WP4 - Testing enhanced cross-border maritime and multimodal freight transport

A.4.2 - ICT pilot actions for enhancing cross-border maritime and multimodal freight transport

D.4.2.11 - Final report on the implementation of the pilot actions

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1 Introduction to this deliverable

This deliverable is included within WP4 “Testing enhanced cross-border maritime and multimodal freight transport”, activity no. 2 “ICT pilot actions for enhancing cross-border maritime and multimodal freight transport”.

In WP4 PROMARES addresses the development of nine ICT pilot actions in 7 ports generating intermodal and multimodal freight transport (Trieste, Venice, Ravenna, Ancona, Bari, Rijeka and Ploče) and the intermodal logistic node of Trieste. Ports have focused on the upgrade of their own Port Community Systems (PCSs), whereas the intermodal terminal of Trieste has improved its multimodal operations through digital data exchange and the deployment of a new gate for inbound/outbound trains.

Pilot actions represent the main output of WP4, and their objective is to enhance cross-border maritime and multimodal freight transport. In fact, PROMARES aims at tackling the challenges hampering the full-fledged development of the potential for maritime and multimodal freight transport between Italy and Croatia, by testing ICT solutions for streamlining freight transport in the ports and the most relevant intermodal terminal of the Programme Area, from the port to the hinterland and at cross-border level. The standards developed may be replicated to other logistic nodes, also beyond the project’s geographical scope.

Based on the methodology outlined in D.4.2.1 “Pilot action assessment methodology” the eight partners of PROMARES have produced a report where to summarise their pilot action.

2 Overview of the pilot actions

Pilot actions represent the main output of WP4 and their objective is to enhance cross-border maritime and multimodal freight transport. In fact, the aim of PROMARES is to tackle the challenges hampering the full-fledged development of the potential for maritime and multimodal freight transport between Italy and Croatia, and will do so by testing ICT solutions for streamlining freight transport in the ports and the most relevant intermodal terminal of the Programme Area, from the port to the hinterland and at cross-border level. The standards that will be set may be replicated to other logistic nodes, also beyond the project's geographical scope.

The eight ICT pilot actions involve seven ports and one intermodal terminal. Ports will focus on the upgrade of their own Port Community Systems (PCSs), as they are a neutral and open electronic platform enabling intelligent and secure exchange of information between public and private stakeholders, optimizing, managing and automating port and logistics processes through a single submission of data and connecting transport and logistics chains. The intermodal logistics node of Trieste, instead, will improve multimodal operations through digital data exchange and the deployment of a new gate for inbound/outbound trains.

Each partner will involve the identified stakeholders (terminal and logistics operators, railway companies, policy makers) through ad-hoc meetings. By streamlining procedures and processes, logistic nodes of the Program Area will increase their competitiveness and productivity, leading to increased total throughput and additional shares of modal shift from road to rail, with positive impacts on the environment in terms of pollution, emissions and noise.

The eight pilot actions can be clustered in four groups:

1. Optimization of the port railway capacity through the upgrade of IT systems: this pilot action will be carried out by the ports of Venice, Ancona, Bari and Ploče
2. Optimization of the port railway capacity through the exchange of digital data with railway and multimodal operators: carried out by the Port of Rijeka
3. Optimization of the railway transport through the upgrade of IT systems: carried out by the Port of Trieste
4. Improvement of rail and multimodal operations through digital data exchange with terminal and logistic operators (Port of Ravenna) and through digital data exchange and deployment of a new gate for inbound/outbound trains (RRT of Trieste)

Table 1 provides a summary of the pilot actions.

Partner	Pilot Action	Description and scope	Progress
Port of Ancona	PP06 AdSPMAC – Central Adriatic Port Authority	Definition of the technical, operational and ICT requirements for the tracking and monitoring of the container traffic at the commercial dock of the Port of Ancona.	Completed
Port of Bari	PP07 AdSPMAM – Southern Adriatic Sea Ports Authority	Enhancement of the railway telematics system for shunting operations (SIMA) and its integration with PCS and information system of other subjects involved in the developing rail services.	Completed
Port of Ploče	PP10 PPA – Port of Ploče	Port of Ploče Authority will Develop the ICT solution as upgrade of existing PCS ICT solution, that can be used as prerequisites in the requirements engineering process for the integration with National AIS system and development of a Pilot Traffic Image Application (application for VTS and SAR operations). The Pilot will be integrated within PCS system and exchange daily data needed for port operations. The aim is to upgrade and develop system for better control and management in all areas, focusing on ship arrival/departure procedures and gate in/out procedure covered within Entrance Terminal and railway related. Within Project PROMARES PPA as prerequisite for future pilot system will equipment for security and control of entry/exit to the port areas and deliver services for Technical design need for future development of PCS system or other port systems.	Completed
Port of Rijeka	PP09 PRA – Port of Rijeka	The existing passage control system on different entrances needs to be updated.	Completed
Port of Venice	PP01 - AdSMAS Port of Venice	Enhancement of the railway telematics system for shunting operations (SIMA) and its integration with PCS and information system of other subjects involved in the developing rail services.	Completed

Port of Ravenna	PP05 - AdSPMACS – Port of Ravenna	Develop a new “Rail Module” for the PCS of the port of Ravenna	Completed
Port of Trieste	LP – Port of Trieste Pilot action 1	Creation of a new module of the PCS Sinfomar dedicated to the management of the movement of goods between external Free Zone areas outside the Port of Trieste, using data from existing cameras both for rail and road transportation to ensure the traceability of goods.	Completed
Port of Trieste	LP – Port of Trieste Pilot action 2	Extension of the PCS Sinfomar to manage the external buffer areas belonging to the zone under the control of the Port Network Authority of the Easter Adriatic Sea.	Completed
Interporto di Trieste S.p.A.	PP03 RRT-TS Interporto di Trieste	Railway inbound/outbound transportation flows management in the FreeESTE area. Railway Gate Automation in the FreeESTE Free Zone area enabling: Train composition data recognition; Train transit (gate in/out) recognition; Data sharing with the IT platform currently in use at Interporto di Trieste (owner of the FreeESTE area) → Logistics freight cycle management; Data sharing with the port community via interoperability with the Port Community System SINFOMAR → Enhanced transport corridor management between port and dry port areas. Data sharing is relevant for the freight movement monitoring among Free Zone areas (i.e., FreeESTE inland terminal and Trieste Punto Franco Nuovo port area) → Customs freight cycle management.	Completed

Table 1 – Summary of the pilot actions

The completeness of the description related to each Pilot Action depend on the information provided by the partners involved.

3 Analysis of the pilot actions

3.1. Port of Ancona

3.1.1. Ex-ante situation – Background of the pilot action

In the year 2018, Central Adriatic Ports Authority launched a highly innovative ICT project called TinS "Transfer in safety" which consists in the transfer of the customs parking area located at the Rizzo pier (Molo Rizzo) of the Port of Ancona to the Marotti area (Scalo Marotti), located outside of the customs circuit. The organizational model of the TINS project was intended to solve important bottlenecks for trucks in embarking and disembarking phase:

- Lack of parking areas;
- Proximity of trucks to the historical area of the port, close to the city centre;
- Reduction of trucks vehicles inside the port areas and related reduction of emissions.

