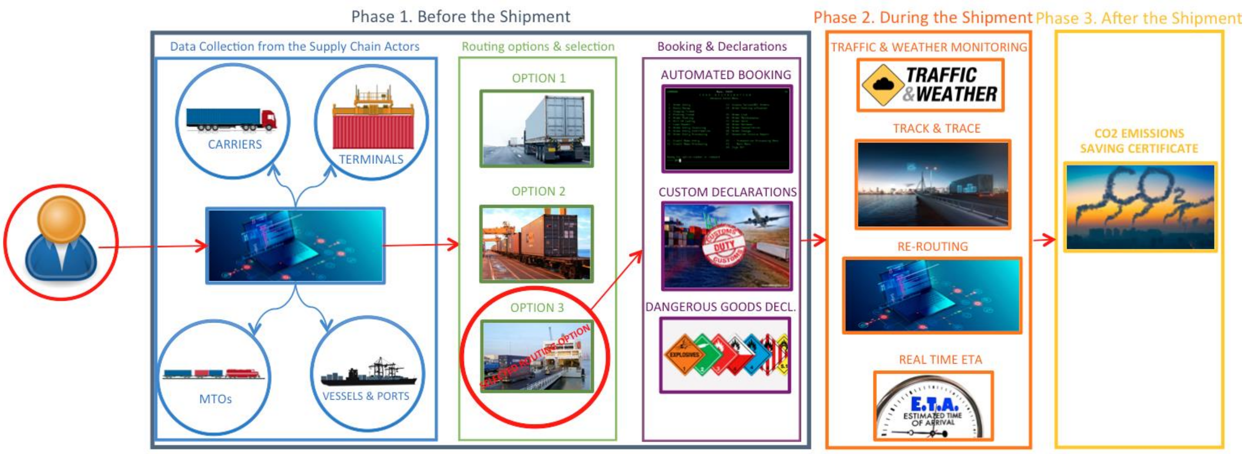
At present, Carriers have high operational costs due to the complexity of the intermodal shipments planning management. At the same time, the decision-making process when setting a specific route for a service could be affected by personal bias, resulting in an inefficient service routing, with consequently higher costs. Another major problem is caused by the complexity in re-routing services in case of unexpected events, including delays, traffic, weather, and other variables. Due to the complexity of rerouting services, the unreliability of ETA can mislead users and make the intermodal services less competitive than the standard ones.

On a long run, the creation of an automated Deliveries Planning System can prevent these issues by guiding the operator throughout the decision-making process of the multimodal service routing, showing the user various alternatives for an intermodal service, allowing the user to book in advance the service needed with an automated system, simplifying the procedures for Custom Declarations and for the Dangerous Goods processing. At the same time, the system aims at allowing a Track&Trace system to guide the user during the shipment, reprocessing the ETD and the ETA considering traffic & weather conditions and eventually re-routing the shipment in real-time. At the end of the shipment, the system would also be able to provide the CO2 emissions saving certificate.

The pilot application is going to focus on the route selection and rerouting algorithms, exploring parameters that affect the selection and calculations. The pilot results would establish the guidelines for the implementation of the full scope Deliveris Planning system and required integrations.

2. Pilot project functions and scope

Table 1. Deliveries Planning - Functions



The current situation of Mid-Adriatic ports on the Italian side is characterized by a general lack of large scale PCS, mainly due to small infrastructure dimensions and traffic flows. For these reasons, and for the general lack of information, transport operators have high operational costs and complexity due to the activities connected with the management of intermodal shipments. At the same time, the decision-making process when setting a specific route for a service could be affected by the personal opinion of the operator, not supported by actual numbers. Inefficient routing processes could lead to unsustainable and wrong choices.

The creation of an automated Deliveries Planning system aims at preventing these issues, by guiding the operator throughout the decision-making process, showing the various alternatives for an intermodal service, allowing to book in advance the service needed, simplifying the procedures for Custom Declarations and the processing of Dangerous Goods. At the same time, the system would allow a track and trace system to guide the whole service, reprocessing ETD considering traffic and weather conditions. The pilot system is going to offer route alternatives, on the basis of parameters given, ranked by defined priorities, suggesting the most favourable option, and the user is going to choose the most preferred option. Automacy will not be part of the pilot test yet. In the testing phase and later, in the post-pilot phase, it is planned to run the system on larger sets of real data, from which the system will be able to learn (by recording user selections from the alternatives given). This will eventually give way to the deployment of an automated system, allowing the automatic booking of the best option.

In order for the system to work, Polo Inoltra considers essential the participation of all the actors of the supply chain to the system: Ports, Transport Operators, Terminal, MTOs, Shipping Companies and Shippers. The more actors do take part in the system creation, the better the information would be. Also, in order to fully make use of the system potential, it is necessary to have updated and real-time information from the various actors of the chain, making it essential in the mid to long run to connect the ERP Systems of the operators to the main system.

Due to the various nature, dimension and sometimes the absence of PCS in port communities, Polo Inoltra has decided to create an independent module, that would be included in existing PCS systems, automatizing processes, or, for smaller ports which do not have a PCS in place, a stand-alone system that could still function without a PCS.

The Deliveries Planning system would need several rail routes, ports and transport operators in order to fully function. During the Pilot Phase, due to the current absence of RoRo services in the central Adriatic, will be lab-simulated the presence of multiple RoRo routes, starting from several ports of the Adriatic, in particular, the simulation will consider at least three different RoRo Services. These three services will have different time schedules, different booking procedures and availabilities. On the other hand, the system will consider actual intermodal rail-road connections to local Terminals. It is expected that actual Transport Operators and Shipping Companies will participate in the Pilot Test as operators needing to plan intermodal services, either rail-road-sea or sea-road-sea ones, from Italy to Croatia and vice-versa. They will access the Deliveries Planning platform, compare the different options available, choose the most favorable route and proceed with the operational organization of the service. Ports and Sea Liners will receive the information, integrating them into their system.

Once the chosen service is booked, the re-routing of the service due to traffic or other issues is going to be considered as part of the Pilot. Again, in the pilot phase, the real time booking would only be nominal and track and trace process is going to be simulated in the lab environment. On the long run, if pilot results prove favourable and feasibile, the prospective full scoped application is expected to implement the whole process based on real-time information. The system, once ended the journey, will also provide basic admin information and the CO2 saving certificate.

It is clear that in the Pilot Phase the system will be considered as an external module, while in the mid to long term it could be integrated with the existing systems of the Transport Operators and Shipping Companies. By doing that, with the help of disseminating the potential of the platform, it will be possible for operators to join the system at a later stage, fully benefiting from the savings provided and starting a process of organizational change, once the automatization of processes will have been given for granted and job roles would have been positively impacted by the system.

