EUSAIR Flagship paper

The thematic contribution the DIGSEA project to the EUSAIR Flagship "Smart/green ports" on digitalization

D.3.2.2

Contents

1 Introduction

On October 23rd-24th 2014, the European Council approved the European Union strategy for the Adriatic and Ionian region (EUSAIR). The Launch Conference organized by the Italian Presidency of the Council in cooperation with the European Commission, took place in Brussels on November 18th 2014.
EUSAIR is based on the maritime strategy for the Adriatic and Ionian region implemented by the European Commission in 2012 and is the only European macro-region strategy that includes 4 member states (Italy, Croatia, Greece and Slovenia) and 6 non-EU countries (Albania, Montenegro, Serbia, Bosnia-Herzegovina, the republic of Northern Macedonia and San Marino).
This strategy aims at promoting the economic and social well-being in the Adriatic and Ionian region, by fostering employment, improving its appeal, competitiveness and connectivity while protecting the environment and ensuring the safety and balance of the sea-coast ecosystems. The EUSAIR is built on four thematic pillars:

1. Blue Growth
2. Connecting the Region
3. Environmental quality
4. Sustainable tourism

Besides these pillars, EUSAIR includes different topics such as capacity building, research and innovation.
The Strategy has been implemented with an Action Plan that includes a list of priorities and objectives for each Pillar, to be achieved by 2021. In addition, a governance mechanism has been set on two levels alongside the political level: a Governing Board (GB) and Thematic Steering Groups (TSG).
The GB includes, among others, the Foreign Affairs Ministries of the 10 Countries, Commission services (DG Regio, DG Mare, DG Near) and representatives of the Adriatic and Ionian Initiative and the Adrion Program. The GN has to orient the work done by the TSGs.
The four TSGs, one for each Pillar, are responsible for the implementation of the Action Plan, by identifying projects and initiatives and promoting them for funding and investments. Each TSG include national and trans-national coordinators. Italy is co-coordinator, with Serbia and the republic of northern Macedonia, of the Pillar 2 "Connecting the Region", with two different but interconnected priorities:

- Transports, divided in maritime and intermodal connections towards the hinterland
- Energy networks

Due to the lack of dedicated funding, the implementation of the EUSAIR strategy requires an integrated approach on the strategic and operational level of all the countries involved, which starts from the identification of the priorities in which to invest and continues with the search for financial resources. The cohesion policy is one of the possible sources of funding and is called upon to contribute to the implementation of the strategy through the so-called process of *embedding* of the priorities of the strategies in the cohesion, mainstream and European territorial cooperation programmes.

The embedding process of the priorities and/or flagship projects of the macro-regional and sea basin strategies within the Programs was at the heart of the efforts of the EUSAIR strategy during 2020, 2021 and 2022, as it represents a fundamental step to ensure that the cohesion policy can actually contribute to the strategy.

In particular, the Transport subgroup of TSG 2 has identified a Flagship action called "The Adriatic-Ionian Multimodal Corridors" which has also been approved by the Governing Board, for inclusion in the Partnership Agreement for ESI Funds 2021-2027 and for IPA III Programming.
This action intends to contribute to the creation of a system of multimodal corridors in the Adriatic-Ionian region, reducing the infrastructural, technological and administrative gaps and increasing accessibility. Within the aforementioned Flagship, the TSG2 has selected two priority actions:

1. ADRIATIC-IONIANCYCLETOUR, which consists in creating a cycle path that runs along the entire Adriatic and Ionian basin called ADRION CYCLE Route;
2. ADRIATIC-IONIAN GREEN/SMART PORT HUBS CONCEPT, which consists in the development of green and smart initiatives in the port network of the Countries involved in the Strategy.

With specific reference to maritime and port operations, the "Green/Smart Port" concept has four main objectives:

1. Improving sustainability in maritime vessels operations;
2. Ports as green hubs;
3. Safety in ports;
4. Digitalization in ports;

These four objectives include the themes summarized in Table 1.

SCOPE	THEME
IMPROVING SUSTAINABILITY IN MARITIME VESSELS OPERATIONS	• Enhancing vessels' energy efficiency • Reducing vessels' air emissions • Creating a network of recharging and refueling infrastructure
PORTS AS GREEN HUBS	• Promoting ports as renewable energy hubs by integrating electricity, hydrogen and other low-carbon fuels • Greening ground port services and operations • Promoting ports as testbeds for waste reuse and the circular economy:
SAFETY IN PORTS	• Improving infrastructure resilience to adapt to extreme weather events • Planning measures to face pandemics and other sanitary emergencies • Vessel Traffic Monitoring and Information Systems (VTMIS)
DIGITALIZATION IN PORTS	• Digitalization of multimodal travel planning • Implementing automated/unmanned terminal and maritime operations • Promoting Port Community Systems • Developing Maritime Single Window solutions • Experimenting the use of digital twins, Internet of Things, artificial intelligence, blockchain

Table 1 - List of themes included in the "Green/Smart Port" concept

In the following sections, the specific contribution of DIGSEA to the EUSAIR strategy will be illustrated in detail. The concluding section will summaries the contributions and propose some ways forward to update and fully realize the Green/Smart Port concept.

