DigLogs

Action plan

Activity title: 5.5 Action plan

5.5.2 Action Plan

Responsible partner: **Involved partners:**			
Version	**Status**	**Date**	**Author**
1.0	Draft	20.11.2021.	Aksentijević Forensics and Consulting
1.1	Draft 2	22.11.2021.	LP - PFRI
2	FINAL	29.11.2021.	Actual
Notes:			

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1. Introduction

DigLogs aims to create the technological solutions, models and plans to establish the most advanced digitalized logistic processes for multimodal freight transport and passengers' services in the Italy-Croatia area. The results of the 7 implemented pilots have shown the significant impact this project has on the quality, safety, efficiency and environmental sustainability of marine and coastal transport by means of multimodal approaches and digitalized process flows.

The objective of Activity 5.5 – Action plan is to provide an easy tool collecting together the most relevant experiences and results of Diglogs project. This document describes the measures to be taken in order to support the digitalization process in the programme area after project closure. The three trends described in the framework of WP3 have been revisited, analyzing the situation before project implementation, the current situation and the future prospective. Results achieved in WP3 and WP4 have been updated, where further improvements were recorded during the project life span.

The SWOT analysis from WP3 has been be revised with the respect of the pilot testing results, in terms of what has been achieved, what has not been achieved and why, lessons learnt and future perspective. Feedback from stakeholders, both after the WP4 consultations and then again during the WP5 pilot implementation and testing, deployment and verification, has been considered in the compilation of the results for each pilot.

This document has been assembled with respect of the all 7 pilot results, collected within *D5.5.1. Main Results Collection Template*, filled in by the pilot project partners. Once completed, the *D5.5.2 Action Plan* document is going to be spread among the sector stakeholders for the future reference.

2. Brief pilot descriptions and most important results

The following subchapters present a brief description of all Diglogs pilot actions, testing the most valuable solutions mapped within the three trends described in the framework of WP3, along with the most important results that were achieved, as follows:

Process informatization trends in the programme area:

- Pilot 1: WMS 4.0 – Dry Port Case Study (PP2 - Elevante)
- Pilot 3: Mobile Safety/Security (PP4 - UNITS)
- Pilot 5: Innovative solution for Access Control (PP8 – Port of Šibenik Authority)
- Pilot 6: M2M Dialogue (PP9 – Port of Rovinj Authority)

Big data for freight and passengers' mobility:

- Pilot 4: Application for Data Flows Management (PP7 – Port of Rijeka Authority)
- Pilot 7: Spatial Data Management System (PP1 - CFLI)

Traffic automation systems in multimodal transport:

- Pilot 2: PCS automation – Deliveries Planning (PP5 - Actual, PP6 – Polo Inoltra)

A more detailed description of individual pilots can be found in Deliverable 5.4.2 - Data Collection, and in the respective Pilot Work Plans.

2.1. Pilot 1 description and results: **WMS 4.0 – Dry Port Case Study** (PP2 - Elevante)

Trend: Process informatization trends in the programme area

Pilot name: WMS 4.0 – Dry Port Case Study

Pilot description:

The Pilot Action WMS 4.0 carried on by Elevante takes place in the intermodal rail-road terminal of Gorizia (**SDAG**), Friuli Venezia Giulia Region, Italy, mandatory transit point of the freight traffic flows between Western and Eastern EU (and also of most Italy/Croatia freight flows).

The pilot is related to the test of a web application that is going be used by carriers, Multimodal Transport Operators (MTO), dry ports and public authorities in the Programme area and that will perform an innovative service: **an information system delivering data about intermodal appointments in the nodes.**

Two are the aims of WMS 4.0:

- to demonstrate how multimodal transport arrangements among a heterogeneous set of logistics operators including carriers, logistic providers, transport operators and authorities can be thoroughly and conveniently optimized by exchanging real-time information concerning planned delivery schedules;
- to overcome existing transport challenges affecting the very last mile of the multimodal transport chain by making the execution of road transport activities from the destination railroad terminal in Gorizia (SDAG), Friuli Venezia Giulia Region, Italy to the final goods delivery destinations in the most efficient, convenient, and seamless way.

Results: A relevant tool of WMS has been implemented in the Pilot Action: a Decision Support System (DSS), implemented in the form of an open-source platform providing optimized transport arrangements for last-mile transport segments, by making use of specific algorithms and coordinated data from multiple stakeholders.

By allocating specific time slots to trucks via a booking system, the terminal operator will be able to optimize:

- the flows of incoming vehicles (specifying the gate, vehicle inspection, potential parking slot where to wait, etc.);
- resources utilization and operations management to the expected volume;
- traffic conditions to the terminal premises and surrounding areas;
- communication between the terminal and the drivers informing on delays, etc.

One of the main objectives of the DSS is to implement in the future a **Truck Appointment System** (TAS), which will enable a communication exchange between the inland terminal and truck operators, and to support the terminal manager in the optimum scheduling of operations.

In summary, the DSS pilot will consist of testing a centralized collaboration platform with MTOs, aimed at collecting from them useful data about their services (e.g., time schedules, origin/destination, delays, ETA/ETD) and providing scheduling support to carriers, other MTOs, dry ports and public authorities. The web application envisaged as part of the pilot will firstly be deployed at Gorizia terminal and will subsequently be open to other dry ports and MTOs in the Programme area, willing to upload their data.

<WMS 4.0 >		
Problem (before the pilot)	**Benefits/Strengths (current situation)**	**Improvements/Opportunities (future)**
Difficulties in communication between terminal operators, warehouse management and carriers for real time decision-making.	Real time decision making provided by DSS - Decision Support System and centralized data system.	Predictive data analysis based on historical data. Using statistical algorithms and machine learning techniques to identify the likelihood of future outcomes.
Difficulties in the exchange of data between MTOs, terminal operators and carriers.	Data synchronization offered by TAS – Track Appointment System, by making use of specific algorithms and coordinated data of the whole intermodal transportation chain, solving also last mile transport segments.	Large scale installation of WMS 4.0 will increase the efficiency of intermodal freight transport in national and international scale. The use of specific algorithms and coordinated data gathered from multiple stakeholders will provide optimized transport arrangements for last mile transport segments.
Redundancy, lack of data and data dispersion (e.i. Exchange of data in paper form or 1to1 mailing).	Digitization of flow management information.	The reduction of the redundancy, the lack of data and data dispersion by integrating further operators' systems.

2.2. Pilot 2 description and results: **PCS automation – Deliveries Planning** (PP5 - Actual, PP6 – Polo Inoltra)

Trend: Traffic automation systems in multimodal transport

Pilot name: Deliveries Planning System

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 results can be seen at the following page.

DelPlan		
Problem (before the pilot)	**Benefits/Strengths (current situation)**	**Improvements/Opportunities (future)**
Lack of information in relation to multimodal planning.	Integrated information on routes (rail-sea-road) & ITU's compatibility.	Potential extension of the geographical coverage.
Difficulties in prediction of transit times, costs and emissions.	Automatic cost, transit times and emission calculations.	Potential improvement of the algorithm in order to add also the hidden fees and external costs.
Delay and complexity in shipment re-routing, basing the operation on personal experience.	Improved re-routing options, based on the current traffic and weather situation.	Potential improvement of the system, in order to transform the current set of data (static) into a dynamic data-set for a real-time calculation of the service.
Complexity in calculating the emissions in a multimodal shipment.	Automatized emission calculator, taking into consideration the different emission classes for rail, sea and road options.	Improved algorithm on the emission calculation, for potential European certification of the emission saving effort.
Subjective selection of the service's ITU type.	Full cost-transit time-emission comparison for different service ITU, for an improved selection beforehand.	Extension of the available ITUs, in order to add more complexity to the system.