3. Project methodology

An **Agile project management methodology** will be used, following the recommended best practices and concepts. This methodology will cover the entire lifecycle of the pilot project implementation. This methodology will be flexible and will allow tackling the potential issues coming from earlier phases of the pilot implementation, as well as addressing the issues remaining at the end of the pilot implementation, thus providing the basis for transferability and action plans.

In order to manage the project, **standard tools together with customized company tools** will be used, like internal business information systems of Polo Inoltra, industry statistics, companies ERP systems, terminal ITU registration systems, e-mails and office automation tools (Microsoft Word, Excel and Powerpoint). Furthermore, a Gantt chart will be used to track the project execution.

Project team will communicate directly (peer to peer), both, in person (CoVid restrictions permitting) and using remote collaboration tools (Google Meet and Skype). Brief regular coordination meetings will be held in order to inform all project team members with the development of the project and to resolve ongoing issues. These meetings will represent the main form of communication between the two project sub-teams, Polo Inoltra pilot project team and Actual pilot development team.

Documents used in the project planning and implementation can be divided into several categories, based on the document type and ownership:

1. DigLogs set of documents, outlined in DigLogs Application Form (includes this pilot work plan);
2. Documents created by Polo Inoltra and its consultants;
3. Documents created by Actual IT as the developer of the pilot.

Expected output documents that will be produced as a part of the pilot project are:

1. Pilot Work Plan (this document) – draft PP6, final PP5;
2. Technical-functional pilot specification – PP5;
3. Pilot development updates and installation documentation – PP5;
4. Concise project reports, minimally on milestones – PP6;
5. Test cases – PP6 and PP5;
6. User manuals – PP6;
7. Optional: communication archives (emails) – available on request.

Monitoring of the pilot project execution will be executed using the following milestones, in sequence (checkpoints):

1. Compiled draft of the Project Work Plan – approved by PP6;
2. Ammended, refined and finalized Project Work Plan – by PP5;
3. Completed Project Work Plan, validated by the project partnership; **← CHECK OFF MILESTONE 1**
4. A written draft of the Technical-functional specification – by PP5;
5. Completed Technical-functional specification, approved by PP6; **← CHECK OFF MILESTONE 2**
6. Deliveries Planning System delivered and completed – by PP5; **← CHECK OFF MILESTONE 3**
7. Deliveries Planning System testing – by PP6;
8. Deliveries Planning System deployment and sign off (pilot development completed). **← CHECK OFF MILESTONE 4**

4. Project preparation

This chapter describes the **phases of the Pilot project preparation** before the actual development and later execution phases.

4.1 Project functional requirements

The project functional requirements contain detailed description of 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.

4.1.1 Booking and Transport Orders input function

The first function of the Deliveries Planning system is to be 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. For the pilot scope, booking information will be provied to DelPlan application as a record set, either from external programs (a formatted file upload) or entered by end user.

4.1.2 Travel Sections & Nodes

The second function of the Deliveries Planning system is to arrange, similar to a travel planner, the routes of the goods shipment by providing several available options, after assessing the three different modalities of transport available for the system: Road, Rail and Sea freight transport. In the process of calculating 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, each travel section will be used to obtain a different travel option, that will contribute to generating system outputs, which will be represented by the alternative routes that will have to be chosen by the transport operator using the system.

4.1.3 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. In order to simplify the pilot scope, a limited ITU fleet is going to be defined for each travel node, enough to demonstrate the selection principle.

4.1.4 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.

4.1.5 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 task will be to add transit times, prices and restrictions for the system output.

4.1.6 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.

4.1.7 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.

4.1.8 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 to 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 no longer 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. From that moment, once selected a re-routed plan, the system will readapt the track&trace function to follow the shipment into the newely selected journey.

The recalculation of routes is supposed to happen at the time of arrival of cargo at the next node (before going on the next leg) and if an unexpected event happens.

4.1.9 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.

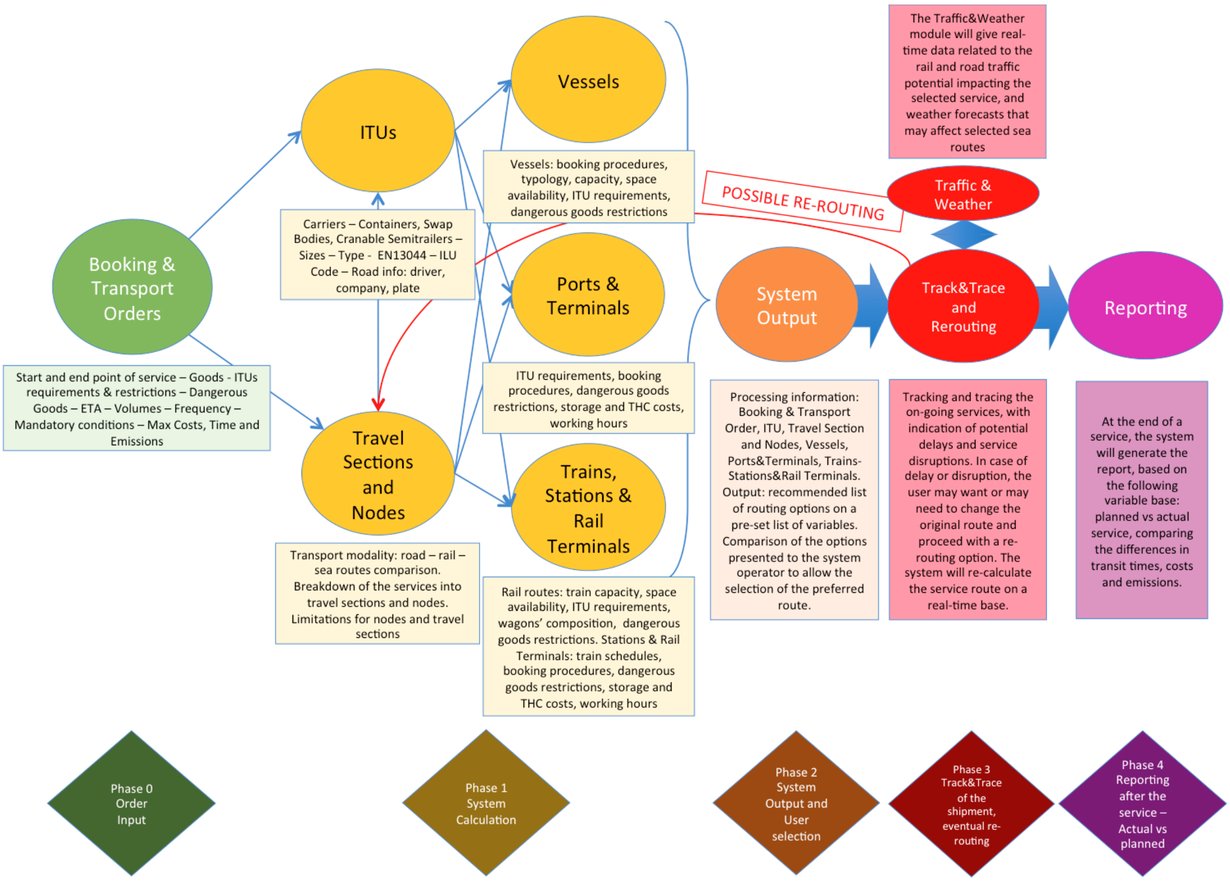
4.2 Resource tendering

Regarding the pilot implementation phase, considering that PP5 Actual IT is responsible for the pilot design and creation, there shouldn’t be any need for the external resources and therefore there are not going to be official resources tendering activities.