2 Specific contribution of DIGSEA to the EUSAIR Flagship "Smart/green ports"

2.1 Contribution from the cross-border inventory of projects on ICT applied to freight transport

With reference to the results derived by the Cross-border inventory of projects concerning IT-HR Standard and Standard+ projects on ICT applied to freight transport (WP3 - 1. O.3.1), DIGSEA will focus in particular to the following projects:

- TRANSPOGOOD, which developed an innovative ICT tool to find the best solution of transport services (e.g., best price of combined transport),
- PROMARES, which assessed the use of ICT solutions in the port-hinterland domain.
- DIGLOGS that looked into improving information flows of transport processes on freight movements, status and authorizations.
- INTESA, which focused on the port-sea relation, with the goal of harmonizing and optimizing the procedures of the maritime transport processes.

For each of them, DIGSEA identified the exploitable results and assessed their value proposition, i.e. the value added of the identified ER relative to the previously available results.

The TRANSPOGOOD platform provided tools to plan and manage transport and supply chain services on a multi-provider and door-to-door context. The platform represented an innovative ICT tool to find the best solutions for transport according to the following metrics: best price of combined transport, lower emissions of entire chain, e-procurement tools for maritime transport services, higher bi-directional load factor. The platform provided four level of services:

- Informative: it provided information about costs and intermodal services based on standard tables provided by shipping lines. It bears a similarity to the google maps path-finding algorithm but calibrated for truck users and considering intramodality.
- strategic procurement: users were informed of the possibility of using specific business platforms to obtain a price quotation of desired transport services. Links to several platforms are provided. As pilot application, for the project's duration, real market data were used as test bed. The platform allowed to have a benchmark of real market costs related to connections between Italy and Croatia;
- spot market: users were informed of the possibility of using a specific platform to make spot transport requests and obtain price quotations. Links to the platforms were displayed;
- connection with PCS: as pilot application, real time data from Ploce PCS were displayed. Data regarded mainly parking availability. Data were sent through xml format.

The PROMARES project:

- increased technical knowledge and transport planning competences of all the ports generating intermodal and multimodal freight transport as well as the most relevant intermodal logistic node of the Programme Area for enhancing maritime and multimodal freight transport;
- improved ability of all the ports generating intermodal and multimodal freight transport as well as the most relevant intermodal logistic node of the Programme Area to streamline freight flows through the use of low-cost and highly efficient ICT tools;
- upgraded Port Community Systems and ICT systems aiming at a better communication and coordination with port stakeholders (private and public) at node and at cross-border level;
- established a multilevel and multidisciplinary cooperation network among transport stakeholders and policy makers, through a convergent bottom-up (from the needs of the territories to the policy actions) and top-down (from the policy actions to the implementation of measurable and concrete low, medium and long-term transport facilitation measures) approach.

INTESA improved the quality, safety and environmental sustainability of marine and coastal transport services and nodes, by promoting multimodality between Italy and Croatia at large, creating a technological integration of the two national safe navigation systems. The project:

- optimized port operations/procedures, short-sea shipping capacity;
- improved links to the mainland network;
- improved coordination and harmonization of data sharing via AIS ASMs messages.
- For first time, Italian and Croatian Authorities jointly defined common guidelines for real-time AIS National Systems and the sharing of Application Specific Messages.

The DIGLOGS project achieved various results via several pilot projects.

- The pilot “Action WMS (Warehouse Management System) 4.0” implemented a Decision Support System (DSS) 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.
- The pilot “Mobile Safety/Security” proved the feasibility of accelerating ship evacuation through the adoption of mobile technology is feasible. 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.
- The pilot “Innovative solution for Access Control” allowed for: a) an increase in the speed of the permitting process; b) the development of an application suite for individual needs (police, Web, mobile application); c) an increase in cost efficiency in comparison to “off the

shelf" products, modernized permit issuing and checking process and the introduction of structured reporting module and capability.