The **lack of space behind the port** brought to the decision to move the ferry terminal and the parking areas away from the quays, in order to improve the organization of the traffic flows and comply with the security standards for maritime traffic. It was deliberated the necessity for a dedicated parking inside the customs area in the port to implement the customs formalities.
In order to reduce long-term burdens and ensure greater surveillance and monitoring of vehicles in and out of the port area, it was introduced the use of an **Artificial Intelligence (AI) system** capable of processing the images of the cameras along a path and identify dangerous situations and anomalous behaviour with respect to user-defined standards. The system is able to recognize, monitor, track and monitor each vehicle from point A to point B and to be able to monitor the parking area, without the need for identification equipment or aids to the vehicles (tags, OBU or other active or passive devices).
Given these premises, the objective of the Pilot Action is the realization of feasibility technical study and the executive project of the extension of the TINS model to the commercial dock (Molo Commerciale) of the port of Ancona. This Pilot Action tackle the following weaknesses identified in the TNS:

- Weak in railway and road infrastructures;
- Poor attractivity in local industry;

- Weak in port infrastructures different that ferry traffic

3.1.2. Description of the pilot action

The Pilot Action consists in the definition of the technical, operational and ICT requirements for the tracking and monitoring of the container traffic at the commercial dock of the Port of Ancona. The study stems from the application of the AI system and its integration with the AIDA software at the ferry terminal, and it will be transferred to the container traffic. The **flows object of the study** are:

- **DISEMBARKING OF CONTAINERS THAT ARRIVE AT THE PORT**

  The trucks that must upload the containers disembarked at the commercial dock enter at the port of Ancona and go through the N7 point – Gate of Commercial Dock. The truck can upload the container only if the container has already been cleared and any other custom formality has been concluded. To exit the port, the trucks cross again the N7 point on the opposite direction.

- **EMBARKNG OF CONTAINERS THAT LEAVE THE PORT**

  The trucks carrying containers that must be embarked at the commercial dock, enter the port and cross the N7 point – Gate of Commercial Dock; the trucks download the container at the commercial area, where it is stored. The trucks cross again in the opposite direction the N7point and leave the port. The custom clearance formalities are implemented at the Marotti area.

3.1.3. Stakeholders

The stakeholders involved in the Pilot Actions are presented as follows.

CUSTOM AGENCY: The National Custom Agency, responsible for the fiscal and security controls of freight in entrance and exit from the UE ports, is the key stakeholder of TINS project in the port of Ancona. In July 2019, a Memorandum of Understanding was signed between the National Custom Agency and the Central Adriatic Ports Authority with the aim of cooperating for the digitalization of the procedures of the port of Ancona. The MoU foresees, among other aspects, the interoperability between the AIDA system, online system of the Custom Agency allowing the implementation of formal custom procedures for the operators, and the software implemented by the port of Ancona to dialogue with the Artificial Intelligent system.

FINANCIAL CORPS: As military corps in charge of the security controls on the freight in entrance and exit in the port areas, Financial Corps operating in the port of Ancona have been involved since the

beginning phase, directly benefiting of the increased efficiency of the security controls performed also via the Artificial Intelligence system.

COAST GUARD/HARBOUR MASTER: The Harbour Master of the port of Ancona has been involved since the initial phases of the project, being responsible for the safety of maritime navigation and of the ship movements and safety in the port basin area.

AGENMAR: Association representative of the maritime agents and forwarders of Marche and Abruzzo regions, it has been involved in the PROMARES project specifically concerning the extension of the TINS project to the container traffic. Within PROMARES project AGENMAR, elaborated an analysis that highlights the main bottlenecks affecting the procedures of the embarking and disembarking of containers at the commercial terminal of the port of Ancona. The study directly contributes to the realization of the present Pilot Action.

MARITIME AGENCIES AND FREIGHT FORWARDERS: As single actors involved in the formal and operative procedures for the maritime traffic (via ferry, container), they will be involved at a later stage, as main users of the new IT system.

3.1.4. Impacts and replicability

The results of the Pilot Action, or more precisely, of the implementation of the AI system for the tracking of the container traffic embarking and disembarking the port of Ancona, are summarised as follows:

- Innovation and Digitalization of maritime traffic formalities, in line with the RFD directive, and in agreement with the National Custom Agency, with the consequent reduction of timing and costs for the operators involved;
- Increased security of the containers traffic flow, and of the surveillance and tracking of the containers thanks to the use of Artificial Intelligence system able to detect any suspected behaviours with reference to a pre-defined indication;
- Increased efficiency in the container traffic flows, with the improvement of KPIs related to timing and costs of operations, security of procedures and reduction of pollutant emissions;
- Possibility of replication of the model to other Italian and/or European ports.

3.2. Port of Bari

3.1.2. Ex-ante situation – Background of the pilot action

The Pilot Action aims to find a solution to the challenges and problems that hinder the full development of the maritime and multimodal transport sector. This is mainly caused by the **unbalanced development** of multimodal transport options, **weak coordination** and **poor communication** between stakeholders, between those responsible for territorial development policies at the port-hinterland interface. The **digitization of port logistics** and the implementation of the **GAIA (Generalized Automatic exchange of port Information Area) Information System** has made it possible to give greater impetus to the activities of tracing, connecting and streamlining the processes of exchange processes for ships, people and goods, and to speed up the timing of control of goods and passengers. The Pilot Action has laid the foundations for improving the management of multimodal transport to / from the port, favouring the development and continuous improvement of the knowledge and skills needed for employment and personal fulfilment both for private people and public bodies, including the whole maritime and multimodal transport community.

3.2.2. Description of the pilot action

The Pilot Action consists in the upgrade of the Port Community System (PCS) **GAIA (Generalized Automatic exchange of port Information Area)**, an IT platform, active for some years not only in the Port of Bari but also in Barletta, Brindisi, Manfredonia and Monopoli. The PCS GAIA allows to **trace, connect and facilitate the exchange processes** of ships, people and goods and was created with the aim of implementing the intelligent and secure exchange of information between public and private entities of the maritime-port cluster, to optimise, manage and automate port and logistics services by creating efficient processes, reducing procedure times and minimising the use of paper documents. Detailed information, on traffic conditions, is also made available to haulers who can thus decide the best possible route to reach boarding and request online authorizations for accessing the port and security areas. GAIA also constantly monitors the entire port process in real time, provides for information on the status of boardings, weather conditions, departure and arrival times of ships through the tracking function by which passengers are also aware of the travel information, which they can instantly view on their mobile devices for free with constant and timely updates, making the travel experience more peaceful.

The PROMARES project has enabled the Southern Adriatic Sea Port Authority (ADSPMAM) to implement targeted interventions capable of improving and strengthening IT security, in relation to:

- **Perimeter security:** strengthening the technological safeguards for the protection of networks and their perimeters with the aim of increasing the ability to promptly identify an intrusion attempt and to improve their defensive capabilities. (PCS Gaia, in the five ports of the ADSPMAM, was equipped with a technological solution known as NGFW Firewall “Next- Generation Firewall” able to guarantee continuous protection through the functionalities of Web Content, Filtering, Anti-Virus, Anti-Spam, Intrusion Detection and Prevention, Application Intelligence, SSL VPN Client, Web Application firewall (WAF), SD-WAN "Software-Defined Wide Area Network" solutions);
- **Backup and Disaster Recovery:** with the aim of guaranteeing the continuity and operational availability of the Gaia PCS, and its rapid recovery following serious damage caused by cyber-attacks, accidental events, sabotage, natural disasters or other problems. In particular, it was necessary to equip the five ports of the ADSPMAM with a new hardware server capable of meeting the minimum-security objectives in terms of:
  - **storage capacity:** in order to ensure a longer period of data preservation/maintenance (RPO - Recovery Point Objective) as well as high disk performance in I/O operations (read/write cycles)
  - **size and performance:** capable of guaranteeing high performance in terms of data processing and network speed to support backup and/or recovery activities, ensuring at least one daily copy of the entire virtual infrastructure, as well as small physical dimensions capable of being hosted in high density environments
  - **recovery time:** RTO (Recovery Time Objective) refers to the concept of ensuring adequate recovery times for core services between the occurrence of the damaging event and the complete restoration of the systems themselves.