2.3. Pilot 3 description and results: **Mobile Safety/Security** (PP4 - UNITS)

Trend: Process informatization trends in the programme area

Pilot name: Mobile Safety/Security

Pilot description: During the UNITS pilot project, the technical feasibility of a system for aiding ship evacuation based on Bluetooth beacons have been investigated. Besides, the effect on the evacuation time due to the usage of mobile technology has been also studied to prove the benefit of such a system. The test on a small test population has been considered first advisable to compare the standard evacuation time with the one related to the adoption of mobile technology. The proposed technique has been tested in a limited area of the GNV Bridge Ro-pax ship. The pilot system is composed of a mobile application to be installed on mobile wearable devices (smart bands) and a backend application to configure and monitor the system from the ship bridge. The APP exploits a Bluetooth beacon net to enable mobile devices unauthorized.

Results: the feasibility of aiding the ship evacuation through the adoption of mobile technology has been proved. The experience gained is expected to foster the application of mobile technology to ease ship evacuation. The tests carried out with a sample population showed a mean reduction of evacuation time equal to 16.9% when some of the escape routes are not available. Hence, the benefits have been clearly demonstrated.

Mobile Safety/Security		
Problem (before the pilot)	**Benefits/Strengths (current situation)**	**Improvements/Opportunities (future)**
Fire or flooding might block some escape routes. Passengers shall then find alternative escape routes wasting time	The mobile guide reduces the evacuation time when escape routes are blocked	Return of image for the shipping company due to increased vessel safety. Besides, guidance might be an additional service to navigate the ship during normal operations.
During the ship's evacuation, panic might occur and passengers can be lost. Crew needs to search for them wasting time	The system enables the localization of passengers in real-time. It might aid the crew in handling lost passengers in a short time	Localization data can be used for commercial purposes, provided that all the privacy regulations are respected
The ship is a large and complex environment that requires the coverage of wide steel-made spaces	The pilot system has been successfully tested in a small space (2 decks in one main vertical zone) of a passenger vessel	The system has been designed to be easily scaled for application to wider environments.
During an emergency, main electric generators might not be available. Only a limited set of systems is connected to the emergency grid.	Beacons are equipped with batteries and the system is designed to continue working even in case of a connection drop between beacons and the backend	Wired connection and power source (connected to the emergency grid) might be implemented to make the system more

		resilient in case of WiFi failure
It is essential to assure a widespread usage of the app onboard to gain benefits during the evacuation	The pilot APP has been developed for specific wearable hardware that can be always carried by the passenger and integrated with other services onboard (e.g. open cabins, make payments, etc.)	A mobile APP downloadable from the main app-stores and working on passengers' own mobile devices could be developed

2.4. Pilot 4 description and results: **Application for Data Flows Management** (PP7 – Port of Rijeka Authority)

Trend: Big data for freight and passengers' mobility

Pilot name: Application for data flows management

Pilot description:

Main pilot function is provision of additional visibility layer to VTS system operators, increasing boat resolution and visibility, showing port basin situation to end stakeholders and passengers and enhancing safety in the area.

Scope of the pilot is requisitioning and purchase of the envisaged equipment, its installation and functional integration with the existing VTS system already in use in the Port control center of the Port of Rijeka Authority, and the visualization of the port panoramic presentation for the end user group of passengers using already existing visualization using Web page presentation.

Results:

First result of the pilot is established a monitoring system using a highly modular, ready to go, compact surveillance solution, consisting of video and fixed lens thermal cameras, which is ideal for short to medium range surveillance applications, capable to exactly pinpoint every small vessel or other vehicle present or approaching the passenger terminal. This underlines the passenger pilot category, where Port of Rijeka Authority's project neatly fits.

Second result of the pilot is installation of the video sensing device, serving output data to a dedicated, custom made Web client application will be connected via a pilot-developed module to existing traffic system and display in real time the inflow of small and large vessels and vehicles moving at the passenger terminal.

Application for data flows management		
Problem (before the pilot)	**Benefits/Strengths (current situation)**	**Improvements/Opportunities (future)**
The passengers did not have digital means to acquire situational data on the passenger port of Rijeka	Opening up information towards passengers	Exploit the path established within the project scope to further open up readily available information towards the public, especially traffic and passenger statistics, from PCS to-be system, in live mode
VTS resolution was lower than possible as all modules were not integrated	Enhanced VTS resolution	Explore technical possibilities for further VTS resolution enhancement
Addition of one more visualization layer decreases VTS visibility and ability to identify smaller vessels	Enhanced VTS visibility	Identify technical possibilities for vessel and other objects (pontoons, unidentified objects) identification and integration
Solutions for traffic management are disjointed and not integrated	Integration with already existing systems increases capability of the IT solutions portfolio (VTS and Rijeka Traffic)	Transfer effects to end users (passengers), even when it is not directly visible to them (enhancement of port basin security due to better resolution and visibility of smaller area objects)

2.5. Pilot 5 description and results: **Innovative solution for Access Control** (PP8 – Port of Šibenik Authority)

Trend: Process informatization trends in the programme area

Pilot name: Innovative solution for Access Control

Pilot description:

Pilot project of the Port of Šibenik is new digital access control system, and that encompasses stakeholders whose activities are aimed towards processes underlying passengers disembarking and boarding cruisers and passenger ships, port concessionaires, business personnel, vehicles, drivers, containers and other stakeholders within identified target groups.

At the beginning of the project, access control to the Port of Šibenik area was governed by the subject Regulation about identification cards of the Port of Šibenik Authority from 11th September 2015. ID cards used for ingress and egress control and access to information, cargo, premises and operative port spaces are used to identify persons and vehicles and they are particular to a certain person or vehicle and non-transferrable. There is also a quite detailed pricing list for permit issuing, as it presents a source of revenue for the Port of Šibenik Authority, in force as of 6th January 2017.

Results:

The system for digitalization of the demand request and access permits for the passenger side of Port of Šibenik has been built and put into production after H1/2021. Permits therefore became digital products whose status can be checked from any physical place using tools embedded in the system. In order to make the system automatic, every access permit has a unique

identification code (QR code) that is embedded and enables cross-checking with other data from the permit. Content of the QR code is hash string derived using ID-number encrypting by SHA-x methodology. Full digitalization ensures traceability and follow up to every request for permit issuing. Digitalization enabled additional functions for better traffic management and tracing port resources and increase general level of security. End users gain higher service levels and lowered levels of stress, as they are able to perform all these actions in advance and remotely.

Basic envisaged way to issue permit cards for the port access is achieved using **Web client**. This is going to be a public and permanently accessible multi-language web page (anticipated languages are Croatian and English languages) based on a web-shop principle.

PC application is used as a stationary register and back-end reporting and oversight component. Central PC application is used to sell all products envisaged as a part of the project, fulfil all requirements of all user categories and pay for the product and activate or deactivate them. For those user categories that need more permanent ID pass cards, there is an option to issue RFID cards.