- The pilot "Application for Data Flows Management" improved the monitoring system allowing to exactly pinpoint every small vessel or other vehicle present or approaching the passenger terminal. It also provided a dedicated, custom-made Web-client application displaying in real time the inflow of small and large vessels approaching the passenger terminal.
- The pilot "M2M Dialogue" enabled faster and more efficient business processes, eliminated the need for using several non-interlinked services in order to keep track of all business-related activities, enabled greater level of autonomy while reducing the possibility of error occurrence due to human factors.
- The pilot "Spatial Data Management System" eased collaboration between employees and stakeholders and the sharing of data processing results. The new spatial data infrastructure proved more reliable and effective, and improved the speed and quality of the decision-making processes. It enabled spatially-based web services and system integration both of internal tools and with external actors' web platforms.
- The pilot "PCS automation – Deliveries Planning" allowed for: a) integrated information on routes (rail-sea-road) and ITU's compatibility; b) automatic cost, transit times and emission calculations, taking into consideration the different emission classes for rail, sea and road options; c) improved re-routing options, based on the current traffic and weather situation; d) automatized emission calculator, and full cost-transit time-emission comparison for different service ITU, for an improved selection.

The following table reports the links between the cross-border inventory of projects on ICT and the EUSAIR - Green/Smart Port concept. It can be seen that they can be associated with many themes characterizing the "DIGITALISATION IN PORTS" and the "SAFETY IN PORTS" strategies.

Output 1. O.3.1 - cross-border inventory of projects on ICT	EUSAIR - Green/Smart Port
TRANSPOGOOD - an innovative ICT tool to find the best solution of transport services	DIGITALIZATION IN PORTS - Digitalization of multimodal travel planning
PROMARES - technical knowledge and transport planning competences	DIGITALIZATION IN PORTS - Promoting Port Community Systems
PROMARES – strengthening intermodal and multimodal freight transport	DIGITALIZATION IN PORTS - Digitalization of multimodal travel planning
PROMARES - multilevel and multidisciplinary cooperation network among transport stakeholders and policy makers	DIGITALIZATION IN PORTS - Digitalization of multimodal travel planning
INTESA - quality, safety and environmental sustainability of marine and coastal transport services and nodes	SAFETY IN PORTS - Vessel Traffic Monitoring and Information Systems (VTMIS)
INTESA - technological integration of the two Italian and Croatian safe navigation systems	SAFETY IN PORTS - Vessel Traffic Monitoring and Information Systems (VTMIS)
INTESA - coordination and harmonization of data sharing via AIS ASMs messages	SAFETY IN PORTS - Vessel Traffic Monitoring and Information Systems (VTMIS)
INTESA - common guidelines for real-time AIS National Systems	SAFETY IN PORTS - Diff Vessel Traffic Monitoring and Information Systems (VTMIS)
DIGLOGS - Warehouse Management System	DIGITALIZATION IN PORTS - Digitalization of multimodal travel planning
DIGLOGS - Mobile Safety/Security	IMPROVING SUSTAINABILITY IN MARITIME VESSELS OPERATIONS
DIGLOGS - Innovative solution for Access Control	DIGITALIZATION IN PORTS - Implementing automated/unmanned terminal and maritime operations
DIGLOGS - Data Flows Management	DIGITALIZATION IN PORTS - Digitalization of multimodal travel planning
DIGLOGS - M2M Dialogue	DIGITALIZATION IN PORTS - Promoting Port Community Systems
DIGLOGS - Spatial Data Management System	DIGITALIZATION IN PORTS - Promoting Port Community Systems
DIGLOGS - Deliveries Planning	DIGITALIZATION IN PORTS - Digitalization of multimodal travel planning

Table 2 - Links between the cross-border inventory of projects on ICT and the EUSAIR - Green/Smart Port concept

2.2 Contribution from the EU-funded projects on ICT applied to freight transport

With reference to the results derived from the transnational inventory of projects' results, with main outputs from EU-funded projects of other cross border and transnational ETC, H2020 or CEF Programmes on ICT applied to freight transport (WP3 - 2. O.3.2), DIGSEA identified the following main topics related to the EUSAIR programme:

- The ports as *highly complex ecosystems* requiring efficient and constructive collaboration among the different stakeholders of the Port Community (e.g., Terminal Operators, Maritime and Shipping Agencies, Freight Forwarders, and Customs Agencies). Examples of such projects are TALKNET, which developed harmonized mechanisms of cooperation among freight transport stakeholders with multimodality optimization and eco-innovation solutions, and SPEED, which promoted an open community platform to connect and link the worlds of port operations and smart technologies.
- *The port of the future* facing the simplification and digitalization of processes related to the maritime transport and logistics hub, also energy transition, electrification, and the use of renewable energy management. Examples are the DOCKTHEFUTURE Project covering all specific issues for a smart ports, PORTFORWARD promoting a combination of different modes of transport through the adoption of green technologies and COREALIS Project, adopting a stakeholders-driven approach to optimize the port infrastructure.
- *Automation and innovative technologies* are at the core of most EU projects. Technologies, including artificial intelligence (AI), blockchain, Internet of Things (IoT), Big Data, Digital Twin, and 5G, are considered to have an extraordinary impact on the work process. Example are: AWARD dealing with Autonomous Driving Vehicle; EPICENTER testing AI-driven logistics software solutions; MOSES implementing robotic container handling system, autonomous tugboats, and automated docking system. PIXEL implemented an IoT platform to evaluate the environmental performance of the port based on the data collected through plugged-in agents. PORTFORWARD Project studied Virtual Twins, and GREEN C Ports introduced sensors, big data platforms, business intelligence tools, and artificial intelligence to model the ports.
- *Information sharing with other transportation systems*, in projects such as E-BRIDGE for full digital data exchange between the Port Community and Railway Operators; North Sea CONNECT to identified transnational barriers and bottlenecks in terms of interoperability, connectivity, smart technologies, and logistics processes; COMODALCE to overcome the lack in digitization of logistic and administrative operations. DATA PORTS to develop a Cognitive Ports Data Platform
- *Responses to emergencies to increase port system security*. Examples are the projects PASSPORT; RESPOND-A; and RAPID, all combining the most advanced technologies to deliver a fully automated and safety-assured maintenance inspection programs.
- *Port sustainability*, in projects such as SMOOTH PORTS and NON STOP to reduce road transport emissions in the port environment and increase the share of renewable energy production,