4.3 Pilot solution design

The Pilot solution design will follow the Project Functional Requirements. In particular, the system will complete its task by tackling each single functional issue, in order to generate reliable results to the user's queries.

Table 2. Deliveries Planning - Pilot Solution Design



4.3.1 Booking and Transport Orders input function

The booking and transport order function will work as the main input point of reference for the system. From this function, the system will acknowledge: the start and end point of service, the kind of goods to be shipped, their packaging (pallets, big bags, rolls, barrels, etc.) and their state (solid, liquid, gas). It should then be checked whether or not an ITU is already assigned to the service (example: already given a 40' tank container unit for the service) or if there is a chance to assign a customized ITU depending on the service. It will also be checked if there are any dangerous goods in the shipment, the ETA required, the type of service (regular vs spot), the volumes of service (example tonnes per year or pallets per week etc.), the frequency (ex. 4x45' swap bodies units per week) and other mandatory conditions (ex. temperature controlled or pressurized bulk goods). Finally the section will ask the user to indicate a maximum cost for a DtD shipment, the required timescale and the maximum emissions. The system will use the final input as a disclaimer in the selection process, excluding the options that do not meet either **the maximum cost criteria, the maximum timescale** or **the maximum emissions**. These are going to be the main KPIs for the pilot phase.

During the pilot phase, the complexity of the resulting algorithm is going to be examined. As the pilot scope is limited, the complexity of the algorithm might have to be reduced and action points defined for the future enhancements. Based on this, it will be decided which of the above mentioned parameters will be marely attributes of the shipment and which ones would count in decision making for the optimal route selection. Furthermore, apart from the main KPIs defined for the pilot phase, other possible KPIs might be examined and suggested as relevant for the future consideration.

4.3.2 Travel Sections & Nodes

Once cleared the Phase 0, the system will move towards Phase 1, for the System Calculation phase. The system will use the information obtained at Phase 0, to check the ITUs requirements and compatibility at point 4.3.3 and compare them with the Travel Sections and Nodes requirements. In particular, this function will evaluate all the available road, rail and sea connections, breaking them down to a comparable scale in terms of transit times, costs, CO2 emissions and availability of service for a particular date or timeframe. The comparison will lead to a mix&match of choices, which will allow the system to generate multiple route options based on the three-modality road-rail-sea. Each section of the journey will have its own modality and the relative nodes for departure and arrival. Each travel section and node will be then mapped and related to a Rail Terminal or a Port Terminal for the rail and sea connections.

4.3.3 ITUs

The ITUs check will happen at the same time with the section 4.3.2 relative to Travel Sections & Nodes. In particular the system will double-check if an ITU has not yet been assigned to the service, as per Phase 0, whether using a craneable semitrailer, a container or a swap body may change the economical output of service, or its timescale or emission profile. In order to do that, the system will need to cross-check containers, swap bodies and craneable semitrailers with the travel sections requirements, using the multiple conditions available such as ITU size (ex. 30', 40', 45' etc.), type (tank, bulk, HC, etc.), EN13044 standard (P386vsP400 for craneable semitrailers), max net load and gross load of the unit, max volume of the unit, restrictions, etc.

Finally, the system aims at collecting all multimodal and road-based information for the service, such as ILU code of the ITU and road info for the DtT, TtD and other eventual road services, including: drivers' name, company and plate for the first and last mile.

In order to simplify the pilot scope, a limited ITU fleet is going to be defined for each travel node, sufficient to demonstrate the selection principle.

4.3.4 Trains, Stations & Rail Terminals

Once cleared the info at points 4.3.2 and 4.3.3, the system will check the rail routes for the following information: train schedules, capacity, space availability for a particular service or period, ITU requirements, wagons' composition, eventual dangerous goods restrictions, booking procedures, storage and THC fees at terminals and terminal working hours (opening times and crane operation times). The aim is to evaluate each single multimodal and conventional rail service for a specific shipment, in terms of costs, times and CO2 emissions, and the ITU compatibility with the wagons.

4.3.5 Vessels

Once cleared the info at points 4.3.2 and 4.3.3, the system will check the sea routes for the following info: typology of the vessels operating sea routes, schedules of service, capacity and space availability for a particular service or period, ITU requirements and eventual dangerous goods restrictions. The aim is to check whether or not a vessel operating a sea route may be capable of loading a selected ITU.

4.3.6 Ports & Terminal

Once cleared the Vessels compatibility at point 4.3.5, the system will then proceed with the relative Ports and Terminal checks, considering them as Travel Nodes for the selected sea route. Per each port of departure and arrival there will be a check for ITU requirements, booking procedures, dangerous goods restrictions, storage and THC cost and working hours.

4.3.7 System Output

Once cleared Phase 1, the system will proceed with the Phase 2. In this phase the system will show its outputs, the results of the route comparison, mapping different options available for a particular service, comparing them with the set of variables such us timescale, cost and CO2 emission. By doing that, the system compares different services available, according to the set of variables acquired and calculated at phases 0 and 1, allowing the user to quickly see the options available, make a choice and proceed with the service booking. The service booking function will not be directly included in the Pilot phase, but it will be added to the transferability plan and the roadmap sections for future development.

4.3.8 Track&Trace and Re-Routing

Once the user will have made the route decision, the system will enter into Phase 3, a phase where the shipment will be tracked in each step of the multimodal supply chain, with a checkpoint system at each travel node. Once cleared each travel node, the system will evaluate potential delays or disruptions that may interfere with the other travel sections within a specific scheduled shipment. Once recorded a potential delay or disruption, the system may allow the user to re-route in any case the shipment, calculating back at Phase 1 the options available at that particular time and date, and the relative differences in costs, time and emissions.