3.2.3. Stakeholders

The main stakeholders involved in the project are **public bodies** (Customs Agency, Ministry of Health, Arpa Puglia, the Port System Authorities), **Police Forces** (Financial Police, Port Authority, Border Police, Security Guards), **port operators** (shipping companies, mooring companies, port companies) and **companies in the logistics sector** (freight forwarders, transport companies).
The GAIA PCS information system allows the implementation of numerous services, including the control of access to the port of passengers by vehicles in real time, the possibility of requesting the Port Access Pass online, of monitoring the containers entering and exiting both the port and from the port depots, to check the routes of ships between the ports of the Authority through

the Automatic Identification System (AIS), to analyse and validate the data of passenger and freight traffic in real-time, to analyse the data warehouses obtained with an archive automatic and integrated for statistical purposes. In this way it will be possible, both for public and private stakeholders, to have a tool capable of facilitating and speeding up the operations to be carried out within the port.

3.2.4. Impacts and replicability

The construction and upgrade of the GAIA Port Community System had a positive impact in the intervention area, improving some services already present and implementing others. In particular, the system allows for the **digitisation of embarkation and disembarkation and entry and exit procedures** from port nodes, the **tracking of the status of goods within the port space** and the **computerisation of port tax payments**. The implementation of the system allows to manage the services present with maximum security and traceability and with a significant reduction in waiting times. This will make it possible to have real-time statistical data on the nature, origin and final destination, as well as all the administrative information regarding customs procedures. A series of facilities that significantly enhanced the attraction of investments to the area, strengthening its strategic importance.

There are several concrete advantages and positive effects that the Pilot Action has brought to the port and their stakeholders. These include the verification and location of goods, the verification of customs control operations for goods, the obtaining of detailed data on port taxes and on the nature, origins and destinations of goods, the streamlining of the flows of vehicles, containers and goods with digital tracking, to streamline the flow of people.

The PSC GAIA system represents a model with a **high potential for replicability**: the use of ICT solutions to optimise freight transport in ports will allow ports to have innovative and powerful tools capable of increasing communication and coordination between terminal operators and logistics and public institutions, reducing transit times and increasing the competitiveness and productivity of multimodal transport.

3.3. Port of Ploče

3.3.1. Ex-ante situation – Background of the pilot action

Port of Ploče Authority as public body and administrative body within Port of Ploče permanently rising safety in port area and aims to improve and speed up port procedures within logistic chain. Port procedures are focused on ship arrival/departure procedures, Cargo manipulation within

port area, custom and logistic procedures, gate in/out procedures and safety procedures within port areas.

Port of Ploče Authority has developed **Port Community System** which is used by port stakeholders and all procedures are covered within system. Port Community System has been integrated with subsystems which are used for access control and subsystem for Control and management of vehicles which enters or leave port area.

For Port of Ploče Authority one of the main bottlenecks is **lack of integrated information systems and low exchange data** with other system which are existing in port areas which have impact on cargo transport by sea and land side and entrance terminal to port area. This bottleneck is not bound to infrastructural improvement, but also to an organisational/management solution.

Port Community System which is integrated with other subsystem controlled by Port of Ploče Authority is **constantly upgraded** in order to achieve harmonised, stable and reliable electronic platform for fast and safe exchange of data between all relevant stakeholders including shipping industry and port operators.

In order to further improve data exchange between port users Port of Ploče Authority identified the **need to develop and upgrade PCS system modules used between port agencies and security authorities** for the automatize secured exchange of authorised gate in/on data regarding vehicles entering port terminals and to analyse actions and needs for data exchange in maritime part regarding ship arrival and departure procedure in a way to have new technological improved control centre to cover Visualization of vessel traffic and port infrastructure in GIS, Inbound/outbound handling and incidents.

With the aim of upgrading and developing a system for better control and management in all areas, the Pilot Action is focused on **ship arrival/departure procedures** and **gate in/out procedures** covered within Entrance Terminal. One of focused activity regards the **integration** with AIS Base Stations and Traffic Image Application for the VTS Centre and SAR MRSC operations of Port of Ploče Authority. Also, Port of Ploče Authority has focused on providing development of local systems as critical environment following national laws and according to development of National systems developed on National level for all Croatian ports.

3.3.2. Description of the pilot action

The primary focus to develop ICT solutions as well as to upgrade of existing ICT solutions to address the above-described bottlenecks. The goal of the pilot actions is to develop an IT system which with positive impact on port operations based on identified bottleneck processes.

The following main phases have been identified regarding ship arrival/departure procedures and processes.

1. Proof of Concept phase: The focus is on demonstrating how the processes of Port of Ploče Authority can be supported within pilot actions based on business processes within port of Ploče area. This phase provides the initial demonstrative solution as start concept for pilot actions. The basic elements to be setup include the geographic information system (GIS) component which will allow geographic information to be added to the solution in the future, and the interface for AIS data, which is the first step for the integration of AIS data into the system.
2. Foundation phase: The operational use case feature achieved by this phase is the visualization of vessel traffic and port infrastructure in GIS. The focus of this phase is to provide the basic backend services and an enhanced and improved client, already customized to Port of Ploče Authority's needs, by enhancing the GIS layer tree. This phase provides the core functionality to the system regarding monitoring and tracking ships.
3. Incident phase: The operational use case features achieved by this phase are the inbound/outbound ship handling, incidents with forms and checklists, and use of an automated log. The focus of this phase is to add incident handling (incident form, checklist, action log) to the AIS visualisation.
4. Analytics phase: The operational use case features achieved by this phase are legal proof recording and incident analysis. The focus of this phase is to provide the necessary modules to load historic events and incidents from the database and save them to external files. The core features provided in this phase support operators with post incident attribution processes, as well as the ability to export incident information for training purposes.
5. Ship database phase: The operational use case features achieved by this phase are the access to ship information at the touch of a button and administration of the own resources/contacts. The Ship DB's focus is to create an automatically updated repository of ships, useful for supporting incident management. This phase complements the incident phase to provide operators with reference information during routine and disruptive events. This phase builds on functionality developed in previous phases to result in a more advanced system. The Ship database (DB) phase consists of further feature development, customization and project management activities.
6. Future expansion: This phase icludes further modules, such as the maritime communication system and its integration, as well as the mobile client, both of which are of interest to Port of Ploče Authority.

3.3.3. Stakeholders

Based on the common agreement between the project partners about the list of the processes which should be considered, the Port of Ploče Authority listed all stakeholders in the port community (Table 2). The crucial criteria for the selection was the level of the involvement in relevant port processes, then the size and volume of the activities, as well as the readiness to

cooperate in pilot actions activity. Also, most of the stakeholders are Port Community System users.