consumption, and distribution in ports sea/landside operations.

- *5G network* to improve data exchange between the hardware and software elements of the port ICT infrastructure. For instance, Terminal 4 tested advanced Industry 4.0 pilots applied to the operational environment of port-container terminals; VITAL 5G demonstrated the value added of 5G connectivity for advanced multi-modal logistics services; 5G-Blueprint validated the technical architecture and business and governance models of uninterrupted cross-border teleoperated transport.

The following table shows that the EU-funded projects on ICT applied to freight transport are closely linked with almost all the themes characterizing the EUSAIR - Green/Smart Port concept. Moreover, it can be also noted that they are largely intertwined since digitalization is a pre-requisite for both improving safety, energy efficiency and reducing the environmental impact of maritime and port transport. Consequently, the analysis of the main exploitable results deriving from the above describe projects shed some light on to best practices that could achieve the objectives of the EUSAIR strategy.

Output 2. O.3.2 - EU-funded projects on ICT applied to freight transport	EUSAIR - Green/Smart Port
The port as highly complex ecosystems	DIGITALIZATION IN PORTS - Deployment of solutions for enabling multimodal travel planning SAFETY IN PORTS - Planning and implementation of measures to reduce the impact of pandemics and other sanitary emergencies DIGITALIZATION IN PORTS - Diffusion and integration of Port Community Systems at the port, port cluster, and national levels
The port of the future	DIGITALIZATION IN PORTS - Development of efficient capacity allocation and traffic management systems DIGITALIZATION IN PORTS - Diffusion of innovation, data and AI for smart mobility PORTS AS GREEN HUBS - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels PORTS AS GREEN HUBS - Greening ground port services and operations
Automation and innovative technologies	DIGITALIZATION IN PORTS - Deployment of IT solutions for planning and management of rail traffic within the port DIGITALIZATION IN PORTS - Diffusion of solutions involving virtualization (digital twin), Internet of Things, Artificial Intelligence, automated/unmanned terminal operations and blockchain DIGITALIZATION IN PORTS - Deployment of IT solutions for the improving the effectiveness of port operations, including infrastructure maintenance and waste management
Information sharing with other transportation systems	DIGITALIZATION IN PORTS - Deployment of solutions for enabling multimodal travel planning DIGITALIZATION IN PORTS - Diffusion and integration of Port Community Systems at the port, port cluster, and national levels
Responses to emergencies to increase port system security	SAFETY IN PORTS - Improvement of infrastructure resilience and deployment of measures to contain the impact of extreme weather events SAFETY IN PORTS - Planning and implementation of measures to reduce the impact of pandemics and other sanitary emergencies
Port sustainability	DIGITALIZATION IN PORTS - Development of efficient capacity allocation and traffic management systems DIGITALIZATION IN PORTS - Diffusion of innovation, data and AI for smart mobility PORTS AS GREEN HUBS - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels PORTS AS GREEN HUBS - Greening ground port services and operations
5G network	DIGITALIZATION IN PORTS - DEPLOYMENT of IT solutions for the improving the effectiveness of port operations, including infrastructure maintenance and waste management

Table 3 - Links between the EU-funded projects on ICT applied to freight transport and the EUSAIR - Green/Smart Port concept

2.3 Contribution from the best practices regarding the most recent developments on ICT tools for enhancing maritime and multimodal transport

With reference to the results emerging from analysis of the best practices regarding the most recent developments on ICT tools for enhancing maritime and multimodal transport (WP3 - 3. O.3.3), DIGSEA will examine the growing array of ICT tools available for enhancing maritime and multimodal transport. They include: digitization and big data, industry platforms, cloud computing, blockchain, internet of things, drones, fast corridors, truck appointment system, big data analytics, automation and artificial intelligence, and digital twin. Each of these offers great potential to achieved higher level of digitalization, thus contributing to the EUSAIR goal of "Digitization of the provided services and the development of innovative ICT solutions to support the supply chain" as illustrated in Table 4.