The re-routing phase will not only base its function on services that may be considered at risk, eventually the re-routing in some cases will become fundamental when an actual delay or disruption will make the originally selected route unavailable or breaking the original criteria of maximum cost-time-emission. In this case the system will intervene by informing the user that the original route is not anymore available due to delays or disruptions, and will go back to Phase 1 in order to calculate at a specific time and date the new options available.

If the re-routing channel will be activated, the system will go back to Phase 1, it will calculate the options available, bring a new Phase 2 output, allowing again the user to select a new re-routed schedule among the new ones available and, once concluded the Phase 2 with a selection, the system will move back to Phase 3 in order to track&trace the new re-routed service.

One of the most important functions to be activated among the Track&Trace and Rerouting ones will be the Traffic&Weather option, that will allow the system to monitor the current situation of the road traffic and weather conditions impacting road and sea services, and also to potential rail traffic delays info. The Traffic&Weather function will eventually populate real-time data comparing it with the Track&Trace system and it will offer a dynamic instrument to evaluate potential service disruptions. For the pilot sake, traffic&weather function might need to be simulated, as real time feeds would most probably be out of scope.

Based on all the info available, the system will use 6 main parameters for re-routing:

- Vessels - RT conditions (ETA, Schedules);

- Trains - RT conditions (ETA, Schedules, Capacity, Delays, Restrictions, CT, RtPU);

- Road - RT conditions (ETA, traffic delays, infrastructure restrictions, driver and health&safety restrictions);

- Ports - RT conditions (loading and unloading times, cargo procedures and delays);

- Weather - RT conditions (temperature, rain/snow/winds, pollution);

- Other restrictions (ex. strikes, etc.).

4.3.9 Reporting

If the shipment will have been concluded, with or without a re-routed option, Phase 3 will end. At that point the system will pass to Phase 4, where the reporting process will begin. At that point the system will need to evaluate all the information processed from Phase 0 to Phase 3, arriving at a clear set of variables: the first set is connected to the Requested Outcomes in terms of costs, times and emissions established on Phase 0, then connected to the Planned Outcomes given by the system at Phase 2 and selected by the user, the eventual Re-routed Planned Outcomes given by the system at Phase 2 (re-routed one), and finally compare them with the Actual Outcomes, given by the final checkpoint Track&Trace system at Phase 3. The long term objective of this function is not only to define whether or not the system is reliable in predicting ETAs, costs and emissions, but also to understand if there are some travel sections that are representing an obstacle or that are unreliable due to their nature or affected by disruptions. For example, it may be the case for the system of being able to predict with good estimates the ETA and cost of a service on the sea and rail department, but a particular road section connecting a rail terminal to a particular port may be affected by important roadworks, impacting the selected services, and forcing a shipment to re-route the selected path towards another road route to avoid traffic. In the future, the roadmap and the transferability plan will include this point, the system may have an AI integrated algorithm that may help the system to learn from previous mistakes and to acquire an experience when selecting a particular route. Another interesting point would be to include in the future a feedback-based function to evaluate travel sections and nodes.

5. Project development

The pilot project development will follow a 4 step process:

1. Preparation of the pilot environment;

2. Development of the pilot application;

3. Pilot application testing and acceptance;

4. Pilot deployment and documentation.

5.1 Preparation of the Pilot environment

The preparation of the pilot environment will be an important step to make sure that all the system variables and notions are in place before the actual development and testing phase can begin. On this subject it is essential to note that most of the information that the system will use in real life will be obtained by other companies' systems.

For the pilot phase, rather than collecting the inputs directly for other companies' systems, the set of variables and inputs will be gained separately and given to the system for the calculations.

The set of variables is important to be carefully defined, covering all required parameters, ranging from the ITUs types to terminal restrictions. For the simplicity, some of them might have to be assigned estimated values instead of the real ones. This might happen for the privacy reasons (reluctance to disclose the information) or the feasibility reasons (as the real system integration is our of the pilot scope).

For the pilot sake, a demo data set is going to be prepared, which can be fed into the DelPlan application and shown to the public, by simulating the transportation process. The application should be able to do this simulation and show the transportation 'milestones'.

In particular, the set of data that the system will need to acknowledge will be:

- Booking & Transport Orders:
    - Types of goods (relative packaging groups & material state);
    - ITUs' compatibility with a set of goods;
    - Dangerous goods (Class, Packing Group, UN codes, Kemler codes);
    - ETAs, Volumes and Frequencies set of variables;
    - Mandatory Conditions (Costs, timescales and emissions).
- ITUs:
    - Category: containers, swap bodies, cr. semitrailers;
    - Type: bulk, tank, HC, curtain side, etc.;
    - EN13044: gabarit, trailers codes, etc.;
    - ILU codes register;
    - Road info registration.
- Travel Sections and Nodes:
    - Modality: road, rail, sea;
    - Travel sections and nodes: mapping the existing services concerning rail and sea connections and the relative nodes. For the pilot phase, this task will be conducted on the selected geographical test area only.
- Vessels:
    - Routes and relative Schedules of services;
    - Vessel typology;
    - Vessel capacity;
    - ITU requirements;
    - Dangerous goods restrictions.
- Ports and terminals:

    - ITU requirements;
    - Booking procedures;
    - Dangerous goods restrictions;
    - Storage and THC costs;
    - Working hours.
- Trains, Stations & Rail Terminals;
    - Train routes and schedules;
    - ITUs requirements;
    - Wagons' composition;
    - Dangerous goods restrictions;
    - Storage and THC costs;
    - Working hours.

Once the set of input above will have been defined, they will represent the base of knowledge for the system in order to make assumptions.

5.2 Development of the Pilot application

The Pilot application will be developed on a 4 step specification:

- A Backend Solution;
- A Front-end Solution;
- An Input Process;
- An Output Process.

The Backend solution will involve the periodic recalculation of possible re-routes, as well as processing alerts in case of service disruptions. The backend solution will eventually be linked to the traffic&weather module and it will use a recalculation algorithm based on a predefined set of inputs. For the pilot phase, the traffic&weather module might need to be simulated.

The Frontend solution will consist of a user-friendly interface to allow the system operator to enter required data, visualize the selection of routing options, filter the relative service options (costs, travel times and emissions) and to make the actual selection of the preferred route. On the same interface, the system will inform the user of potential disruptions or delays of service, displaying the re-route options.

The Input process will consist during the pilot phase of a simulated environment with prepared data (lab-simulated mixed with real-time data). The future development is envisaged to include a Webservice API based-platform, capable of obtaining the inputs directly from the operators' ERP systems.

The Output process will allow the system to generate data towards a Webservice API based-platform, which will in the future be capable of feeding the results of the system directly into the operators' ERP systems.