Terminal operators	Forwarding agents	Public institutions	Port Security
1. **Luka Ploče d. d.** 2. **Adriatic Tank Terminal d.o.o. Ploče** 3. **NTF d.o.o. Ploče** 4. **Top Logistics d.o.o**	1. INA d.d. 2. Trans integral d.o.o. 3. Jadroagent d.d. Ploče 4. Adriatic Tank Terminal d.o.o. Ploče 5. Luka Šped d.o.o. 6. Ploče Šped d.o.o. 7. Petra Marina d.o.o	1. Port of Ploce Authority 2. Customs	1. Port security d.o.o.

Table 2 – List of the stakeholders identified

3.3.4. Impacts and replicability

With aim to upgrade and develop a system for better control and management in all port areas, with **focus on ship arrival/departure procedures**, Port of Ploče Authority has focused on some working directions, one of those being regarding the integration with AIS Base Stations and Traffic Image Application for the VTS Center and SAR MRSC operations of Port of Ploče Authority.

All cargo transport related issues have been more covered from the starting point when cargo is delivered to port terminal by ships, stored on terminal, transported through the entrance terminal from port areas. These are the crucial and critical services which must be also in line with cybersecurity laws and coordinated with activities on National level regarding development of National Port Community System which will be used in all Croatian ports.

In terms of replicability, the know-how from Port of Ploče Authority regarding this Pilot Action can be implemented on National level. Investments in new technology and upgrades of existing systems are crucial for data flow and exchange of information on local level between all stakeholders. Also, it is crucial for exchange of information on National level. The exchange of information with other systems are also crucial.

3.4. Port of Rijeka

3.4.1. Ex-ante situation – Background of the pilot action

The Port of Rijeka Authority has a **traffic control system** at six locations. All protected locations are communicatively connected into a single system via **different communication technologies** (LAN over optics, wireless LAN), and are managed from a **single centre**. Each location is essentially a local access control system that can operate completely autonomously and independently. The basis of the access control system is the GRANTA controller to which a maximum of 8 independent readers can be connected. These controllers are installed at each of the protected locations and they are connected to access control readers that are placed at the entrance of each location. Two readers (input and output) are installed at each entrance to the port area, so that the entry is recorded separately, and the exit from the port area separately. Different solutions of entrances and exits to the port area were used:

- metal double doors if it is a railway entrance,
- automatic road ramps in the case of a car entrance,
- swing doors (tripods) if it is a pedestrian entrance.

Due to the SWOT analysis, prepared in the framework of the D.3.2.8 Territorial needs assessment (TNA) for the Port of Rijeka, the most important weaknesses are emphasized:

- Focus on operative tasks and lack of quality analysis and study of port concessionaires needs for commonly used ICT services;
- Caused by lack of funds and limited time available according to CEF funding rules, implementation of the new PCS system does not foresee a wholesome solution for access control and permits issuing;
- Port of Rijeka basin is very distributed geographically, covering many locations, several terminals and related to EU funded project execution, along with successful project completion;
- Ongoing project of PCS implementation using latest technologies, detailed study of port concessionaire's needs and cybersecurity / business continuity requirements, is at the time of TNA creation execution on time and within budget;
- Competent and flexible ICT implementation team.

Regarding the SWOT analysis, the pilotage concessionaires' communication enhancement is a subject of further intra-stakeholder agreement and consensus is not yet reached, while permits issuing and access control procedures according to valid Regulation is a process overseen by Port of Rijeka Authority, it is concluded that **this particular IT system is a strong candidate to upgrade** as a key Pilot Action within PROMARES, and definitive recommendation can be given for its digitalization and enhancement as it can result in additional increase of ISPS compliance and

control of the port area, new revenue stream for Port of Rijeka and better experience for all involved parties, along with identified cross stakeholder transfer benefits.

3.4.2. Description of the pilot action

The **existing passage control system has been modernised** at the following locations: Mlaka Entrance, Žabica Exit, Brajdica - service entrance, Brajdica - official entrance / exit, Breakwater and the Administrative Building: Actions are summarised as follows:

- replacement of existing GRANT controllers:
- replacement of all passage control elements that are damaged or worn out;
- installation of new elements of passage control in accordance with the current situation and needs;
- construction and craft work for the realization of the full functionality of control of the passage at the subject locations.

Modern equipment was procured, which is used today for the mentioned purpose. These solutions are in line with the latest world practice for the protection of areas of similar purpose (ports). The new control devices are microprocessor controlled and network oriented.

3.4.3. Stakeholders

The stakeholders involved are all users in the Port of Rijeka Authority. The building of PCS has a significant impact on all port of Rijeka stakeholders and their IT systems, and they have been involved in the process from the very beginning, even before than EU funding was secured. PCS will have several dedicated modules for various concessionaires, and they will have to adjust their systems as part of regular planned internal growth and maintenance activities.

3.4.4. Impacts and replicability

The implementation of the pilot project has **completed the process of digitalisation** of the procedure for **obtaining approval to enter** the port area under the management of the Port of Rijeka. Users received a fully automated system for submitting applications for entry into port areas managed by the Port of Rijeka Authority. They can **submit and track the status** of the request online. After approval through their own user page, they can see the status of all requests. The possibility of all **types of payments** has been implemented, even the prepaid variant. Users have access to the **records of entry and exit for trucks** with the aim of optimising and planning the operation of trucks. The **introduction of the "booking" system** for the needs of the container terminal affected the balancing of the traffic pressure of trucks during the working

day. The goal was to reduce traffic peaks and thus relieve the port operational area from unnecessary detention and entry of trucks to the same. The main impacts are as follows:

- The level of security from the aspect of ISPS has increased;
- Greater speed and ease in submitting requests and announcements for arrival in port areas;
- Possibility to control the arrival of trucks in port areas;
- Balancing road traffic pressure;
- Completely digital process.

3.5. Port of Venice

3.5.1. Ex-ante situation – Background of the pilot action

Taking as reference the 2018, the railway traffic generated by the Port of Venice was about 5.543 train equal to 2.6 million tons of freight moved (about 100 trains/week), showing a growth of 13% in respect to the year before. Also, the constant traffic growth of the last 6 years leads to suppose that the trend is structural. This stated and in line with the prescriptions included in the "National Plan for Ports and Logistic", acknowledged by the Port Operational Programme 2018-2020, the Port of Venice is carrying on **a series of investments aiming at improving its railway infrastructures** and easing the port's railway accessibility services, with the aim to increase its multimodality. This will be functional to strengthen the railway traffic in relation to road one, that is still predominant, allowing to overcome one of the weakness emerged within the TNA and SWOT analysis. Besides several infrastructural investments oriented to increase the railway traffic capacity, there is a **need to improve also the services and the systems that manage the railway traffics** in order to finally increase the Port of Venice logistic and multimodal efficiency.
The Pilot Action is devoted to **re-engineering the current railway telematics systems for shunting operations (SIMA)** in order to introduce new and better tailored functionalities.
Currently, the SIMA IT system retrieves, processes and stores data during the manoeuvring procedures and the wagons positioning operations inside a port area or a railway hub, aiming to support management and real time monitoring of the operations. SIMA comprehends the following functional modules:

- manoeuvres Management;
- manoeuvres Monitoring;
- reporting;

- account management;
- mobile and GPS infrastructure.