Output 3. O.3.3 - Best practices regarding the most recent developments on ICT tools for enhancing maritime and multimodal transport	EUSAIR - Green/Smart Port
Digitization and big data, industry platforms, cloud computing, blockchain, internet of things, drones, big data analytics, automation and artificial intelligence, and digital twin	DIGITALIZATION IN PORTS - Diffusion of solutions involving virtualization (digital twin), Internet of Things, Artificial Intelligence, automated/unmanned terminal operations and blockchain DIGITALIZATION IN PORTS - Diffusion of innovation, data and AI for smart mobility DIGITALIZATION IN PORTS - Deployment of solutions for enabling multimodal travel planning DIGITALIZATION IN PORTS - Diffusion and integration of Port Community Systems at the port, port cluster, and national levels DIGITALIZATION IN PORTS - Development of efficient capacity allocation and traffic management systems
Fast corridors	DIGITALIZATION IN PORTS - Diffusion and integration of Port Community Systems at the port, port cluster, and national levels
Truck appointment system,	DIGITALIZATION IN PORTS - Deployment of IT solutions for planning and management of rail traffic within the port DIGITALIZATION IN PORTS - Deployment of IT solutions for the improving the effectiveness of port operations, including infrastructure maintenance and waste management

Table 4 - Links between best practices regarding the most recent developments on ICT tools for enhancing maritime and multimodal transport and the EUSAIR - Green/Smart Port concept

2.4 Contribution from the cross-border training curriculum on ICT application in the freight transport sector

With reference to the results concerning the cross-border training curriculum on ICT application in the freight transport sector (WP3 - 4. O.3.4), DIGSEA examined how a training curriculum could enhance management efficiency and effectiveness in many areas of the supply chain.
The increasing use of new technologies are redefining the transportation and logistics industry. Hence, there is a growing need for training with well-defined learning outcomes that keep pace with the needs of the market. To this purpose, a cross-border training curriculum has been designed.
This 3-week training program addresses multiple areas and subjects. They include the following topics

- Internet of things
- Blockchain
- Big data analytics
- Artificial intelligence in transportation
- Simulation and modelling in transportation
- Global trends in transport and logistics
- Innovation management in transport and logistics
- Soft skills for innovation processes

A list of learning outcomes and evaluation tools is provided to clarify how the organization of the cross-border training curriculum on ICT application in the freight transport sector might provide interesting results to enhance management efficiency and effectiveness in many areas of the supply chain.

As Table 5 illustrates, there is a clear link with the EUSAIR - Green/Smart Port strategy, since the knowledge improvements and life-long training of the human resources is crucial for the successful implementation of any technological innovation.

Output 4. O.3.4 - Cross-border training curriculum on ICT application in the freight transport sector	EUSAIR - Green/Smart Port
Internet of things Blockchain Big data analytics Artificial intelligence in transportation	DIGITALIZATION IN PORTS - Diffusion of solutions involving virtualization (digital twin), Internet of Things, Artificial Intelligence, automated/unmanned terminal operations and blockchain DIGITALIZATION IN PORTS - Diffusion of innovation, data and AI for smart mobility DIGITALIZATION IN PORTS - Deployment of solutions for enabling multimodal travel planning DIGITALIZATION IN PORTS - Diffusion and integration of Port Community Systems at the port, port cluster, and national levels DIGITALIZATION IN PORTS - Development of efficient capacity allocation and traffic management systems
Simulation and modelling in transportation Global trends in transport and logistics Innovation management in transport and logistics Soft skills for innovation processes	DIGITALIZATION IN PORTS - Diffusion and integration of Port Community Systems at the port, port cluster, and national levels DIGITALIZATION IN PORTS - Deployment of IT solutions for planning and management of rail traffic within the port DIGITALIZATION IN PORTS - Deployment of IT solutions for the improving the effectiveness of port operations, including infrastructure maintenance and waste management

Table 5 - Links between cross-border training curriculum on ICT application in the freight transport sector and the EUSAIR - Green/Smart Port concept

3 Conclusions

The previous sections have shown that DIGSEA contributes to several objectives of the EUSAIR strategy, including:

- Enhancing vessels' safety
- Vessel Traffic Monitoring and Information Systems (VTMIS)
- Promoting Port Community Systems
- Digitalization of multimodal travel planning
- Developing Maritime Single Window solutions
- Implementing automated/unmanned terminal and maritime operations
- Experimenting the use of digital twins, Internet of Things, artificial intelligence, blockchain