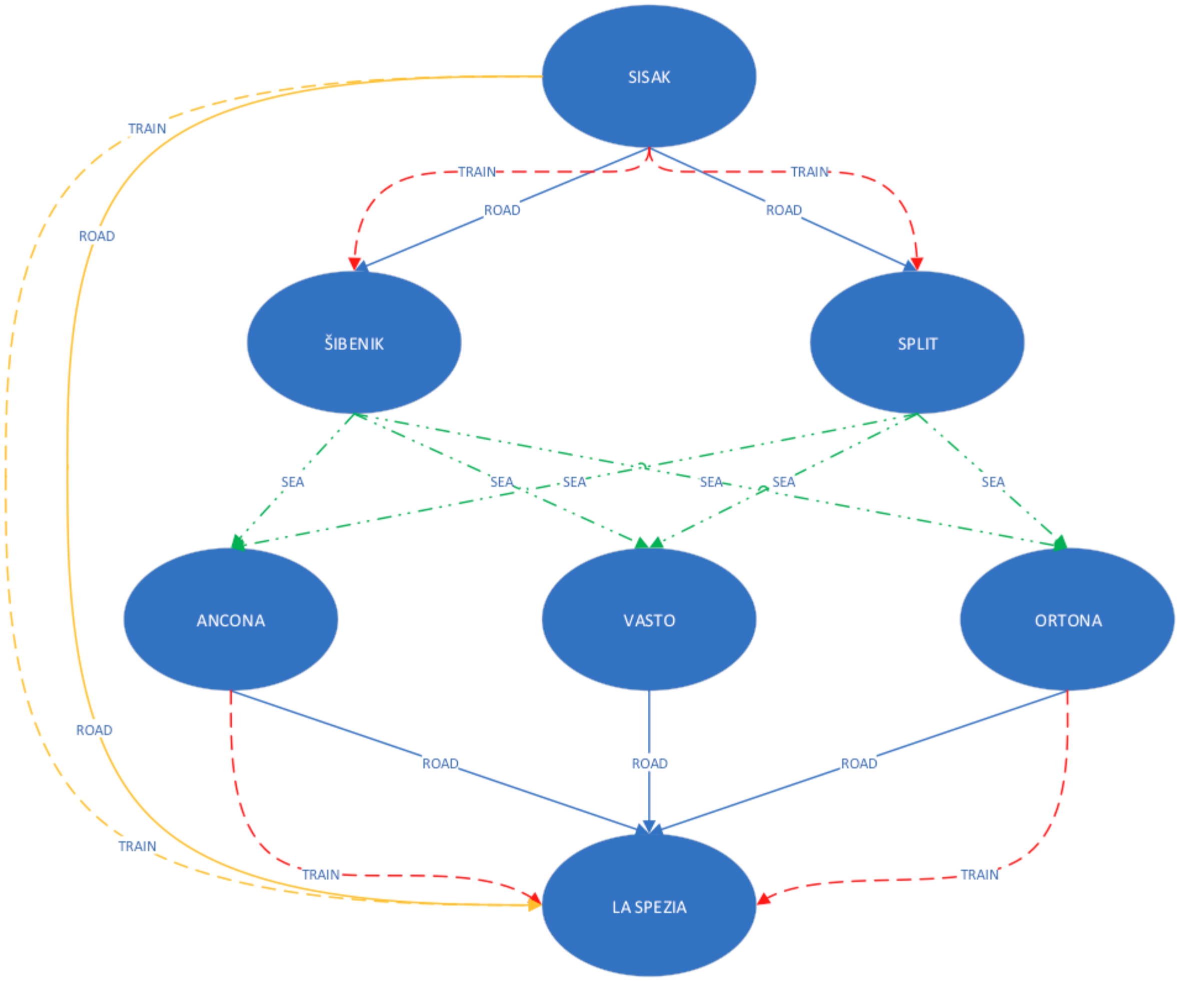
An agile, test driven development approach is going to be applied, consisting of development and test iterations, operating on demo data sets. Depending on the results of each iteration, data sets are going to be enhanced and new functionality developed until the satisfactory output is obtained.

Although a functioning Web service, communicating with external systems, would be a desired final outcome, it is clearly out of scope for the pilot. WebAPI development is very time consuming and should be technically aligned with possible target system, which is not feasible within the pilot timeframes and available resources. However, it is expected to get a fair idea on the data structure to be exchanged and exposed as a web service API, as the basis for the future integration developments.

5.3 Pilot application testing and acceptance

The Pilot application testing phase will concentrate on the specific transport corridor, considering Sisak area and port of La Spezia. For the particular service, there will be potential opportunities for choosing the right ITU and determining suitable travel routes by selecting services on the three modal options, road, rail and sea.

Table 3. Deliveries Planning - Pilot Application Testing



By limiting the geographical area of coverage for the system, it will be possible to better identify the issues and mistakes of the Pilot application, thus getting a better chance to solve them.

The **first objective** of the Pilot final testing will be to evaluate, in terms of cost, transit times and CO2 emissions, the various options available in connecting the industrial site of Sisak to La Spezia.

On this particular point, the Pilot results will need to compare a standard 100% road service made by truck to a multi-modal service. Several options on this subject will be compared: train services from Sisak to the ports of Sibenik and Split, and sea connections (some of which will be lab built) between the ports of Sibenik and Split to Italian ports, in particular Ancona, Ortona and Vasto. Finally, there will be a comparison of the rail services actually available on the Italian side of the Adriatic, such as two existing MTO services connecting Interporto d'Abruzzo (at a short range of distance from Ortona and Vasto Ports) to Interporto Novara T1 in the Piedmont Region (with the final part of the service made by road from Interporto Novara T1 to La Spezia), or the connection between Interporto Marche (linked by a shunting rail connection with the Port of Ancona) to Port of La Spezia. The different rail connections will have peculiar implications and differences also in the ITU requirements.

The **second objective** of the Pilot testing would be to handle an unexpected event that would disrupt the originally selected service, forcing the user to re-route the service and to choose another option. Within the pilot scope, we will have a demo datasets for parameters like weather alerts, traffic congestion, route closure and other disruptive events, with the possibility to simulate these disruptions. If feasible, we will try to connect to real external sources of data.

The **final objective** of the Pilot testing would be to generate a report, where the final chosen option after the re-routing will be compared to the originally scheduled one, comparing the differences between planned vs actual costs, transit times and emissions.

As part of the pilot project methodology, we are planning to engage existing operators as stakeholders, to cooperate where deemed necessary within the expected Pilot plan. This would be mostly benefitial in data collection and testing phases. In particular, we are planning to engage one Shipper (a large manufacturing plant, originating the service), one Multimodal Carrier (operating the multimodal service with his own ITU), two Road Carriers (operating the road services for the first and last mile to move the selected ITU), three MTOs (operating different rail services: Sisak → Port of Sibenik, Interporto d'Abruzzo →Interporto Novara T1 and Interporto Marche → Port of La Spezia) and one sea shipping company (operating the Ro-Ro or the container ship service from Port of Sibenik to Vasto and Ortona ports, and from Port of Split to Port of Ancona).