SIMA offers the following macro-functionalities:

- **data acquisition,** i.e. during the start-up phases of the manoeuvring procedures, through the insertion of the annual, weekly or daily schedules of the single manoeuvres, by entering data from the user interface;
- **data processing,** through application of rules, constraints and suggestions for the benefit of the various users of the system (Business Logic);
- **notification of the status change** of a procedure, through certified (timestamps based) and traceable communications;
- **data archiving and database query** functionality, through facilities such as affinity search or recent history;
- system log recording for tracking all events and who did what;
- automatic interface with GPS-EGNOS satellite tracking system, installed in locomotives;
- representation, through a synoptic table, of the entire railway park area with real time monitoring of: tracks and relative occupation status; locomotives (pushing or pulling) together with wagons, tugs and trains, each with its state (to be unloaded, repaired, departing, etc.); recent, in progress or imminent operations.

Currently, the software solution includes, for the web part, the two client applications:

- **a web application** (front-end) complete with user interface aimed at the various actors of the system (infrastructure managers, railway company and customers) and organized in a way that is intuitive and easy to use and which must allow the management of the whole maneuvering process;
- **a mobile application** aimed primarily at maneuvering operators and installed on special devices, which must allow management and monitoring of operations.

At today, SIMA does not fully meet the operational management needs that are upcoming together with the scenarios. The most critical aspects concern above all the non-intuitive graphic interfaces, the absence of wizards, the absence of some useful correlations between the different modules of the system and the presence of unused data and functions. In addition to the critical issues on the use of the system, there is also the need to update the technologies used for its development. Moreover, it is also necessary to introduce a component with process optimization and decision support functions that, through the processing of time series of data stored by the

system and data received in real time, give indications on the most effective solutions to process management problems.

3.5.2. Description of the pilot action

The **enhancement of railway telematics systems for shunting operations (SIMA)** and its **integration with PCS and information systems** of other subject involved in developing rail services is the main goal of the Port of Venice pilot action. The system architecture, at today based on the restful model, has to be updated to more effective models such as micro services-based architecture. At the very least, the architecture has to be rethought for an easy future migration. As for the user interface, it must be subject of a careful analysis on usability and user experience, ensuring an easy start-up of the system in the environment where it will be used. Interfacing with the new external systems is another critical aspect to consider, for more details regarding these systems.

A redesign intervention involves the analysis of the current situation (AS IS) with the mapping of the primary process and the support processes, the identification of critical issues and points that can be improved, the study of solutions and the consequent redesign of the process in an organic way. Therefore, the Pilot Action is intended to conduct to a radical overhaul, rethinking the entire "Web App" and "Mobile App" from scratch, and not just simple adjustments, calibrations, or operational improvements. The goal is the re-engineering of the SIMA software system and the removal of obstacles that influence the process.

The activities included in the overall re-engineering of the SIMA are:

- Implementation of a **new architecture for the Web and Mobile part**
- Development of **ad hoc software**, which includes: remaking of software modules or individual applications, whose functions are not satisfied with the current methods or characteristics, therefore they will have to be completely rewritten on a new architecture; the development of entire software modules, or autonomous parts of the same that solve specific needs in the face of new features to be computerized, also to be implemented on the new architecture;
- **Evolutionary maintenance of the architectural layers** from the API Gateway / ESB to the database, which includes interventions aimed at enriching the solution (with new features or other non-functional features such as performance, etc.) or in any case to modify or integrate the functionality of the solution. This maintenance involves writing additional functions for integration with existing information systems or applications or parts of functions (also replacing other already existing ones).

The overall re-engineering activity consists of the following steps:

- STEP I: Technical-functional analysis to define the requirements of the new architecture and subsequent implementations
- STEP II Implementation of re-engineering of existing modules
- STEP E III Implementation of new features
- STEP IV: Database migration and Business Intelligence tools

3.5.3. Stakeholders

The re-engineering of the SIMA has been done in tight contacts with main pilot action stakeholder, i.e. ERF, the Rail Shunting Operator of Venezia-Marghera Railway District.

Stakeholder	Role	Importance	Contribution	Benefit	Conflict	Current support	Strategies to improve support
Italian Ministry of Infrastructure and Transport	National Authority responsible for transport policies, planning and coordination	High	Approval of policies, plans, permits and funds to implement infrastructure	Improvement of last mile connections. Increase of rail capacity	None	High	Coordination within EU TEN-T Corridors implementation
Railway Infrastructure Manager (RFI)	National infrastructure Manager	High	Approval and authorization of investments. Annual check of infrastructures	Improvement of last mile connections. Increase of rail capacity	None	High	Agreements (last 2018)
Veneto Region	Regional Authority for transport policies, planning and coordination	Medium	Approval of policies, plan, permits and funds to implement infrastructure	Improvement of last mile connections. Increase of rail capacity	None	High	Agreements (last 2018)
Esercizi Raccordi Ferroviari (ERF)	Rail Shunting Company of Venezia-Marghera Railway District	High	Port shunting operations	Reduction of shunting time. Increase of rail capacity	None	High	
Terminal Operators	Companies managing port terminal and logistics operations	High	Port terminal and logistics operations	Increase of shunting quality (time) and reduction of costs.	None	Medium	
Railway Operators	Rail transport companies	Medium	Dealing with Rail transport operations	Increased integration of Rail IT systems	None	Low	
European Rail Freight Corridors	European Network of Rail Infrastructure Managers and Rail operators	Medium	Integration among IT systems	Increased integration of Rail IT systems	None	Medium	

Table 3 – List of the main stakeholders involved

3.5.4. Impacts and replicability

The main impacts related to the SIMA re-engineering are as follows:

- the possibility to create and manage the M.53 of District (called “M53 di Comprensorio”) model. The M.53 of District model will replace the M.53 Integrated model (now done by the Infrastructure Manager) and contains some additional useful data concerning

operation of the Shunting Operator. These additional data could be used by the system to improve planning procedures efficiency through an optimisation of train placement in railway yard and their relative movements using machine-learning techniques and logistic algorithms;

- the possibility to interact with the PIC system of RFI that allows real-time communication of changes to the general planning of arrivals and departures (e.g. deletion or changes in the schedule) and the insertion of unplanned trains through an XML protocol or similar one;
- the possibility of interfacing with the Mercitalia Rail SIM system that allows the management of waybills through an XML protocol;
- the possibility of interfacing with the Railway Undertakings IT systems (such as SIR system of Mercitalia Rail) for the recovery of information regarding train composition (list of wagons and containers carried by each wagon), useful for the automatic management of wagon groups through an XML protocol or similar one;
- the insertion of a new software component for the automatic calculation / optimization of the precedence on single tracks as Decision Support System, which assists manoeuvre planners in logistics decisions regarding train movements on the tracks beam by the proposal for the entire daily manoeuvres scheduled respecting both operational and infrastructural constraints using machine-learning techniques and logistic algorithms;
- the possibility to manage the shunting personnel through the system to assign each shunting team to their respective loco automatically.

3.6. Port of Ravenna

3.6.1. Ex-ante situation – Background of the pilot action

One of the main objects for the Port of Ravenna is to **optimise and improve the rail infrastructure**. Seven main interventions are foreseen in the next years as described, in Table 3 (for a detailed description see D.3.2.5 Territorial needs assessment for the port of Ravenna - Subsection A.3 – Tools and measures supporting multimodal transport (policies, plans, etc.)).

Logistic node	Project ID	Interventions
Port of Ravenna	P142A	1. Rails extension on the right side of the Candiano Canal
		2. Suppression of the level crossing in via Canale Molinetto
		3. Adjustment of the silhouette of the overpass Teodorico
	P142B	A new station at the base rail track
	Other interventions	1. Activation of junction on the left side of the Candiano Canal
		2. Realization of other seven tracks and their electrification
		3. Transformation of the base rail track into tracks for arrivals and departures

Table 4 – Summary of planned interventions

The investment in physical infrastructures must be supported by the implementation of **adequate digital infrastructure** in terms of digital services gave to the port operators in order to improve the efficiency of the logistic processes and, specifically, of the processes related to the transportation of goods by rail.