In the last decade, the main emphasis of many projects was on digitalization while the environmental and energy aspects played a secondary role. Digitalization, however, is a *crucial technical enabler*, spreading in different parts of the transport sector.
In order for digitalization to realize its full potential, some prerequisites are needed. We will discuss five of them:

1. Understand the interplay between seaports and supply chains
2. Move from port community systems to port management systems
3. Improve the management of human resources
4. Develop prediction and simulation tools
5. Contribute to the green\smart port strategy

3.1 Understand the interplay between seaports and supply chains

Logistic activities provide the link for the efficient flow of the traffic of goods and smooth the operations and handling of cargo. Ports are the main nodes in the maritime transit network. Ports are competitive if they are capable of facilitating international trade to shipping lines and providing flexible, efficient and secure services. From a logistic and supply chains' integration perspective, the maritime activities that are performed at a port not only impact the port environment, but mostly influence the transportation activities beyond the port boundaries, have an effect on the manufacture facilities located in the surrounding areas and also impact the market access at the point of destination. As global supply chains have become more complex, seaports need not only be global hubs in logistics networks, but they must also act as central nodes in organizational and information networks. When all three of these networks are connected, they can create economic value, improve environmental performance, and enhance security in global trade. The EUSAIR

strategy could develop projects to further enhance the understanding of the interplay between seaports and supply chains.

3.2 Move from port community systems to port management systems

So far, a Port Community System has functioned as an electronic platform, connecting the multiple systems operated by a variety of organizations, intended to facilitate movement of the consignment through the port into and from the hinterland. The next step, promoted also by the (WorldBank, 2020), is the development and introduction of a Port Management System (PMS). A PMS encompasses the management of port calls, dues, journal, incidents, waste, dangerous goods, planner, cargo, inspections, permits, services, security, and assets in an integrated manner via one system.

As example, information technology department of the Port of Antwerp developed the Antwerp Port Information and Control System. Their PMS deals with all relevant aspects of managing shipping traffic to, from, and within the port boundary, including tug activities, lock planning, berth management, and registration of dangerous goods. The Antwerp Port Information and Control System is the main working solution of traffic controllers, dock masters, quay supervisors, harbor masters, dangerous goods operatives, port dues collectors, tug operators, pilots, shipping & signaling services, the Agency for maritime and coastal services, and the shipping police.

A port management analysis requires an understanding of the port conditions, including intra-port distribution, and routes and hinterland connections outside the port. There is a need to study network solutions to access and routing in order to assess most effective means to improve the efficiency in the supply chain. Global distribution analysis allows to see beyond the boundaries of the port and address issues related to movement through the entire distribution system. Analysis of cargo growth trends, inbound and outbound flows, efficiency of the transportation system, and institutional and regulatory influences are all keys to identifying opportunities for improvements to the logistics activities. Other factors, important in our consideration, are traffic congestion, integration of supply chains, information processes, and cargo security. The EUSAIR strategy could finance initiatives to spur the transition from Port Community System to port management system.

3.3 Improve the management of human resources

It commonly accepted that digitalization rests on the shoulders of women and men that used it. The issue of human resources is, consequently, crucial. This is why DIGSEA focused on such issue. Two crucial aspects should be paid further attention and could be an issue to be further explored in the EUSAIR strategy: 1) how to attract and retain talent; 2) How to use software resources for better recruitment, development, training processes. A vast array of studies could provide idea and suggestions (Song et al., 2021) such as: a) assess tasks of supply chain personnel; b) assess human capital and the mindset of managers; c) matching job tasks to human capital levels; d) assessing the effectiveness of the supply chain personnel and development planning. Incorporating such

suggestions in an innovation project might help improve the effectiveness of the actions implemented.

3.4 Develop prediction and simulation tools

As more data become available thanks to the process digitalization, it becomes feasible to implement new approached such as Maritime Informatics (Alexander Artikis, 2021)(Lind et al., 2021). The objective of Maritime Informatics is to promote standardized digital data sharing to achieve high levels of coordination and resource utilization. The ultimate goal is to use the data that accumulates through data sharing to develop and implement new types of shipping analytics, which will advance operational performance and strategic planning to further raise the capital productivity of the shipping industry and increase the energy and environmental efficiency. Maritime Informatics is about enabling understanding, predicting, advising, and improving maritime activity by digital means.