The **final testing results** will be handed over to the Multimodal Carrier which will also be considered as the system user. One operative user will be responsible to operate the Pilot testing system, will make the final decisions in terms of service routing and re-routing and will receive the final shipment report. The other actors will not participate directly in the decision-making process within the system, but will provide the data that will be required for the system to work.

To be clear, for the pilot testing, we will need stakeholders' datasets, but we don't need real-time connection to their data, as this would be beyond the pilot scope. Rather, we will use off-line data or "snapshots in time" in order to simulate decision making process.

For the Pilot testing results assessment, the main success factors are going to be the reliability of data and the ease of use for the end-user, the operative staff of the Multimodal Carrier. In order for the pilot system to be positively assessed, the end-user interface will need to be simple, effective and reliable. The same would need to be considered for the Pilot service report, as the final report will bring several important insights on the service performance and it needs to be credible. The external stakeholder feedback would be a brilliant tool to get valuable and realistic content for the Transferability and Action plans.

5.4 Pilot deployment and documentation

If testing results prove favourable, the pilot application is going to be released for usage, subject to transferability and action plans. The procedure and the preconditions for publishing the solution for use to the target users will depend on their function within the multimodal supply chain.

For the Multimodal Carriers and Shippers, there will be a dedicated user manual and the explanatory Whitepaper that will show the target groups how to use the system in order to reduce cost, transit times and CO_2 emissions of standard freight transport services, by comparing them to multimodal ones. The user manual will show users how to use the system for deliveries route planning, in particular how to:

- enter the required data
- filter the results given by the system
- proceed and confirm a single route among the ones presented
- track&trace a shipment

- get alerted in case of delays or disruptions
- proceed with re-routing calculations
- request a shipment report at the end of a service

Other target groups are going to benefit from the pilot testing results and the subsequent Transferability and Action plans, which are going to follow on the pilot deployment phase.

The following are some important aspects for inclusion into the prospective **Transferability and Action plans,** the required deliverables after the pilot completion:

For Road Carriers, there will be a dedicated chapter displaying the opportunities to use the system as an advertisement for their services, while at the same time managing the services on an operational level directly on the platform. For these users, the system will work as the road travel section management platform.

For Ports and Sea Shipping Companies, the pilot will represent a strong opportunity to advertise their connections, to boost the sales of shipping spaces and to better manage the information flow between the Multimodal Carrier, the Port Terminal and the Sea Shipping Company. This information flow will be directly managed by the system and a dedicated chapter will be provided for the process. For these users the system will work as the sea travel section & nodes management platform.

For Rail Operators, MTOs and Rail Terminals, the pilot will represent a strong opportunity to advertise services and connections, to boost the sales of terminal storage spaces, train ITU spaces, and to better manage the information flow between the Multimodal Carrier, the MTO, the Rail Terminal and the Rail Operator. This information flow will be directly managed by the system and a dedicated chapter will be provided for the process. For these users the system will work as the rail travel section & nodes management platform.

Each travel section and node manager is going to be given an opportunity to update the system data, initialy manually, but if proven feasible, in the future, ideally by using the provided automatic connection between the Pilot system and the ERP company system. By updating schedules, restrictions, space availability and ITU restrictions across the travel sections and nodes, decision making parameters, as well as by replacing lab data with real data, it will be possible for the system to become more reliable and precise, thus leading to the wider and real time use in the future.

The dissemination activities at the end of project events will point out the potential developments of the system on a long term base, including the potential AI intervention on the system in learning and predicting routes disruptions and delays, reaching the end goal of the whole system, making multimodal deliveries easier to manage.

A dynamic access form will allow new users' accessibility in the 5 year post-deployment phase, increasing the user base and the geographical area of coverage. The maintenance will be required only to make sure the info are updated and still reliable, the system itself will have an internal data control to detect potential wrong information or missuse.

In the Transferability Plan and the Action Plan, apart from recommending the extension of the geographical area of coverage, making it larger and more pan-European, the potential use of AI for the system to become more adaptive to changes, it will be possible to include the function's map expansion, including new potential functions to the system. One of the most important functions to include will be the Automatised Booking Function, allowing the system to directly share the info obtained for the booking processes, completing the booking steps with Sea Shipping Companies, MTOs, Port and Rail Terminals, making the system even more effective.

6. Project team

The Project Team will be composed of 3 members from Polo Inoltra and 6 development team members from Actual IT.

Polo Inoltra pilot project team with identified roles and responsibilities:

1. Marco Grifone, project team leader, job role: Freight Transport Division Development Manager, project role: Project Manager, in charge of overall project management, financial & organizational governance, and technical development;

2. Emanuela Di Luca, project team member, job role: Director, project role: Project Financial Director, Steering Meeting Committee representative, in charge of top-level project steering;

3. Luca Gasbarro, project team member, job role: Admin, HR & Communications, project role: Project Communication Manager, responsible for communication and dissemination activities.

Actual pilot development team with identified roles and responsibilities:

4. Karmen Krivičić Spajić, Pilot development team leader, job role: Project Manager for PP5 within DigLogs, project role: Pilot Development project team leader, in charge of anaylsis and management od Pilot application implementation; also DigLogs WP5 Package Leader, in charge of WP5 steering

5. Ivor Grlaš, Pilot development team member, project role: Lead pilot application developer, in charge of drafting the IT structure of the pilot and leading the application development team

6. Kristijan Nikolozo, Pilot development team member, project role: Pilot project analyst, in charge of requirements specification and testing

7. Borna Plentaj, Pilot development team member, project role: Pilot project analyst, in charge of requirements specification and testing