The **Port Community System of Ravenna** (for a detailed description, see D.3.2.5 Territorial needs assessment for the port of Ravenna - Section D – Analysis of IT systems) need to be implemented with a function devoted to share information about the train circulation and to give to the stakeholders (terminals, freight forwarders, ship agents, MTOs, …) all the data necessary to optimize the timing in the see-rail intermodal transportation. The Pilot Action is intended to show how ICT implementations can have positive effects on the multimodal logistics within a port system.

3.6.2. Description of the pilot action

The object of the Pilot Action is to **develop a new "Rail Module" for the PCS** of the port of Ravenna. The module must respect the following main characteristics:

- interoperability with the IT system of RFI (the rail infrastructure managing company);
- interoperability with the IT system of the railway shunting operators;
- interoperability with the other PCS's modules in order to acquire the information about the customs clearance and, in general, about the status of the goods;
- interoperability with the MTOs;

- interoperability with the Terminal Operator Systems

The Pilot Action has been tested on a scenario related to the container traffic, although the module must be ready for the management of all the types of package of the goods (containers, general cargo, solid or liquid bulk, …).

The module must support the **following processes:**

- train schedule
- shunting schedule
- goods status querying
- gate verification
- train tracking

3.6.3. Stakeholders

The main stakeholders involved are freight forwarders, terminal operators, Customs Agency, rail operators, and shunting operators.

3.6.4. Impacts and replicability

The Pilot Action provides valuable insights on how ICT implementation can have positive effects on multimodal logistics within a port system. The main impacts are reported as follows:

- optimisation of the logistics process related to intermodal transportation;
- accuracy improvement in the coordination among operations related to rail transportation;
- reduction of the time to complete the customs operations.

3.7. Port of Trieste

3.7.1. Ex-ante situation – Background of the pilot action

The main feature of the Port of Trieste is represented by its legal status of **Free Port**, in application of the rules of the Paris Peace Treaty (Annex VIII). According to it, the **Free Zones of the Port** of Trieste enjoy the legal status of customs clearance exception and do not belong to the customs territory of the European Union.

In the design of the Port Community System PCS, called “Sinfomar”, it was necessary to consider the special legislative situation due to its status as a Free Port. The Free Port of Trieste currently includes **five distinct Free Zones**, three of which reserved for commercial activities (Old Free

Zone, New Free Zone, Timber Terminal) and two used for industrial activities (Mineral Oils Free Zone, Zaule Channel Free Zone). As regards the customs regime, the Free Zones of the Port of Trieste enjoy the legal status of customs clearance exemption, which involves a whole series of beneficial operating conditions for the Free Port of Trieste. This is undoubtedly the biggest area of difference between the regulations of the Free Port of Trieste and national and EU ones.
Against this background, it is necessary to **allow the free flow of goods** between Free Zone areas also outside the Port areas and, at the same time, **reduce the road congestion** due to the increasing traffic flows, thus optimising the use of the existing infrastructures.

3.7.2. Description of the pilot action

The aim of the Pilot Action consists in **creating a new module of the Sinfomar PCS**, dedicated to the management of the movement of goods between external Free Zone areas outside the Port of Trieste, using data from existing cameras, both for rail and road transportation to ensure the traceability of goods.
The new module of the Sinfomar PCS has the objective of **managing the goods arrived** in a Free Zone area to be transferred to another Free Zone area using road or rail transportation in a controlled way, without implementing traditional customs operations, but using ICT procedures and tools (**e.g. cameras or virtual gates**).
This module has also the objective of **managing** at the same time **logistics data** (e.g., plate of the trailer and semitrailer, type of vehicle, container number, train tracks,...), data to identify the **subject responsible of goods** (e.g., personal identification data of the driver and of the freight forwarder) and **customs data** (e.g., type of goods using HS (Harmonized SysteM) standard, initial and foreseen final date of transport, weight, type of customs document, MRN (Movement Reference Number), …).
Also, a complementary activity focuses on the extension of the PCS Sinfomar to **manage the external buffer areas** belonging to the zone under the control of the Port Network Authority of the Eastern Adriatic Sea. These areas are authorised spaces where vehicles directed to the Port of Trieste can stop with the aim of a better and integrated management of the traffic flows to the Port of Trieste and to track in advance the vehicles (through the utilisation of the pre-arrival notification). The buffer areas are of different types: public (such as the Interporto di Trieste – Fernetti), Free Zone areas (such as the Industrial Free Zone called FREEeste) and private ones. In accordance to the activity already foreseen, this extension of the PCS would allow the management of such external areas and the movement of goods between them and the Port of Trieste.
At operative level, to properly utilise the functionalities enabled in the module “External Free Zone Areas” (literally “Punti Franchi Esterni”) in the PCS Sinfomar, it is necessary to update the

registry of the warehouses in Sinfomar, by registering in the PCS the data concerning the free zone area/s.
Then, the processes are based on the concept of “pre-arrival” that is a declaration made by the local representative of the carrier or by the carrier itself. The pre-arrival collects data of three different types: (i) logistical; (ii) customs related; (iii) about the driver. The customs data concern details relevant from the customs point of view in relation to the goods to be loaded or unloaded from a warehouse in a free zone area. It is possible to use a research function to find out all the data declared in a pre-arrival notification for a specific truck as well as to visualise the authorisation to be transferred to a different logistical area (virtual traffic light green or red) and also to monitor the accesses in a specific free zone area. By opening the link associated to the Sinfomar number of a selected truck it is possible, for the terminal, to confirm the arrival (also by using data detected by devices such as OCR cameras, documents and passports readers, at gates). In addition, it is possible to visualise the details of the goods transported by a specific truck.
During the development of the pilot activities, drawbacks or problems have not been recognised. On the contrary, the deep analysis of the activities to be carried out led the identification of the second pilot action that is strictly related to the overall goals of the pilot.
This second pilot, as anticipated, focuses on the extension of the PCS Sinfomar to manage the external buffer areas belonging to the zone under the control of the Port Network Authority of the Eastern Adriatic Sea. In particular, the pilot action focuses on the private external buffer areas that are named as “Authorized Buffer Area – A.B.A.”. Hereafter, the main activities carried out are listed:

- Definition of the official regulations and guidelines: the General Secretary of the Port Network Authority of the Eastern Adriatic Sea approved the guidelines that have been sent to all the operators that stated their interest to be authorized to operate as “A.B.A”. These guidelines indicate the rules to be applied and the processes to be followed to obtain the authorization;
- For the time being, the Port Network Authority of the Eastern Adriatic Sea officially received five complete requests. All of them are positively evaluated and five operators are authorized to be “A.B.A” to manage, accordingly to the guidelines and established rules, the road traffic of Ro-Ro trucks directed to the Port of Trieste;
- In addition to the guidelines, an operative manual has been prepared. Moreover, specific training activities have been performed directly in the offices of the different authorised operators;
- Constant support is offered to the operators in order to use properly the PCS Sinfomar and to align their operations to manage the traffic flows in accordance to the availabilities

of the port terminals and the department of the Port Network Authority of the Eastern Adriatic Sea dedicated to the management of the road traffic.