Basic **sale channel** for ID cards is the Web. Advantage of the PC application is ability of the person in charge to intervene in case of need, there is no need to create user account (this activity is transferred to the user) and there is oversight of all business processes and phases. Large portion of the application is the reporting part. It is possible to determine roles and access rules to the application server. Laser printing of the reports and bills and ID cards is supported.

PC application for the police is a derivative of the base PC application that has a single basic function which is overview and processing of the created requests for access to the port area. Police employee or security designated person can deny access without changing the requests. Comment can be entered. There are basic reporting functions envisaged to view requests that have been cancelled ex posts – in order to check the work of the police and security officers. Police officer is a special dedicated class of the user representing him/herself using ID badge number.

The technology of the request acceptance and approval is similar to that used in the communal traffic vigilance.

Innovative solution for Access Control		
Problem (before the pilot)	**Benefits/Strengths (current situation)**	**Improvements/Opportunities (future)**
Manual permit issuing is a hindering effective cruiser passengers processing during the arrival	Increased speed of permit processing	Increase revenue
The process is manual, paper based, disjointed and not streamlined between different involved actors	Various applications suite for suitable and individual needs (police, Web, mobile application)	Increase control
The funds for access control solution implementation are not adequate and available	Cost efficiency in comparison to "off the shelf" products	Retain the know-how and transfer knowledge to other Port Authorities, become center of competence for the process
Passenger processing procedure is obsolete in comparison to the competition	Greatly modernized permits issuing and checking process	Transfer effects for other stakeholders and immediate positive externalities for the Ministry of Interior
Paper based system does not allow for searching and reporting	Introduction of structured reporting module and capability	Better reporting, automated reporting

2.6. Pilot 6 description and results: **M2M Dialogue** (PP9 – Port of Rovinj Authority)

Trend: Process informatization trends in the programme area

Pilot name: M2M Dialogue

Pilot description: Rovinj Port Authority's pilot for the DigLogs project consisted of upgrading the existing maritime traffic control system in order to further improve port's performance. The pilot set out to improve information system functionalities related to vessel traffic monitoring through an alternative to the traditional PCS which is able to interconnect with all of the port's stakeholders which would in turn result with improvement of the system functionality quality on all levels. This undertake referred to upgrade of the traditional PCS system which will serve its purpose as an intermediator between the given software and the National Single Window's – CIMIS.

Results: The acquired solution for the RPA's pilot on DigLogs project offers a lot of implementable modules covering the whole spectrum of port's business process which in result required a narrowing down of choice options while trying to improve Rovinj port's performances. The results following the installation and deployment of the acquired equipment greatly facilitated the overall port's business conduct. The facilitation came mostly through ease of contract generating process, graphic and visual representation of berth occupancy, preparation of official notes and complaints as well as facilitated way of making reservations and ship announcement entries. Real use-case performance indicators refer to the level of system automation, shorter time needed to perform simple tasks such as invoicing or billing, simplification and facilitation of mooring reservation procedures, accommodation to digital era requirements.

Customization and modularity are a prerequisite for any solutions that seeks to be a new backbone of any system. Here we have a specific situation where the operational and accounting parts of the business were not unified under one solution which made a situation slightly more difficult for Marina Master. Lot of customization, tweaks and further developing is required to arrive in a position where the working product can be fully deployed. It is common knowledge that this process can be really time-extensive and often costly. Marina Master is a great umbrella solution which offers a variety of features that elevate the port's performance levels in all of the business aspects, but it is unrealistic to expect that in such a short period every segment of port's business has been adjusted into the system's performance capabilities.

M2M Dialogue		
Problem (before the pilot)	**Benefits/Strengths (current situation)**	**Improvements/Opportunities (future)**
Use of outdated technological solutions	Currently used solutions enables faster and more efficient business processes	Possible facilitation of future integration with NSW
Incompatibility due to multitude of programs needed for smooth business conduct/Use of non-unified technological solutions	Elimination of need for using several non-interlinked services in order to keep track of all business-related activities	Easier future upgrades and transitions due to the fact that unified solution require less transitional work than several unrelated programs
Lack of automation/digitalisation	Simple improvements encompassed in pilot's solution enable greater level of autonomy while reducing the possibility of error occurrence due to human factors	Full automation of simple business processes resulting in greater efficiency, increased control and revenue

2.7. Pilot 7 description and results: **Spatial Data Management System** (PP1 - CFLI)

Trend: Big data for freight and passengers' mobility

Pilot name: Spatial Data Management System

Pilot description: The Spatial Data Management System for the North Adriatic Sea Port System Authority is a centralized and interoperable spatial data repository aimed at giving a robust structure to the information and data used within the internal processes and to provide services to external operators and institutions. The pilot aimed at obtaining the best results from integrating different data sources in terms of added value in knowledge and management capability. The previous situation at the Port System Authority was such that the use of the available dataset generated several copies and reprocessed data within many different and inhomogeneous systems reducing performance and the overall quality in usage and updating of data among various operators and making decision making process significantly inefficient. The new Spatial Data Infrastructure (SDI) performs both, data storage and processing functions, making copies no longer necessary and allowing processing to be archived, both in the form of new data archives and as algorithms that provide results in real time, allowing operators to maintain the known methods and tools thanks to the interoperability protocols.

Results: the main results of the pilot action are basically divided into the pillars:

- The implementation of the Spatial Data Infrastructure
- The execution of the internal job training programme

The Spatial Data Infrastructure (SDI) has two main components, one for the vector maps and data table and one for the imagery data and some 3D models. Both components enable direct access from desktop application as well as web access through standard interoperability protocols. With the pilot action, the SDI has been implemented with 45 data sources (mostly spatial data sources), loaded by processing, and optimizing over 500 existing layers, images, and data tables. The optimization and loading operations of additional data sources will be in progress during December 2021 and should be completed in 2022.

The training activities are also still ongoing during December and should be completed before the end of 2021. The programme includes 23 days of individual and customized training-on-the-job and involves 17 operators from 6 different departments. The training-on-the-job activities are strongly based on the user's needs, but they basically include some main topics are related to the environment and data-access settings, the data visualization and mapping techniques, and some custom tools or techniques as well as special processing / geoprocessing techniques.

In the long-term perspective, the new infrastructure and skills will foster the development of new services and tools. A new public Open Data web portal will probably be the first step, as it is moreover strongly recommended by national regulations, but also they could be developed new data-driven online services such as online booking services, real time (or near real time) warning services or performance monitoring systems based on historicized data series, new real-time data-driven services for all the port community, people, tourists, or companies, and a new generation of Business Intelligence tools based on spatial data analysis and indicators, georeferenced documentation systems and interactive maps.

Spatial Data Management System		
Problem (before the pilot)	**Benefits/Strengths (current situation)**	**Improvements/Opportunities (future)**
Ease the communication and sharing of information	The new centralized data infrastructure ease collaboration between employees and stakeholders and the sharing of data processing results.	Many actors will be able to directly share data through digital interoperable applications, reducing time waste and environmental impact.
Improve processes control and decision-making	With the new Spatial Data Infrastructure, data visualization is more reliable and effective, and it improve the quickness and the quality of the decision-making processes.	Some recurrent outputs needed for decision-making and control processes are now easier to obtain and can also be stored as dynamic procedures.
Eliminate data duplication and redundancy	The optimization process that has been carried-out to implement the infrastructure have decreased the number of datasets from hundreds to dozens. The centralized repository will help to reduce fragmentation as recommended by INSPIRE EU directive.	Some in-use software platforms can dynamically share data by implementing special database connectors and increase the capability of integrated data processing.
Allow the creation of new generation location-based services for companies, institutions, and citizens	The new Spatial Data Infrastructure is mainly an interoperable system that enables spatial based web services and system	New tools and services such as Open Data web portal, data-driven online services, Business Intelligence tools and platforms.

	integration both of internal tools and with external actors' web platforms. So far, some spatial datasets already fuel a, experimental mobile APP for small ships navigation.	