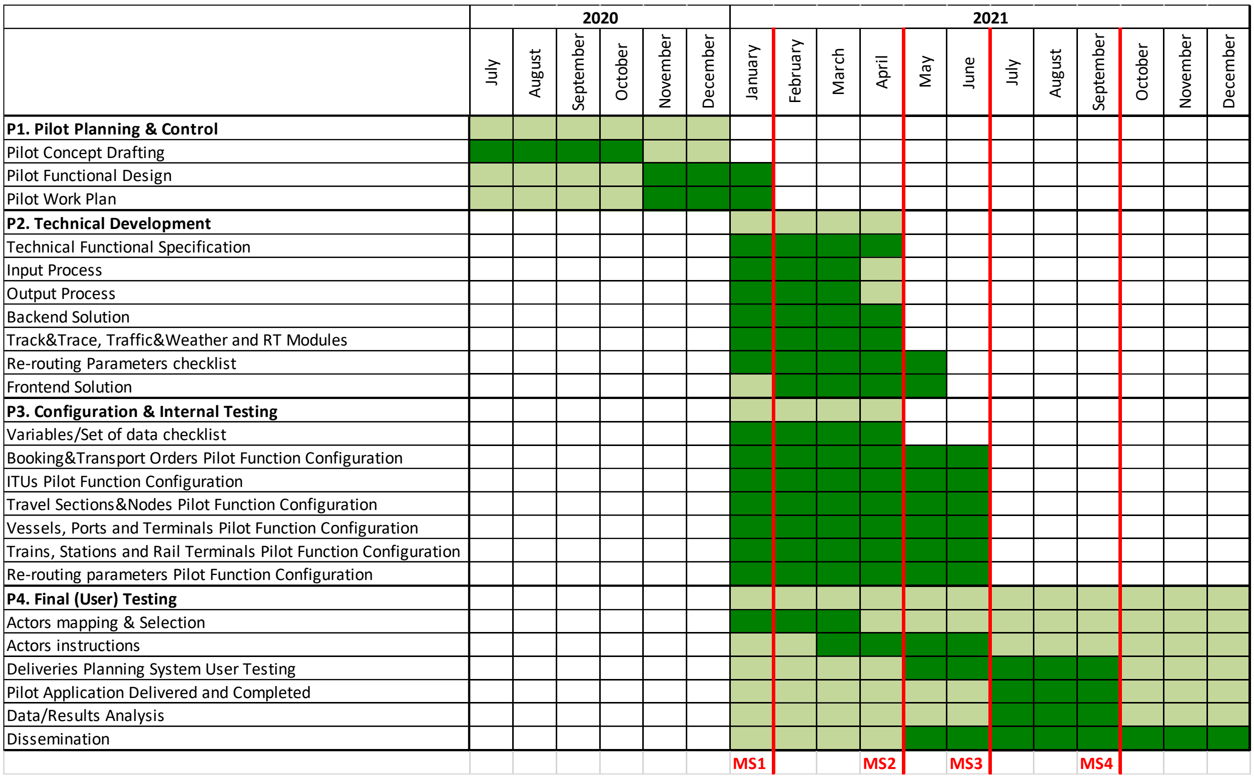
8. Darko Tarandek, Pilot development team member, project role: Pilot application developer, in charge of backend tier development

9. Daniel Vodopija, Pilot development team member, project role: Pilot application developer, in charge of frontend tier development

7. Project Timeline

Table 4. Deliveries Planning - Project Timeline

As shown in Table 4. the Project Timeline will follow the 4 previously indicated milestones and the 4 phases of the project.



The first phase, the Pilot Planning & Control will end in January 2021, the second phase, the Technical Development will mostly run in parallel with the third phase, the Pilot Configuration & testing, ending in June 2021. Finally, the last phase, P4, related to the final Pilot testing will end in September 2021, allowing dissemination activities to spread all the way till the end of the project in December 2021, running in parallel with the final WP5 phases, transferability and action plans.

8. Project risk management

Common risk register methodology was developed by the Responsible Partner of WP4, in earlier stages of the project, and it will be used to identify and mitigate risks that might arise from the pilot execution.

The goal of the risk management of the pilot project is to address all the foreseen risks from various aspects:

- Use preventive measures and risk avoidance, where possible, in order to avoid risk occurrence (most favorable),
- Use mitigation measures, where possible, to lessen the risk impact (less favorable),
- Use risk transfer (to third parties), to lessen the risk impact, and
- Establish a clear list of actions and contingencies including escalation path towards WP5 leader and LP and have informed opinion on residual risk.

However, the project will be relatively short in duration (pilot execution), so it is logical that this fact will help significantly in its successful completion.

No high level of technical risks is anticipated, so most common project risks may reasonably be expected.

The used risk register is shown in Table 5 below.

ID	Date raised	Risk description	Likelihood of the risk occurring	Impact if the risk occurs	Severity *Rating based on impact & likelihood.*	Owner *Party who will manage the risk.*	Mitigating action applicable to pilot project action *Actions to mitigate the risk e.g. reduce the likelihood.*	Contingent pilot project action *Action to be taken if the risk happens.*	Progress on pilot project actions	Status of the registered pilot project risk
1	[risk identification date]	Pilot project purpose and need is not well-defined	Medium	High	High	LP/SC	Complete a business case for the harmonization pilot if not already completed and ensure purpose is well defined according to project plan	Escalate to the LP/SC and inform WP5 leader with an assessment of the risk of runaway costs/never-ending project.	Business case re-written with clear deliverables and submitted to the LP/SC for acknowledgement	[Open/ Closed]
2	[risk identification date]	Project design and deliverable definition is incomplete.	Low	High	High	LP/SC	Define the scope in detail via design details, workshops and meetings with PP/LP and input from subject matter experts.	Document assumptions made and associated risks. Request high risk items that are ill-defined are removed from scope.	Design workshops and meetings scheduled.	[Open/ Closed]

3	[risk identification date]	Project schedule is not clearly defined or understood	Low	Medium	Medium	PP	Hold scheduling workshops with the project team (internal and external providers) so they understand the plan and likelihood of missed tasks is reduced.	Share the plan and go through upcoming tasks at each weekly project progress meeting.	Workshops scheduled.	[Open/ Closed]
4	[risk identification date]	No control over staff priorities	Medium	Medium	Medium	PP	PP should brief internal team managers on the importance of the project. Soft book resources as early as possible and then communicate final booking dates ASAP after the scheduling workshops and meetings. Identify back ups for each project team member engaged on the project.	Escalate to the PP's top management and bring in back up resource, inform LP/SC, and inform WP5 leader	PP's top management has to agree to hold briefings. Identification of suitable arrangements (meeting room, teleconferencing tools)	[Open/ Closed]
5	[risk identification date]	Consultant or subcontractor delays	Medium	High	High	PP	Include late penalties in pilot project contracts. Build in and protect lead time in the schedule. Communicate schedule early. Check in with supplier's progress regularly. Query statements like '90% done'. Ask again and again if the supplier or consultant requires additional information.	Escalate to LP, SC and top management of the supplier and inform WP5 leader. Implement late clauses.	Lead time from each contractor built into the project schedule. Late penalties agreed to and contracts signed.	[Open/ Closed]