The results gained with this Pilot Actions have important impact on the Port Community, since this initiative helped to support the management of the traffic in a particular period like the lockdown caused by the Covid-19. Therefore, this action is really appreciated by the operators. Figures below show the screenshots taken directly from the PCS Sinfomar.

3.7.3. Stakeholders

The main stakeholders are freight forwarders, terminal operators, Customs Agency, and Financial Police. They have been kept constantly updated about the implementation of the activities through informal ad-hoc communication actions.

3.7.4. Impacts and replicability

The main impacts are as follows:

- the increase of data accuracy and the certification that goods moving between Free Zone areas do not change path;
- reduction of road congestion due to the increase in traffic flows and optimisation of the use of the current port infrastructures.

The Pilot Action is fully replicable in other contexts, even beyond the Programme Area.

3.8. Interporto di Trieste S.p.A.

3.8.1. Ex-ante situation – Background of the pilot action

The main feature of the Port of Trieste is represented by its legal status of Free Port, in application of the rules of the Paris Peace Treaty (Annex VIII). According to it, the Free Zones of the Port of Trieste have the legal status of customs clearance exception and do not belong to the customs territory of the European Union. The Free Port of Trieste currently includes five distinct Free Zones, three of which reserved for commercial activities (Old Free Zone, New Free Zone, Timber Terminal) and two used for industrial activities (Mineral Oils Free Zone, Zaule Channel Free Zone). Moreover, the Free Zone status is also applied to the inland terminal FREEeste located in Bagnoli, 10 kilometres far from the Trieste Port. The **terminal is owned by Interporto di Trieste S.p.A**, the inland terminal of the Trieste Port. This dry port area has been created in 2019 in order to **avoid**

congestion in the Trieste Port and, even more important, with the aim to **enable industrial production** in Free Zone area. The trade flows insisting on FREEeste are currently operated via road and refers mostly on maritime traffics operated in the major Trieste Port terminals. Considering that the Trieste Port is the first Italian port for railway traffics and that the Trieste Port Authority (AdSP MAO) has the target to increase rail traffic to and from the port of Trieste up to 25,000 trains in 2025, to achieve this goal, it is starting the executive part of the design of the extension of the railway capacity of the station of Trieste Campo Marzio and Adriafer park. In addition, it intends to proceed with an integration increasingly distributed throughout the territory in order to connect the intermodal hubs (eg. Monfalcone, Cervignano, Villa Opicina, FREEeste, Aquilinia) with the main maritime port of reference.
The dry port of FREEeste has to be integrated in the railway network as from the physical infrastructural perspective as from the immaterial infrastructural one, following the AdSP MAO roadmap. In this scenario, the sharing of information referred to the railway customs and logistics cycles is fundamental and the main reference platform, in terms of local technological and information standards, is the "Sinfomar" Port Community System (PCS). Based on the aforementioned considerations, the **adoption of automated railway portals** is becoming essential in order to detect and transfer the necessary information assets to PCS Sinfomar.

3.8.2. Description of the pilot action

In such a context, the aim of the Trieste Port and the FREEeste management is to enrich the Trieste railway opportunities to offer on the global market more train operations from/to FREEeste, also exploiting the strengths of the Free Zone Regime.
The aim of the Pilot Action consists in the realisation of a **gate automation-based infrastructure for railway traffic management** in the FREEeste area. The **new gate** has been located at the entrance of the FREEeste dry port area, in correspondence with the rail network already in place.
The railway gate automation is a combination of **innovative technological components** such as:

- Automated railway gate management: 2 laser scanners, 1 context camera, Nr. 1 IP54 wired cabinet with power supplies, network switches and lane controllers;
- Automatic UIC code recognition system: 2 High resolution colour cameras complete with a pair of white light illuminators and power supplies + dedicated software license;
- Automatic ISO 6343 container code recognition system: 3 High resolution colour cameras complete with a pair of white light illuminators and power supplies + dedicated software;
- Damage control system: dedicated software;
- Automatic ILU automatic code recognition system: 1 lane controller.

The main railway gate automation goals are:

1) **Data collection:** The hardware components installed on the gate are able to collect on-filed data concerning inbound /outbound trains. The main data types refer to the following groups:
    a. **Railcars gate in /out:** the system is able to detect on-field data concerning wagons sequence and wagons id. Moreover, images can also be captured in order to monitor the status of the railcars, for example evidencing if a damage is present;
    b. **Intermodal Transport Units (ITUs) gate in/out:** the system is able to detect on-field data concerning ITUs id and type. Moreover, images can also be captured in order to monitor the status of the railcars, for example evidencing if a damage is present;
    c. **Train composition:** the system is able to detect the assignment wagon / ITUs, thus detecting data about the train composition for inbound and outbound flows;
    d. Train direction: the system is able to detect the train direction (inbound / outbound) data;
    e. Damages monitoring: the system is able to detect damages images concerning wagons and /or ITUs.
2) **Data processing:** Once the data have been collected, they are shared with a virtual machine on a remote server in which appropriate software procedures elaborate them in order to refine data quality and produce relevant outputs for final users.
3) **Data sharing:** The solution also provides the possibility to share via interoperability services the elaborated data with:
    - Sinfosec IT platform: the operating system used by Interporto di Trieste for the terminal management;
    - Sinfomar IT platform: the Port Community System of the Trieste Port Authority (AdSP MAO).

    Concerning the interoperability with Sinfomar, the PCS has specific information requirements in order to enable the software procedures embedded in the train management modules.

3.8.3. Stakeholders

The main stakeholders are Trieste Port Authority, inland terminal, freight forwarders, Customs Agency, and Financial Police: They have been kept constantly updated about the implementation of the activities through informal ad-hoc communication actions.

3.8.4. Impacts and replicability

The main impacts are summarised as follows:

- increase of data accuracy and the certification that goods moving between Free Zone areas do not change path;
- reduction of data entry processing concerning inbound / outbound trains;
- enhanced data visibility along the supply chain.

The Pilot Action is fully replicable in other contexts, even beyond the Programme Area.

4 Discussion and closing remarks

4.1. Summary of Pilot Actions

The above-described Pilot Actions well reflect the ongoing evolution of the role of ports, that are progressively shifting to pure intermodal nodes to much more complex ecosystems where the relationship with multiple stakeholders and related flows represent the key element for the system development. This shift comes along with increased process complexity to be managed, due to the high variety of players involved in the transportation processes. This entails the need for improving the Port Community System (PCS) as well as promoting integration among the stakeholders.

Based on these premises, all the examined Pilot Actions involve actions towards an increased automation of information flows supporting data exchange and sharing among the stakeholders involved. In summary, three main work directions have been addressed:

- **Increased digitisation** by means of a variety of technologies, ranging from imagine/data capturing systems (e.g. Port of Trieste) to Artificial Intelligence (e.g. Port of Ancona)
- **Improved integration** with the railway systems and other stakeholders (e.g. Port of Ravenna)
- **Enhanced relationship** with the **areas** close to the **port** (e.g. logistics areas, dry port)

Looking at increased digitisation, as an example Interporto di Trieste S.p.A. implemented a railway gate automated system as a combination of several innovative technological components such as laser scanners, automatic recognition systems and damage control systems allowing for data collection concerning inbound /outbound trains. Images can also be captured in order to monitor the status of the railcars, for example evidencing if a damage is present (Figure 1).