3. Project results durability

This chapter describes the measures to be taken in order to support the digitalization process in the programme area after project closure, ensuring the project results durability.

The following subchapters contain the most important measures coming out as a result of each pilot implementation and testing phase, together with strategies developed to overcome the weaknesses and threats identified.

Each pilot implementation and testing process brought up a list of mandatory requirements (conditions ‚sine qua non') that should be satisfied in order to achieve the project results durability. The assumptions that had to be made during the pilot implementations evolved into the measures needed to be taken for stabile project results.

Besides, during the pilot implementation various constraints and bottlenecks were encountered. Furthermore, each pilot owner has revisited their SWOT matrix developed for the related innovation considered during WP3, as part of the analysis of the 3 digitalization trends, and mapped the *weaknesses* and *threats* quadrant to their particular pilot action results and limitations. The strategies developed in order to overcome these findings have to be considered as measures to support the project results durability.

Finally, the conclusions stated in the tables below for each pilot action have captured all the findings obtained during the project, including stakeholders' feedback during WP4 and WP5 testing phase.

3.1. Pilot 1 durability - **WMS 4.0 – Dry Port Case Study** (PP2 - Elevante)

Trend: Informatization processes

Pilot name: WMS 4.0 – Dry Port Case Study

Measures supporting the pilot results durability:

No.	Mandatory requirements for successful pilot implementation
1.	Updates and maintenance activities must be done by a development team that operates continuously;
2.	It is necessary to have qualified personnel for the management of WMS4.0;
3.	A total and not partial digitization and centralization of the data by the authors involved;
4.	Optimization, and various upgrades with the addition of improvement tools;
5.	The possibility of communication with external services already present in the intermodal system.

Constraints, weaknesses and threats with strategies to overcome them:

No.	Constraint / bottleneck/weakness/threat	How to overcome it or avoid it
1.	Initial assessment for personal training by using digital information;	By using user-friendly interfaces and clear and detailed user guides;
2.	Providing staff with computers, tablets, smartphones or other devices connected to the Internet;	Nowadays obtaining communication and internet-connected devices is very easy and not expensive;
3.	Digitization should be fully completed to have a full working WMS4.0 service;	Gradually making its use mandatory by all the actors involved;
4.	"Acts of God" - also known as force majeure events – are natural disasters (or other destructive events) which are utterly outside of human control;	Making periodic backups of the data to avoid their loss at any time. Backups must be periodically performed every few days so as not to block the operation of the system;
5.	Initial data digitization cost (digitization is the conversion process applied to the current system into a digital information);	Providing sufficient funding for the future development services.

3.2. Pilot 2 durability - **PCS automation – Deliveries Planning** (PP5 - Actual, PP6 – Polo Inoltra)

Trend: Multimodal Traffic Automation System

Pilot name: Deliveries Planning System

Measures supporting the pilot results durability:

No.	Mandatory requirements for successful pilot implementation
1.	Geographical extension beyond the Italy-Croatia area, towards a pan-European coverage
2.	Real-data collection of traffic and weather conditions
3.	GPS coverage of ITUs, intermodal trains and Ro-Ro services to be included in the system for better multimodal planning
4.	Certified dataset for emission calculations, in order to issue an emission' saving certificate at the end of a shipment
5.	Full participation on the system implementation of key intermodal operators, in particular MTOs operating open-access intermodal train services and Ro-Ro operators across Europe

Constraints, weaknesses and threats with strategies to overcome them:

No.	Constraint / bottleneck/weakness/threat	How to overcome it or avoid it
1.	Weak system routing selection	Increase the number of services available in order for the system to find the best solution
2.	International services crossing Italy and Croatia are not considered by the system	Expand the geographical coverage
3.	The traffic and weather calculator may be ineffective	Link the system algorithm to reliable real-time traffic and weather portals
4.	Train and Ro-Ro delays are not reliable	Link the delay-calculation to actual tracking system mounted on intermodal open-access trains and Ro-Ro services
5.	Emissions-saving calculations may be subjective	Link the emissions saving calculation to a certified portal in order to formalize the procedure

3.3. Pilot 3 durability - **Mobile Safety/Security** (PP4 - UNITS)

Trend: Passenger

Pilot name: Mobile Safety/Security

Measures supporting the pilot results durability:

No.	Mandatory requirements for successful pilot implementation
1.	Integration of the system with other passenger service (e.g. APP used to unlock cabins, billing, book activities, etc.)
2.	Make APP available on the the main app-stores
3.	Connect onboard WiFi to emergency grid or implement wire connection between beacons and backend
4.	Analyze the privacy issues for storing and using passenger localization data to define the consent forms for passengers
5.	Simulate/test the effect of guidance system in more complex environments (e.g. a complete cruise vessel) to raise the interests of shipping companies

Constraints, weaknesses and threats with strategies to overcome them:

No.	Constraint / bottleneck/weakness/threat	How to overcome it or avoid it
1.	Smart bands battery capacity is insufficient	Redesign smart bands to improve battery capacity
2.	Beacon battery capacity is insufficient	Connect the beacons to emergency grid and use battery as backup source of power
3.	Steel-made structure causes reflection problems	Uses limited signal power of sending beacons to avoid reflection issues
4.	Steel-made structure causes reflection problems	Limit as far as possible the number of active sending beacons per area
5.	A WiFi failure before activating the system can compromise its functionality	Include the WiFi network among the essential systems connected to the emergency grid or establish wired connection between beacons and backend

3.4. Pilot 4 durability - **Application for Data Flows Management** (PP7 – Port of Rijeka Authority)

Trend: Informatization processes

Pilot name: Application for data flows management

Measures supporting the pilot results durability:

No.	Mandatory requirements for successful pilot implementation
1.	Compliance with the VTS system used as a part of this pilot
2.	Skilled and trained personnel (external/internal) for unobstructed installation
3.	Ongoing maintenance contract for the VTS maintenance services
4.	Ongoing maintenance contract for the traffic visualization application
5.	External company well versed in maritime processes and development technologies

Constraints, weaknesses and threats with strategies to overcome them:

No.	Constraint / bottleneck/weakness/threat	How to overcome it or avoid it
1.	Custom solution built by a smaller vendor and as a consequence, somewhat dependent on the vendor availability	During preparatory phases, identify a reputable vendor even if smaller enterprise, that will be able to complete development and provide maintenance services
2.	Maintenance and upgrades are required for the pilot outcomes to continue functioning	For the anticipated duration of the project outcomes, reserve annual financial means and other resources for the maintenance and upgrades
3.	Parts of the equipment are installed in open space towards the sea and as such, could be jeopardized by weather elements as the time passes, despite being IP-certified, increasing possibility for equipment failure and maintenance costs	Use adequate sheltering and purchase only adequate IP-certified equipment. Use shielded cabling and shelter/isolate the cabling and equipment appropriately
4.	Passengers need to be informed how to access information on the situation in the passenger port	Furnish Web pages and passenger spaces/areas with information, URL link and QR codes to be used to access the information. Use other means of promotion
5.	Application needs to be adjusted for usage in other ports	During subsequent development, try to standardize the mapping portion and create a standardized application to be used with other ports