6	[risk identification date]	Estimating and/or scheduling errors	Medium	High	High	PP	Break this risk into two parts: 'cost estimating' and 'scheduling errors'. Use two methods of cost estimation, and carefully track costs and forecast cost at completion making adjustments as necessary. Build in 10% contingency on cost and scheduling. Track schedules daily and include schedule review as an agenda item in every project team meeting. Flag forecast errors and/or delays to the Project Board early.	Escalate to LP and SC and inform WP5 leader. Raise change request for change to budget or schedule. Pull down contingency.	Contingency agreed by the top management of the PP; LP informed.	[Open/ Closed]
7	[risk identification date]	Unplanned work that must be accommodated	Low	High	Medium	PP	Attend project scheduling workshops. Check previous projects, for actual work and costs. Check with peer companies for actual events during similar projects. Check all plans and quantity surveys. Document all assumptions made in planning and communicate to the vendor's project manager before project kick off.	Escalate to the vendor's project manager with plan of action, including impact on time, cost and quality.	PP's team attending scheduling workshops.	[Open/ Closed]

8	[risk identification date]	Lack of communication, causing lack of clarity and confusion.	Medium	Medium	Medium	LP/SC/PP	Write and discuss a communication plan which includes frequency, goal, and audience of each communication. Identify stakeholders early and make sure they are considered I the communication plan. Use most appropriate channel of communication for audience e.g. don't send 3 paragraph email to developers, have a call instead.	Correct misunderstandings immediately. Clarify areas that are not clear swiftly using assistance from Project Sponsor if needed.	Communication plan in progress.	[Open/ Closed]
9	[risk identification date]	Pressure to arbitrarily reduce task durations and or run tasks in parallel which would increase risk of errors.	Low	High	Medium	PP	Share the schedule with key stakeholders to reduce the risk of this happening. Patiently explain that schedule was built using the expertise of subject matter experts. Explain the risks of the changes. Insist on contractual obligations towards pilot project vendors.	Escalate to LP and SC with assessment of risk and impact of the change, and inform WP5 leader Hold emergency risk management call with decision makers & source of pressure and lay out risk and impact.	Awaiting completion of the schedule.	[Open/ Closed]

10	[risk identification date]	Scope creep	Medium	High	High	PP	Document the pilot project scope in a Project Initiation Document or Project Charter and get it authorised by the PP. Include the full scope in the contract. Refer to it throughout the project and assess all changes against it also ensuring alignment of any changes with the business case.of the pilot project.	Document each and every example of scope creep NO MATTER HOW SMALL in a change order and get authorisation from the project board BEFORE STARTING WORK. This includes ZERO COST changes.	Scope clearly defined in the contract.	[Open/ Closed]
11	[risk identification date]	Unresolved project conflicts not escalated in a timely manner	Low	Medium	Medium	PP	Hold regular project team meetings and look out for conflicts. Review the pilot project plan and stakeholder engagement plan for potential areas of conflict.	When aware immediately escalate to LP and SC and gain assistance from LP to resolve the conflict. Inform WP5 leader	Project team meetings scheduled.	[Open/ Closed]
12	[risk identification date]	Proposed pilot action becomes obsolete or is undermined by external or internal changes.	Low	High	High	PP	No ability to reduce likelihood, but make sure early warning is given by reviewing pilot action on regular basis with the LP/SC prior to stipulating the contract.	Initiate escalation and project close down procedure.	Project close down procedure confirmed with Project Board.	[Open/ Closed]
13	[risk identification date]	Delay in earlier project phases jeopardizes ability to meet fixed date. For example delivery of just in time materials, for conference or launch date.	Medium	High	High	PP	Ensure the project plan is as accurate as possible using scheduling workshops and work breakdown structure. Use Tracking Gantt and Baseline to identify schedule slippage early.	Consider insurance to cover costs and alternative supplier as a back up, if possible.	Awaiting completion of the schedule.	[Open/ Closed]

14	[risk identification date]	Added workload or time requirements because of new direction, policy, or DigLogs project changes	Low	Medium	Medium	PP	No ability to reduce likelihood.	Acquire advanced notice from SC/LP if possible. Inform WP5 leader	Pilot project management reviewing options.	[Open/ Closed]
15	[risk identification date]	Inadequate testing by the project team or involved (aimed) stakeholders leads to large post go live snag list.	High	High	High	PP	Ensure that test cases/quality checks are timely prepared and testing/quality assurance window is protected.	Raise risk immediately and raise issue if it is clear that UAT testing is inadequate. Stakeholders could extend testing & bring in additional resource.	Stakeholders preparing test cases.	[Open/ Closed]
16	[risk identification date]	Legal action delays or pauses project.	Low	Medium	Medium	SC/LP/PP	Ensure all contracts signed before starting the pilot project. Follow all regulatory requirements and complete stakeholder management plan.	Escalate to the PP's management who will notify legal department. Follow instructions from legal department and inform LP/SC. Inform WP5 leader	Contracts issued.	[Open/ Closed]
17	[risk identification date]	Stakeholder or PP refuses to approve deliverables/milestones or delays approval, putting pressure on project manager to 'work at risk'.	Medium	Medium	Medium	PP	Ensure that PP's decision maker with budgetary authority is identified before project start and is part of the project board. Communicate dates for sign-off points up front.	Escalate to PP's management and LP and recommend action e.g. - to stop the project. Inform WP5 leader	Pilot project manager is confirming their sponsor / top management of the supplier.	[Open/ Closed]

18	[risk identification date]	Theft of materials, intellectual property or equipment.	Low	High	High	PP	Follow security procedures, ensure Non-Disclosure Agreements (NDAs), & compliance certificates are in place along with required confidentiality clauses. Verify all physical security measures in place. Secure insurance, if applicable.	Notify appropriate authorities e.g. police, legal department, LP, SC and initiate internal investigations . Inform WP5 leader	NDAs issued. Security certificates confirmed for contractors/suppliers working on the pilot project.	[Open/ Closed]
19	[risk identification date]	Acts of God for example, extreme weather, leads to loss of resources, materials, premises etc.	Low	High	High	PP	Ensure insurance in place and valid. Familiarise project team with emergency procedures. Where cost effective put back up systems in place, if applicable.	Notify appropriate authorities. Follow health and safety procedures. Notify stakeholders, LP and SC. Inform WP5 leader	Public Liability Insurance confirmed along with additional premises insurance at site / for the pilot project.	[Open/ Closed]

20	[risk identification date]	Pilot project stakeholder's action (or lack of) delays project.	Low	High	High	PP	Identify interested and dedicated stakeholders before start of the pilot project, analyze power and influence and create a stakeholder engagement plan. LP/SC to check and if applicable, authorise the plan. Revisit the plan at regular intervals during pilot project execution to check all external stakeholders are managed. Consider getting additional insurance.	Notify appropriate authorities and follow internal procedures e.g. for activist demonstrations. Inform WP5 leader	Stakeholder involvement analysis in progress.	[Open/ Closed]

Legend:

LP = Lead Partner

SC = Steering Committee

PP = Project Partner (PP6 in this case)