Prediction tools
Predictive analytics uses techniques from statistics, data processing, modelling, machine learning, and artificial intelligence to make predictions about events. Useful technique are: linear regression, support vector, machine support vector regression, decision tree, k-nearest neighbors, naive Bayesian classifier, logistic regression, and artificial neural network.(Mahajan et al., 2021).
Interesting examples are the use of Automatic Identification System (AIS) data are the following:
Estimated time of arrival prediction: It is obvious that knowing the arrival time of vessels before they arrive helps a lot when it comes to managing loading and unloading activities. Estimating the actual time of arrival of vessels in port is critical from the perspective of terminal operators in order to better assess the daily demand of work- shifts. Predicting the arrival time of vessels aids in the efficient management of all capital, human strength, and space at ports. Combining the data accessible via the Automatic Identification System (AIS) framework with the above mentioned technique can help obtain more reliable predictions.
Route prediction: Differently from road vehicles which use pre-determined lanes, the route of vessels is not always set. It varies slightly each time, depending on the experience of the ship's captain. In the case of the ocean, AIS messages gather raw data relevant to boats. The algorithms used for ship route prediction are known as point-based or trajectory-based, and they use a probabilistic approach
Traffic prediction: In some cases (e.g. sea canals), traffic prediction is needed to effectively manage traffic. Seasons, trade demand, and the ability to forecast vessel traffic in the ocean are all essential factors in planning future activities that are dependent on vessel arrival at the port.
Transport volume prediction: Transport freight volume is a key parameter in logistics from a business point of view and knowing it prior will help to manage space at port. At present, many forecasting methods are used to fore- cast freight volume. Each has strengths and limitations.

Truck arrival: Similarly to ships, truck arrival times are difficult to predict. A reliable prediction can help reduce waiting times at the gates

Simulation tools
Simulation is a commonly used tool to analyze uncertain systems and offers a great potential for modeling and analyzing port processes and, therefore, reduce the risk associated with process change. Over the years the use of simulation models has been increasingly favored and instrumental in the development of ports and more specifically of container terminals (Dragović et al., 2017). Simulation models can be essential and significantly helpful in the evaluation of the port's productivity and realistic capacity. (Xie et al., 2021) performed simulation to test the capacity of a single-berth multipurpose seaport with wharf space restriction. Other areas of applications include intermodal operations, automated operations, performance evaluation, comparison of analytical models and simulation models, transfer and storage equipment, storage policies, logistics planning, integration of simulation and optimization models, operational policies, education and training.
The EUSAIR strategy could be instrumental in strengthening the adoption of prediction and simulation tools in port planning, operation and management.

3.5 Contribute to the green\smart port strategy

A smarter port makes is easier to achieve greener results.

Ports and the environment
Ports and their operation are often both the cause of environmental issues, such as sediment contamination and spills from ships and are susceptible to larger environmental issues, such as human caused climate change and its effects. Ports are also a source of increased air pollution both because of the ships and land transportation at the port. Transportation corridors around ports have higher exhaust and emissions and this can have related health effects on the local communities. Water quality around ports is often lower because of both direct and indirect pollution from the shipping, and other challenges caused by the port's community, such as trash washing into the ocean.
There are several initiatives to decrease negative environmental impacts of ports (Hossain et al., 2021). The World Port Sustainability Program points to all of the Sustainable Development Goals as potential ways of addressing port sustainability. These include the World Ports Climate Initiative, EcoPorts and Green Marine, and the African Green Port Initiative (Walker, 2016).
Potential actions to decrease the port environmental footprint include: a) establishing a collaboration among ports and communities; b) conducting emission inventories, c) monitoring quantified emissions targets; and c) supporting technical innovations. Advanced port digitalization will facilitate the implementation of such policy actions.

Ports as energy hubs

Along the same lines, ports are characterized by the geographical concentration of high–energy demand and supply activities, because of their proximity to power generation facilities and metropolitan regions, and their functions as transport hubs in the transport.

In many transport chains, several different means of transport are utilized, and numerous transport hubs are used for transshipment. To achieve fossil fuel free operations, transport hubs need to support those chains by providing, for example, the development of renewable energy installations in port areas to generate green electrical or hydrogen power. There is now a strong call for the port of tomorrow to expand its capabilities to an energy hub, in addition to its role as a transshipment hub.

Electrification and fossil free transports have the potential to accelerate the climate and energy transition and improve the air quality in the cities. To solve these challenges, a port needs to develop capabilities to provide electricity to operate vehicles and machines used within the port as well as obtaining electrical connections to all berths that handle ships.

Port authorities are required to engage in energy management in order to diversify and respond to environmental pressure. Port authorities can promote energy management by coordinating power generation, energy use and the uptake of renewables. Again, digitalization might act as a technical enabler. The interplay between digitalization and electrification in ports is an unexplored area of research. Having more electrified carriers means that re-charging facilities are required, putting demands on a re-charging infrastructure to be placed in the ports. Large electrified vessels require effects in megawatt size over extended and variable periods of time. The port itself thereby becomes an important node with significant power loads connected to the electricity grid. While many ships today are not propelled by an electric motor there is a global movement for them to connect to shore power when in port. Episodically visiting carriers, independent of transport mode, waiting to be served may want to re-charge batteries to secure energy for the next transport leg. The combined result of all these demands is that a port will be a large electricity consumer that is connected to the grid and must cater for a large and varied load requirement that can both help and upset the stability of the grid.