3.5. Pilot 5 durability - **Innovative solution for Access Control** (PP8 – Port of Šibenik Authority)

Trend: Informatization processes

Pilot name: Innovative solution for Access Control

Measures supporting the pilot results durability:

No.	Mandatory requirements for successful pilot implementation
1.	Availability of the development team for the maintenance of the Web and mobile application
2.	Sufficient funding for the future development services
3.	Sufficient funding for replacement of faulty hardware equipment when out of warranty
4.	Inspecting the equipment for mechanical and other functional damage
5.	Proper system hardware and network patching and ongoing maintenance upgrading

Constraints, weaknesses and threats with strategies to overcome them:

No.	Constraint / bottleneck/weakness/threat	How to overcome it or avoid it
1.	Custom solution built by a smaller vendor and as a consequence, highly dependent on the vendor availability	Liaise with the vendor, follow up its situation, timely plan for migration in case that the situation calls for it, ensure proper documenting of the pilot project and its future upgrades
2.	The solution requires maintenance and upgrades to continue functioning	Ensure adequate funding for the maintenance of the permit issuance system mid-term
3.	Budgetary project limitations have enabled on premise solution while hybrid or public cloud would be more flexible albeit much more costly	Timely study technical possibilities and identify possibilities for migration to the cloud as a part of overall IT strategy
4.	New technologies might render developed solution as obsolete	Follow technological trends for similar technologies as the ones used in the pilot project development
5.	Tentative adoption of a new maritime management solution might already include similar permit issuance module, that might displace developed solution within pilot project	Research possibilities to integrate existing solution with the future PCS system displacing need for generic PCS access control module to be implemented

3.6. Pilot 6 durability - **M2M Dialogue** (PP9 – Port of Rovinj Authority)

Trend: Informatization processes

Pilot name: M2M Dialogue

Measures supporting the pilot results durability:

No.	Mandatory requirements for successful pilot implementation
1.	Availability of vendor's services regarding regular maintenance and upgrade work
2.	Sufficient funding for replacement of malfunctioned equipment
3.	Ensuring proper infrastructural and superstructural environment
4.	Timely inspection of installed HW and SW and taking the proactive approach in case of irregular/non-ordinary occurrences
5.	Employee's acceptance and adaptation to the newly installed equipment

Constraints, weaknesses and threats with strategies to overcome them:

No.	Constraint / bottleneck/weakness/threat	How to overcome it or avoid it
1.	Marina Master is a turn-key solution with features that must blend with the existing ones or completely replace them	Timely and often costly endeavor requiring certain level of patience until the data is extracted from existing solutions and adapted to the new ones.
2.	Complexity of not having an integrated accounting service within the existing PCS	The situation presents as fairly unique as the implementation was successful until a certain point. External accounting services are mostly maintained the same until the development of the accounting service within the pilot's solution is fully capable of providing the service itself.
3.	Absence of general ledger	Ensuring that the general ledger has the capability of accepting the exports of journal entries from the system
4.	Requirements for invoice issuance	The current process requires a multitude of information in order to issue an invoice which is not always an easy task as the employees are often required to work in difficult weather situations. Facilitation will come through simplification or reduction of required data entries
5.	Difficulties regarding the connection to the national e-invoice system	Difficulties occur when the aggregate orders for payment of invoices are set to be exported through a bank. Avoidance is unacceptable but tweaks and further development from the developers is a key to overcoming the issue.

3.7. Pilot 7 durability - **Spatial Data Management System** (PP1 - CFLI)

Trend: Big data for freight and passengers' mobility

Pilot name: Spatial Data Management System

Measures supporting the pilot results durability:

No.	Mandatory requirements for successful pilot implementation
1.	Availability of a master (or detailed) plan for implementation
2.	A hardware/software IT responsible team (or person) to ensure platform efficiency and reliability
3.	One or more internal operators with sufficient (advanced) skills in spatial data management to ease data collection and internal support between operators
4.	Identification of a responsible team (or person) for internal training activities
5.	Availability of funds for IT equipment (upgrade), external expertise for possible advanced operations, and training activities.

Constraints, weaknesses and threats with strategies to overcome them:

No.	Constraint / bottleneck/weakness/threat	How to overcome it or avoid it
1.	Difficulty to collect data (get the up-to-date and most accurate data)	Create a workgroup to create a list of data, repositories, responsible persons and draft a plan for the collection activities. Involve department directors.
2.	Resistance of employees to attend training activities	Carry on internal promotion events. Involve department directors, draft a training program in collaboration with the human resources responsible.
3.	Hard to obtain the right IT equipment dimensioning	Use a scalable platform. Oversize the hardware as much as possible. Execute stress tests, if possible, also during training activities.
4.	Resistance of employees to share data with others	Carry on internal promotion events in order to clear the advantages in data sharing. Use data shared from several departments in training activities. Involve department directors. Show some advanced results (data or applications) obtained integrating different data sources.
5.	Some advanced data management requiring external expertise	Consider different type of data management operations in master and detailed plans. Allocate special funds for possible external expertise needs.

4. Steps to be taken in order to support the digitalization processes after project closure

This chapter is aimed to describe the steps and measures to be taken in order to support the digitalisation process in the programme area after project closure. For that purpose, two approaches will be suggested: European Digital Innovation Hubs and Smart Specialization Strategy.

Furthermore, the results from 7 pilots implemented as part of the DigLogs project, some valuable initiatives have been raised towards possible future pilot extensions, in line with the digitalization strategy on the maritime IT horizon and beyond.

4.1. European Digital Innovation Hubs

European Digital Innovation Hubs or EDIHs are one-stop shops helping companies to respond to the digital challenges in order to become more competitive. They are conceived as a single organization or as a group of organizations with the required expertise and a non-profit objective.[1] Those organizations are aimed to support the digital transformation of the companies, especially the small and medium-sized enterprises, on the one side, and the public sector organizations which conduct non-economic activities, on the other side.[2] Companies should improve their business, production and other operation by implementing the digital technologies in those processes. EDIHs should help them to do so. Besides offering the assistance in implementing the digital technologies, EDIHs provide some additional services, such as financial advice, training and skill development.[3] The additional services are needed for the successful implementation of the digital technologies.