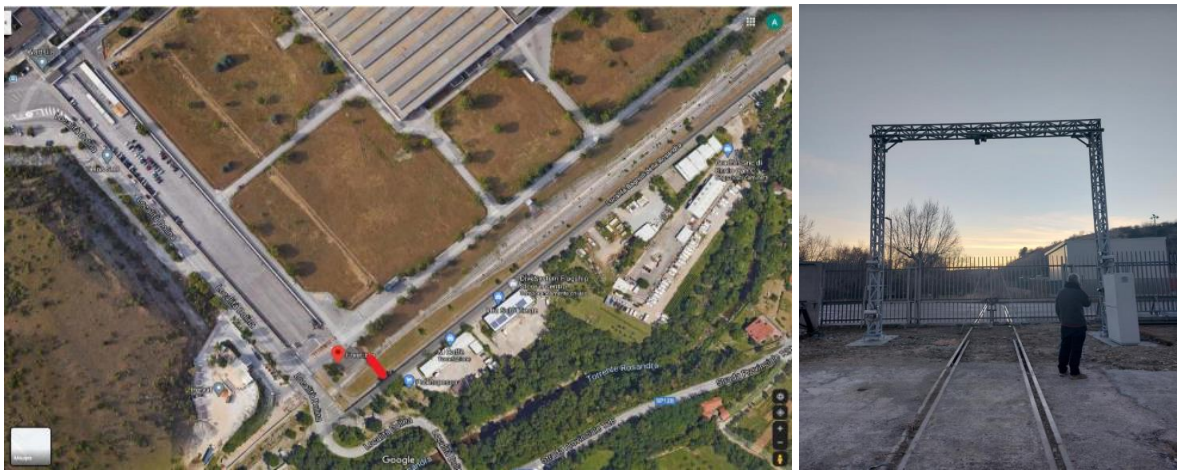

Figure 1 - Automated gate in FREEeste

As another example in terms of digitisation, the port of Ancona introduced the use of an Artificial Intelligence (AI) system to reduce long-term burdens and ensure greater surveillance and monitoring of vehicles in and out of the port area. The system can process the images of the cameras along a path and identify dangerous situations and anomalous behaviour with respect to user-defined standards. The system is able to recognize, monitor, track and monitor each vehicle from point A to point B and to be able to monitor the parking area, without the need for identification equipment or aids to the vehicles (tags, OBU or other active or passive devices).

Looking at improved integration, an example is provided by the Port of Ravenna, whose Pilot Action focused on developing a new “Rail Module” for the PCS of the port of Ravenna. The module allows for interoperability with multiple IT systems, such as the one of RFI (the rail infrastructure managing company), of the railway shunting operators; of the other PCS’s modules (to acquire the information about the customs clearance and, in general, about the status of the goods). It also allows for interoperability with MTOs and the Terminal Operator Systems. Figure 2 shows the interconnection of the new module with the other existing systems.

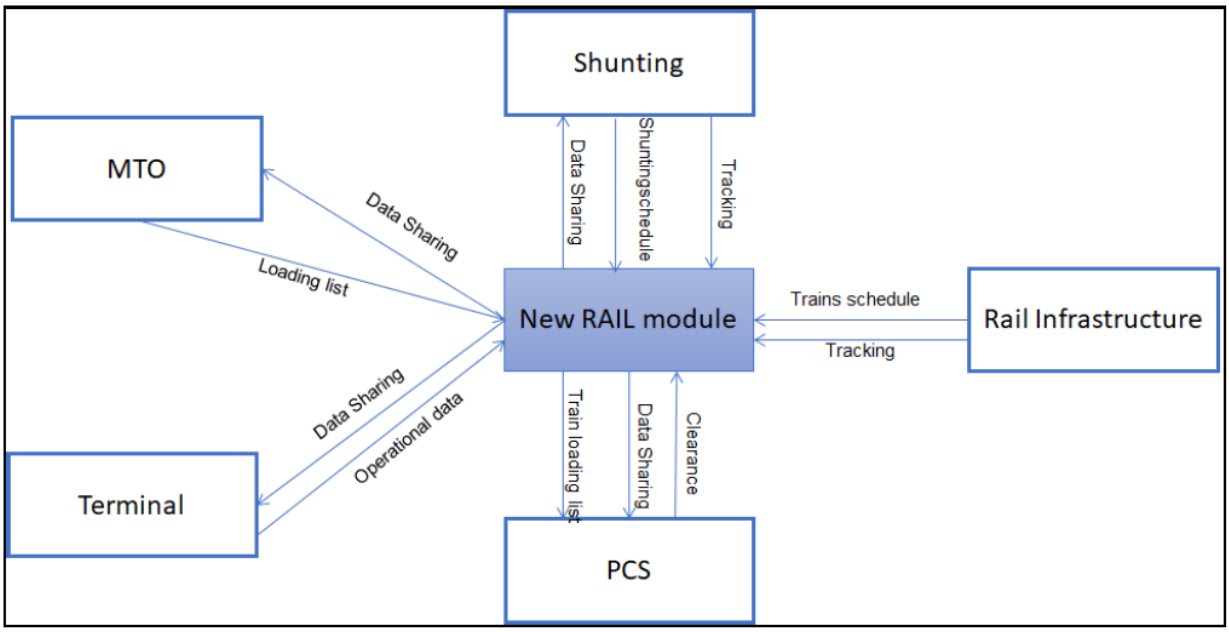

Figure 2 – Port of Ravenna: interconnections between the new module and the other existing systems

4.2. Impacts and future recommended directions

The resulting impacts are essentially associated to improvements in terms of **security**, **efficiency**, as well as **speed and accuracy**.

For instance, as far as security is concerned, the Port of Ancona highlighted an increase in security of the containers traffic flow, and of the surveillance and tracking of the containers thanks to the use of Artificial Intelligence system able to detect potential suspected behaviours. Regarding efficiency, the Port of Ancona also observed an efficiency increase in the container traffic flows, with the improvement of KPIs related to timing and costs of operations, and reduction of pollutant emissions. Looking at speed and accuracy, among the key impacts generated by the Pilot Action, the Port of Rijeka pointed out greater speed and ease in submitting requests and announcements for arrival in port areas.

Besides these general achievements, other types of impacts can be highlighted that are directly related to enhancement of the local PCS. Specifically:

- In all cases, the Pilot Actions made it possible to **strengthen the existing systems** thanks to both upgrading interventions and the introduction of new specific modules or technologies;
- In several cases, the interventions and new solutions introduced by the Pilot Action allowed for additional impacts also on other ICT systems already present in the port (e.g. shunting operations in Venice).

The achievement of the above-described impacts is consistent with the objectives and work directions identified by the EU as parts of its strategic plans EUSAIR (EU Strategy for the Adriatic and Ionian Region), EUSALP (EU Strategy for the Alpine Region), and EUSDR (EU Strategy for the Danube Region), with particular reference to:

- promote intermodality;
- support modal shift;
- increase cooperation;
- develop of efficient multimodal terminals.

Based on the results achieved, some key directions for future developments can be identified, namely:

- Further promote synergies between each port and its catchment area, starting from the dry port and areas behind the port (e.g. case of Trieste);
- So far, the peculiarities of each port have mostly led to solutions tailored around the specific port environment. This can represent a valuable starting point for further work on further promoting the integration also among different ports;
- Foster the use of analytics made available by the new technologies/solutions implemented to support to decision-making processes thanks to information sharing. From this viewpoint, the Port of Rijeka is a good example of enabling solution that can be further used to support decisions;
- The integration with the railway system has implications in terms of increased efficiency and effectiveness. In the future, positive impacts in terms of reduced environmental impact.