The port might act as an energy hub. Related questions concern technology, business models, agreements, planning, distribution and ownership of energy storage, and needed information exchange. Port could produce its own electricity, such as by solar panels, and to store energy locally, for example using fixed banks of batteries, its own idle electrically powered vehicles, or produce hydrogen.

As ports are not energy companies and electrification most often is not the core competence, there is a need to engage in collaboration with local energy companies. There is a strong development towards establishing collaborative innovation processes between ports and local energy companies. The information interface between the different subsystems needs to be defined and the business models must be worked out.

The port as an energy hub will be an important competitive advantage in the future for what is starting to become required by the buyers of transport services.

3.6 Final Considerations

After many years of implementation, it can be said that the EUSAIR Strategy is robust and resilient. However, a number of new challenges are constantly emerging (e.g. climate change adaptation and decarbonization, digitalization, after covid recovery, youth involvement, migration, security etc.). Furthermore, present and past crises (Covid 19 pandemic, war in Ukraine and related adjustments in the energy sector's priorities) and their long-term effects also call for a coordinated response. Furthermore, the revision process of the combined transport directive (92/106/EEC) and of the DAFI directive (COM/2021/559/Final) are introducing even more new elements of change.

It is important to consider that the current geopolitical scenario is in continuous evolution. The recent Covid Pandemic and war in Ukraine have impacted negatively on the resources available. Moreover, the phenomena of nearshoring and onshoring are also modifying the current situation, along with the modification of the maritime traffic routes on the eastern Med area due to the Ukraine war. Due to their geographic location, this change is particularly relevant for the ports in the Adriatic Ionian region.

Adding to all the above, the current and ongoing revision process of the TEN-T regulation will most likely result in an enlargement process of the TEN-T towards the western Balkans, in which the EUSAIR strategy will surely play an important role.

Furthermore, the legal framework of the environmental and digital transition is ever changing and will be strongly impacted by the final results, if there will be any, of the ongoing revision processes of the EU Combined Transport Directive, of the TEN-T regulation and other Regulations and international agreements.

Due to the above-mentioned reasons a revision of the EUSAIR Action Plan has been started in 2022 and will probably be concluded in 2023. The Declarations of Tirana and Izola indicate the main drivers of this revision:

- to respond better to current challenges including those generated by the COVID-19 pandemic, and the Ukrainian crisis, in line with the existing EU and West Balkans agendas and strategic guidelines;
- to adapt the Strategy to the changes in its membership, and in the geography, enhancing the role of the Strategy in promoting and accompanying the enlargement process

The Strategy therefore needs to align with new policy developments, address common challenges with its own region-specific response and respond to regional needs such as support for the enlargement process, education and skills gap, economic and social disparities etc.

In this context the EUSAIR flagship "Smart / Green Ports" centers perfectly the scope of the Green Deal, of the Smart and Sustainable Mobility Strategy and is consistent with the eFTI regulation as well. However, the current ever-changing environment requires a more flexible approach which considers also the resilience not only of the ports but of their development strategies with a clear outlook towards the many challenges set both at EU and at global level.

All ports involved in the DIGSEA project are committed to continue striving for further implementation of technological upgrading of the ports and procedures integration which are capitalized by the project. Moreover, DIGSEA is labelled as EUSAIR relevant for PILLAR 2: CONNECTING THE REGION, underlying the strategic added value at cross-border level at a wider scale.

A **durable and sustainable territorial cooperation will be needed in this sense**. For this reason, the project partners have agreed to continue cooperating within and outside of the umbrella of the Intereg Italy Croatia programme leading to the creation of some sort of virtual project pipeline, where all of them are more or less involved, making the territorial cross-border cooperation more durable and sustainable through a constant exchange of best practices and participation in joint actions. As long as all actors of the maritime sector within the region are involved with each other and aware of each other's activities, the territorial cooperation can lead to a general overall improvement in the ability to reach the set objectives through a better synergy and complementarity for the undertaken actions and strategies both inside and outside of the Programme area. Deliverable 3.2.1 "Project Ideas for the 2021 – 2027 programming period" is a clear example of this commitment.

In this context, which could possibly bring, under the umbrella of the revision of the Action Plan, a new role to Flagship actions in general, the Flagship project "Smart / Green Ports" could have an important role in advancing the ability of ports in the Adriatic Ionian region to cope with the environmental and energy challenges, exploiting the technical opportunities offered by the growing data digitization and port digitalization processes. Finally, as shown in this document, the DIGSEA project results can have an important role in this process, making sure that the experiences, expertise, outputs and results achieved during the 2014 – 2020 period are properly exploited by the interested stakeholders and particularly by the EUSAIR Flagship project "Smart / Green Ports" in order to have as many instruments as possible to cope with the upcoming challenges of the transport sector.

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