There are four main groups of services provided by the EDIHs. The first group of activities is known as „Test before invest". The implementation of the digital technologies should start with the awareness raising, knowledge transfer, as well as the technology transfer, testing and experimenting with digital technologies, demonstrative activities etc.[4] The stated activities are mandatory in order to start the digital technologies implementation process successfully. The main technologies which should be implemented are promoted in the Digital Europe Programme. Those technologies are the High-Performance Computing technologies, the Artificial Intelligence and Cybersecurity.[5]

Another type of services concerns the „Skills and training". In the digital transformation process, the implementation of the new digital technologies is not enough. In order to use the digital

[1] Implementation details of European DIHs in Digital Europe Programme - Draft working document 25-01-2021 (https://digital-strategy.ec.europa.eu/en/activities/edihs)
[2] ANNEX to the Commission Implementing Decision on the financing of the Digital Europe Programme and adoption of the multiannual work programme – European Digital Innovation Hubs for 2021 – 2023 (https://digital-strategy.ec.europa.eu/en/activities/edihs)
[3]European Digital Innovation Hubs, European Commission https://digital-strategy.ec.europa.eu/en/activities/edihs
[4] Implementation details of European DIHs in Digital Europe Programme - Draft working document 25-01-2021 (https://digital-strategy.ec.europa.eu/en/activities/edihs)
[5] Ibid.

technologies effectively, it is compulsory to develop some advanced digital skills. According to that, EDIHs cooperate with the education providers for the provision of the short-term training for the future users of the digital technologies. There are a few forms of the skill development processes supported by the EDIHs, such as advertising, providing of training, hosting, boot-camps, traineeships etc.[6]

Since the EDIHs primary support the small and medium-sized enterprises, start-ups, and then companies and public organizations, they provide the group of services known an „Support to find the investments". In order to develop the digital skills which should increase their competitiveness, companies need certain financial means. To facilitate the search for the financial resources, EDIHs provide the access to the financial institutions and investors. To provide this service, EDIHs co-operate with the InvestEU Advisory Hub 4, the Enterprise Europe Network and other relevant financial mechanisms.[7]

The last group of services is referred to as the „Innovation ecosystem and networking". EDIHs shall bring the diverse companies and businesses together. Companies must form networks, better known as value chains, which should enable them to operate successfully. EDIHs bring in contact the companies with other companies of the same value chain, as well as with the innovators and clients. However, EDIHs promote local companies to increase the economic strength of their own region. But, the connection does not limit on the local level. If there are no suitable companies in the local area, the local EDIH can network to another EDIHs in order to find a suitable company in the other areas.[8]

EDIHs should work as a single organization or a coordinated group of organizations, meaning there could be many companies and organization involved. Some of them are the research and technology organization and the university labs offering technology services. Regarding to EDIHs, they should offer innovative services. In order to do so, they usually cooperate with partners with the expertise in the business development and the public sector. EDIHs also include large companies which should define some services to them, since there is an intention to ensure that the local economy profits from the digital technologies.[9] As mentioned before, the public sector

[6] Ibid.
[7] Ibid.
[8] Ibid.
[9] Ibid.

should also be included. There is also a room for some other stakeholders, such as artists and others.

Digital technologies and local economy are in the focus of EDIHs. EDIHs shall be the access points to the digital capacities such as Artificial Intelligence, Cybersecurity, High Performance Computing etc. The implementation of the digital technologies in the industry and in the public sector should lead to the local economy strengthen. The objective to strengthen the local economy is not supported by the digital technologies' implementation only. EDIHs also encourage the companies in adopting Industry 4.0, circular economy methods and may other.[10] Not all EDIHs have the same focus. Each of them shall support companies and private sector from different regions. The focus of each EDIH should rely on the needs of its local companies and public sector to support their digital transformation.[11] In some regions, companies and public sector entities could have very low level of the digital maturity. EDIHs supporting those regions should adapt their services to first deliver the basic services.[12] Different EDIHs may not have the same focus, but they should complement each other across the Europe.[13] The key of the EDIH complementation is the networking.

EDIHs should act as an intermediary between public administrations and companies providing e-government technologies.[14] They should also bring various companies in the contact with the other companies participating in the same value chain. Also, not all of them have the same focuses, since they rely on the circumstances on the regional level. Besides that, each EDIH should be able to connect each company to the company in another region if there are no suitable companies in the region. Therefore, all EDIHs should be brought together by networking. The

[10] Ibid.
[11] ANNEX to the Commission Implementing Decision on the financing of the Digital Europe Programme and adoption of the multiannual work programme – European Digital Innovation Hubs for 2021 – 2023 (https://digital-strategy.ec.europa.eu/en/activities/edihs)
[12] Implementation details of European DIHs in Digital Europe Programme - Draft working document 25-01-2021 (https://digital-strategy.ec.europa.eu/en/activities/edihs)
[13] Ibid.
[14] ANNEX to the Commission Implementing Decision on the financing of the Digital Europe Programme and adoption of the multiannual work programme – European Digital Innovation Hubs for 2021 – 2023 (https://digital-strategy.ec.europa.eu/en/activities/edihs)

network must be supported through the Digital Transformation Accelerator.[15] The Digital Transformation Accelerator serves as a central node. To form the network and the collaboration, some support activities are required. Support activities include: guidance of hubs, managing and maintenance of an interactive catalogue of EDIH, „train the trainer" or developing the ways to transfer the knowledge generated in the Cybersecurity, Artificial Intelligence and High Performance Computing to the EDIH, community building and engaging DIHs outside Europe, matchmaking, making available the information about short-term training, training the EDIHs about financial instruments in InvestEU, engaging with the start-ups, small and medium-size enterprises and regional and national policy makers, international collaboration etc.[16] The networking of the EDIHs shall provide some important benefits to the companies included. The main objective is to support the digital transformation of the small and medium-sized enterprises and of the public sector.[17] Besides the main objective, there are some specific impacts expected. Those are: the creation of new European value chains, the improvement of the capacity of each EDIH through training and networking events, availability of collaboration tools for common activities and of high quality KPIs and a full functional interactive catalogue of EDIHs.[18]

The performances of the success of EDIHs are measured by the KPIs. The main KPIs shall be the number of companies and public sector entities which have used the EDIH services, the usage of the Artificial Intelligence, Cybersecurity and High-Performance Computing technologies, the quantity of additional investments successfully triggered, the increase of the number of collaborations between EDIHs and stakeholders in the Europe and, finally, the increase of the number of the joint investments and infrastructure shared.[19]

EDIHs offer diverse services in the field of digitalization in order to provide benefits for the businesses and for the local economy in the Europe. The EDIHs shall be organized as one-stop shops supporting the digital transformation of the private sector, industries, small and medium-

[15] Implementation details of European DIHs in Digital Europe Programme - Draft working document 25-01-2021 (https://digital-strategy.ec.europa.eu/en/activities/edihs)
[16] Ibid.
[17] ANNEX to the Commission Implementing Decision on the financing of the Digital Europe Programme and adoption of the multiannual work programme – European Digital Innovation Hubs for 2021 – 2023 (https://digital-strategy.ec.europa.eu/en/activities/edihs)
[18] Ibid.
[19] Implementation details of European DIHs in Digital Europe Programme - Draft working document 25-01-2021 (https://digital-strategy.ec.europa.eu/en/activities/edihs)

sized companies etc. By supporting the implementation of the digital technologies, they support the increase of the competitiveness, efficiency and production, as well as the strengthening of the local economies. By being brought together in the network, they offer the service of forming value chains between the companies in the whole Europe. Therefore, EDIHs use digitalization to increase the prosperity of the European regions and Europe itself.

4.2. Smart Specialization Strategy

Smart Specialization Strategy is a place-based approach which is characterized by the identification of the strategic areas for the intervention based on the analysis of the strengths and potential of the economy and on the Entrepreneurial Discovery Process, with a wide spectrum of stakeholders involved, as stated by the European Commission.[20] It is an innovative approach whose main objective is to enable each European regions to identify and develop their competitive advantages.[21] Countries and regions should select limited number of priority areas. To do so, Smart Specialization Strategy combines education, innovation and industrial policies.[22] The implementation of the long-term growth strategies, Smart Specialization brings together local authorities, academia, business and the civil society.[23] The developed strategies should be funded by the EU funds. To develop such strategy, a comprehensive approach is required. That is a reason why so many stakeholders participate in the development process. The real meaning of the Smart Specialization Strategy is contained in its own name. It is smart, since it identifies countries' or regions' strengths and competitive advantages, then the specialization stands for prioritizing research and innovation in competitive advantages and strategy stands for defining a vision of regional innovation.[24]

There are a few key elements of the Smart Specialization Strategy. One of them is a place-based approach. This approach is based on the resources available to the regions and countries and on their socio-economic challenges in order to identify opportunities for the growth and development.[25] The second key element is a choice for investment. This choice should be made based on the competitive advantages and realistic growth potentials. Another key element is setting priorities. The process of setting priorities is centered on an entrepreneurial discovery,

[20] What is Smart Specialisation?, European Commission https://s3platform.jrc.ec.europa.eu/what-we-do
[21]Smart specialisation, European Commission https://s3platform.jrc.ec.europa.eu/documents/portlet_file_entry/20125/Factsheet+%E2%80%93+What+is+Smart+specialisation.pdf/48da2521-e4bd-1c5f-6de9-17859b7ae427
[22] Smart specialisation , OECD https://www.oecd.org/sti/inno/smartspecialisation.htm
[23]Smart specialisation, European Commission https://s3platform.jrc.ec.europa.eu/documents/portlet_file_entry/20125/Factsheet+%E2%80%93+What+is+Smart+specialisation.pdf/48da2521-e4bd-1c5f-6de9-17859b7ae427
[24] Ibidem
[25] What is Smart Specialisation?, European Commission https://s3platform.jrc.ec.europa.eu/what-we-do

which is an interactive process in which market forces, together with the private sector, provide information about the new activities, after which the Government estimates the outcome and empowers the actions with the highest realization potential. A broad view of innovation is also the key element of the Smart Specialization Strategy. The view on the Smart Specialization Strategy should be comprehensive and unique for each country or region. This means that the view must be practice-based, technological and social. That should allow each country and region to shape their policies based on their internal socio-economic circumstances. Sound monitoring and evaluation system must also be taken as a key element.[26]

As mentioned before, setting priorities is one of the key elements of the development of the Smart Specialization Strategy. The domains and economic areas where countries and regions have competitive advantages and growth potentials should be prioritized. Activities of finding the solution for social and environmental challenges should also be taken as priorities. This means that the priorities should not be framed to the science only. They should include activities and challenges in other fields too, such as society, culture etc. Not all priorities need to refer to the radical innovations. Traditional fields of innovation should be concerned too. For instance, that could refer to the development of the new business and organizational models.[27]

Priorities identifying is a part of structuring Smart Specialization Strategy. There are two fundamental processed based on which the priorities should be identified. The first process is an Entrepreneurial Discovery Process which utilizes entrepreneurial knowledge of the region or country. The EDP brings together diverse stakeholders, who jointly identify the smart specialization fields and develop the policy to implement them. The other process is an objective analysis of the regions or countries current situation. The purpose of this process is to stipulate which activities have the highest potential of success in a region or a country. In order to do so, the state of many fields is examined and compared to those in other countries and regions. Such fields may include innovation, industry, skills, human capital, public and private budgets for research and innovation, etc. That is how the competitive advantages are identified. Since many fields are concerned, many diverse participants take part in developing the Smart Specialization Strategy. Those who take a part in the process are various organizations, civil society, universities and research institutions, national, regional and local authorities and entrepreneurs, who are

[26] Ibid.
[27] Ibid.

experienced in detecting what should work the best at some place and which cooperation could be helpful.[28]

There many advantages provided by the Smart Specialization Strategy development. Some of them are: the increase of public resources spending, synergies between public support mechanisms for research and development and innovation, as well as an industrial promotion and training institutions, the elimination of policy interventions, an identification of the most promising fields for entrepreneurship and growth, multi-governance interactions in developing of the strategies, benchmarking and evidence-based monitoring and evaluation systems.[29] In general, Europe's competitiveness relies on the new growth models on the regional level.[30] In order to develop the growth models, it is necessary to determine targets with significant growth potential. The importance of targeting potentials and developing the growth models forms challenges that should be addressed. Four of those challenges are: reform of the regional research and development systems, increasing the interregional cooperation in innovation investment, asserting the importance of research and innovation in less developed regions and countries and harnessing complementarities between the European policies.[31] The Smart Specialization Strategy can bring the great contribution to face those challenges.

Since the Smart Specialization Strategy is able to make such a great impact and it includes many fields and participants, the Smart Specialization Platform has been developed to facilitate the development of the strategy. The Platform facilitates the mutual learning, data analysis and networking.[32] Also, the platform enables the regions and countries to join forces and resources

[28] Ibid.
[29] Smart specialisation , OECD https://www.oecd.org/sti/inno/smartspecialisation.htm
[30] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, European Commission https://s3platform.jrc.ec.europa.eu/documents/portlet_file_entry/20125/com_2017_376_2_en.pdf/3e58fbca-d9f9-04ba-bf94-dd431ef27537
[31] Ibid.
[32]Smart specialisation, European Commission https://s3platform.jrc.ec.europa.eu/documents/portlet_file_entry/20125/Factsheet+%E2%80%93+What+is+Smart+specialisation.pdf/48da2521-e4bd-1c5f-6de9-17859b7ae427

on the basis of the mutual smart specialization priorities. Additional to sticking together, the Smart Specialization Strategies have made an impact on European cohesion policy reorienting.[33]

Smart Specialization Strategies are aimed to increase the economic growth of the European countries and regions. The strategies are developed at a regional level and many participants are included in the development process, so that the potential of various fields could be identified. The comprehensiveness of the priority identification enables the participants to identify the competitive advantages of the region or the country. Investing in those advantages by developing the Smart Specialization Strategy should help the regional economy to meet its highest potentials.

[33] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, European Commission https://s3platform.jrc.ec.europa.eu/documents/portlet_file_entry/20125/com_2017_376_2_en.pdf/3e58fbca-d9f9-04ba-bf94-dd431ef27537

4.3. Initiatives raised from pilot results

As stated in chapters 2 and 3, each pilot developed as part of DigLogs project brought up ideas for future scope extensions and defined measures for overcoming encountered obstacles, thus establishing the path towards new opportunities on the horizon.

In particular, the columns labeled '*Improvements/Opportunities*' for each pilot in chapter 2 and the columns labeled '*How to overcome it or avoid it*' in the '*Constraints, weaknesses and threats*' table for each pilot in chapter 3, contain the key takeaways for each pilot, which can be considered as steps and measures to be taken in order to support the digitalisation process in the programme area after project closure.

The WMS4.0 pilot results call for predictive data analysis based on historical data, using statistical algorithms and machine learning techniques. Large scale installation of WMS 4.0 will increase the efficiency of intermodal freight transport in national and international scale. The reduction of the redundancy, the lack of data and data dispersion could be achieved by integrating further operators' systems and use of specific algorithms and coordinated data gathered from multiple stakeholders. This could provide optimized transport arrangements for last mile transport segments.

The Deliveries Planning pilot results identified possible improvements towards the extension of the geographical coverage, adding the number and types of services considered, adding hidden fees and external costs to the route calculation algorithm, potential improvement of the system by transforming the current mainly static set of data into a dynamic data-set for real-time calculation of the service by integrating web based services and available external systems (i.e. linking to real-time traffic and weather portals), adding the complexity by extension of the available ITUs and their attributes, as well as linking the delay calculation to actual tracking system mounted on intermodal open-access trains and Ro-Ro services. Improvements of the CO2 emission calculation algorithm for potential European certification would benefit the emission saving effort in the framework of the **European Green Deal**. The innovative route calculation algorithm developed at the core of the Deliveries Planning pilot achieved valuable outcomes towards multimodality approach, in favor of rail and SSS alternatives to the road transport, directly contributing to the initiatives such as **MAE incentive scheme**. The European commission

is showing an increasing interest towards the formulation of this incentive scheme for combined road – maritime transport. The Deliveries Planning pilot results have pioneered the solid efforts in building the path towards sustainable SSS sector and the implementation of the **European Maritime Space (EMS)**.

Finally, the synergic effect between WMS4.0 and Deliveries Planning pilot gave rise to the idea of extending the deliveries planning algorithm to the last mile planning, thus extending the multimodal transport supply chain.

The Mobile Safety/Security pilot implementation has proven the feasibility of aiding the ship evacuation through the adoption of mobile technology. The experience gained is expected to foster the application of mobile technology to ease ship evacuation. The system has been designed to be easily scaled for application to wider environments. The improvements that could be addressed in the next period include redesigning smart bands to improve battery capacity, limiting number of beacons and their signal power to avoid reflection issues, as well as connecting onboard Wi-Fi to emergency grid or implementing wire connection between beacons and backend.

The Mobile Safety/Security application enables the localization of passengers in real-time, which might help the crew in finding lost passengers quicker. The use of this localization data can be extended to commercial purposes, which opens up for numerous new opportunities, including marketing and monetization through mobile application that could be developed, downloadable from the main app-stores and working on passengers' own mobile devices.

The Application for data flows management established a monitoring system using a highly modular surveillance solution, capable to exactly pinpoint even small vessels present or approaching the passenger terminal, as well as displaying the inflow of small and large vessels and vehicles moving at the passenger terminal through the custom made Web client application. The possible enhancements in the next period include opening up real-time information towards the public, including traffic and passenger statistics from PCS, exploring technical possibilities for further VTS resolution and visibility enhancement, as well as further integration possibilities with the existing systems, thus increasing the capability of the IT solutions portfolio.

The Innovative solution for Access Control deployed in Port of Šibenik has increased the speed and control of permit processing and improved reporting. The possible enhancements include reporting automation and further increase of revenue and control. The steps to be taken to support the digitalization processes beyond this project are definitely in retaining the know-how and transferring knowledge to other Port Authorities, transferring effects to the other stakeholders, including the Ministry of Interior, and thus becoming the center of competence for the process.

The M2M Dialogue pilot has upgraded the existing maritime traffic control system in Rovinj port through an alternative to the traditional PCS which is able to interconnect with all of the port's stakeholders, serving its purpose as an intermediator between the given software and the National Single Window's – CIMIS. The possible enhancements related to the future integration with National Single Window Cimis or the mainstream PCS system, as well as further automation of the business processes resulting in greater efficiency, increased control and revenue.

The Spatial Data Management System that integrated different data sources for the North Adriatic Sea Port System has improved data storage and processing functions, improving data consistency by making copies no longer necessary, thus leading to better knowledge and management capability.

Key takeaway is that many actors will be able to directly share data through digital interoperable applications, reducing time waste and environmental impact. Possible future enhancements lay in implementing special database connectors and increasing the capability of integrated data processing, helping to reduce fragmentation as recommended by **INSPIRE EU** directive. Further improvements in the area of big data processing can be achieved with the new tools and services such as Open Data web portal, data-driven online services and business Intelligence platforms.

5. Conclusion

This Action plan brings together the most important results of the project and defines the next steps to be taken in order to assure a proper digitalisation in the programme area.

The main objectives of WP5 were to test the most valuable solutions mapped in the previous WP, to demonstrate reliability and applicability of innovative solutions assessed to a larger group of stakeholders, to improve hubs performances towards multimodality management and passengers' mobility improvement, to determine transferability measures to allow players outside the partnership to adopt tested solutions and to collect together precise indications to guarantee project results durability.

In the framework of WP5, partners have identified some key fields of intervention to test the solutions outlined in previous WPs. Pilot actions tested real solutions both in private and public daily management combining informatization, BIG DATA management and automation solutions. The pilots were divided on the base of final beneficiaries: freight pilots (5.1 – PP2, PP5, PP6), passengers mobility pilots (5.2 – PP4, PP7) and combined pilot implementation (5.3 – PP1, PP8, PP9). Pilots' work plans were drafted and validated by the whole partnership in order to assure their representativeness for the whole programme area (5.1.1, 5.2.1, 5.3.1), implemented and assessed (5.1.2, 5.1.3, 5.2.2, 5.2.3, 5.2.4, 5.3.2, 5.3.3). The assessments were then collected in a transferability plan (5.4.2) which described for all tested technologies how to transfer them in different contexts within the programme area. As final output, this action plan was delivered bringing together the main important project results defining a long term prospective for the innovation deployment.

Diglogs project has positively affected multimodal logistics chains and passengers' mobility in the programme area. This concerns the most relevant digitalisation processes affecting mobility in the IT-HR area, big data management for freight and passengers' mobility and traffic automation systems in multimodal transport flows. The project created a new awareness in the Programme Area among private and public actors and players of the transport sector concerning the main digital and informatization innovations. The Transferability plan (D5.4.4) should make the results of the project's pilot implementations replicable by external and further stakeholders in IT-HR area. This will create impact and paths for improvements in multimodal transport services for

freight and passenger transport services. Diglogs project results should increase the level of digitalisation of the transport flows, concerning freight and passengers, of the IT-HR area by implementing innovative ICT solutions able to support a wide range of IT services for logistic operators, private passengers, public authorities etc. The Deployment Roadmaps will deepen the impact of innovation deployment with a particular interest on multimodalities improvements and better management in passengers' mobility.

On the basis of the results of 7 different pilots implementations, we are able to conclude that this project has set up the path and achieved some valuable results towards the vision statement: "*In five years' time, most of the transport flows, concerning freight and passengers, of the Italy-Croatia area will be digitalised and therefore connected through innovative ICT solutions able to support a wide range of IT services for logistic operators, industrial users, private passengers and public authorities.*"

The project results have contributed to the following relevant benefits for businesses and the society, summarized into DigLogs impact objectives:

1. enhanced and widespread capability to monitor, trace and safely handle moving goods and passengers flows
2. increased efficiency of transportation networks, by improving synchronization between logistic users, operators and control authorities
3. Improved sustainability of logistic systems, by reducing their impact on local communities in terms of traffic congestion and pollution

The DigLogs project result could readily be used for the inclusion and future extensions within currently supported initiatives and programmes on the horizon, such as EDIH, Smart Specialization Strategy, European Green Deal, MAE incentive scheme, MoS and European Maritime Space (EMS) and INSPIRE EU directive.