Background

In recent decades, the maritime traffic flows of goods and passengers have had an unceasing growth. Ports are key players in the global supply chain and represent the interface between land and sea; however, they generate externalities on the reference contexts in a direct and indirect way, linked to maritime transports and port activities. Therefore, the policies of the European Union encourage the digitalization like a fundamental component for development sustainable port systems, especially in urban areas; it is a determining factor in order to reconcile operational performance, economic competitiveness and environmental management.

The introduction of new digital technologies, consequences of Industry 4.0, have already started an important transformation process also in the maritime and port sectors. Port digitalization use technologies like Big Data, 5G, IoT sensors, Artificial Intelligence and blockchain and is extremely effective for operations. Thus, among the new challenges is the development of digital applications in the management of administrative processes, application interoperability, paperless management, data tracking and digital route, cybersecurity.

Thanks to digitalization, the ports can adopt automation processes, process cargo at a higher speed with less error and increase their effectiveness; port and logistic operations are safer, more efficient, more accurate and more traceable; data solutions allow all the actors involved to see all activities that are happening in real time. Therefore, there is better communication between employees, time saved thanks to automation, and all systems speak with each other thus improving reliability. Moreover, the digitalization also improves overall port security.

The Italian Scenario

The digitalization facilitates interaction between all actors operating in the port

area, optimizing coordination and streamlining the operations of the entire maritime and logistic supply chains. The digitalization can be encouraged, with different solutions, to ports of different sizes and different capacities.

In Italy, a review process of the national port system has been launched,in 2015 [1], with the approval of the *National Strategic Plan of Ports and Logistics* (NSPPL), the strategic plan of the sector, aimed at improving the competitiveness of the Italian port and logistics system, facilitating the growth of traffic, promoting intermodality in freight traffic and the reform of port governance through a process of rationalisation, reorganization and unification of existing Port Authorities. The main objective is to create a new national model of economic and competitive development, based on innovative services, large infrastructures, simplified bureaucratic and administrative procedures and multifunctional integrations between port areas and surrounding territories. The Law [2] n.169/2016 introduced the Port System and established 15 Port System Authorities (PSA), a new public body with the institutional purpose of managing and organizing goods and services in port areas, for greater coordination of the strategies of the individual ports within a national single vision [3] and directly connected to the European policies for the development of the TEN-T Network.
One of the strategic objectives identified by the NSPPL is the innovation. Among the Actions to encourage research, development and technological innovation in the Italian port system, the *Digitalization of the logistics chain* Action is fundamental, which provides for the definition of measures and a coordination table, at the competent Ministry, to define the governance and significantly improve the integration, interaction and interoperability between the multiple institutional information systems already operating (currently not fully integrated); also, it aims to improve the effectiveness of the technological offer dedicated to the Business Community in support of the entire transport and logistics chain (*NSPPL*, 2015).
Thus, the *Excise, Customs and Monopolies Agency* (ADM) has initiated, in 2019, a digitization process of the procedures under its responsibility in national ports, to automate and optimize the entry/exit and loading/unloading operations connected to the import/export of goods having customs relevance; the operations connected to the payment of port taxes and the tracking of the customs status of the goods. That is by encouraging the rationalization and interoperability between information systems and allowing the reduction of times and costs of the entire customs clearance process and increasing its security. The goal is the creation of a seamless

logistics chain characterized by a rapid transit of goods to be cleared at the port to their final destination along a fast corridor, encouraging gate automation.

To promote [4] innovation and digital development of the Nation, and seize the opportunities within the NextGenerationEu [5] programme, the Italy approved in 2021 the *National Recovery and Resilience Plan (NRRP)*. The *NRRP* Mission 3 [6] *Infrastructures for sustainable mobility* aims to make the national infrastructural system more modern, digital and sustainable, capable of responding to the challenge of decarbonisation indicated by the European Union with the strategies connected to the *European Green Deal* [7], also, it aims to achieve the sustainable development goals identified by the *United Nations 2030 Agenda*.
The main tool to implement the exchange of information and documents between operators and public offices is the Port Community System (PSC). However, to date, not all PSAs are equipped with PCS and not all operational PCSs carry out and offer the same services to port users. Furthermore, the digital revolution and the related increase in productivity require significant investments to bring broadband and 5G to the main nodes of the logistics chain. Thus, in order to overcome the fragmentation and delay in the development of the PCS by some PSAs, within the *NRRP*, in 2021-2022 period, reforms and investments were envisaged aimed at developing and implementing a homogeneous digitization system for the entire system national port. In the logistics field, the reform interventions are linked to the improvement of the competitiveness, capacity and productivity of the ports (*M3C2 Intermodality and integrated logistics*) and investments are planned in the digitization of the logistics chain to make the logistics infrastructures adequately interconnected, which allow the handling of loads as rapid and without bottlenecks. In particular, the investment “2.1 Digitalization of the logistics chain” of the *NRRP*, funded for 250 million euros, aims to create this type of integrated infrastructure and strengthen national logistics competitiveness; thanks to the creation of an interoperable digital system between public and private actors for freight transport and logistics, capable of simplifying procedures, processes and controls by focusing on the dematerialisation of documents and on the exchange of data and information.
The envisaged reforms are aimed at implementing the Single Control Desk (*Sportello Unico dei Controll* [8]) and to implement an interoperable digital platform [9]. The first involves the implementation of the Sportello Unico Doganale, in order to speed up customs clearance processes and reduce costs for operators; the

second is the development of a shared platform, the *National Logistics Platform*, for the network of ports and interports; the objective is the dematerialisation of document flows, the speeding up of checks on the goods, the operational relations between the different players operating in the port and logistics sectors (terminal operators, customs agents, shipping agents, shipowners, shippers, technical-nautical services, warehouse operators) and between all of these and the numerous public administrations that exercise control or regulation functions at the ports (Report Investments and reforms of the *NRRP* for ports, 2022).

Port System of the Eastern Sicily Sea

The Port System of the Eastern Sicily Sea was established in 2016 by organizing the ports of Augusta, an oil and commercial port (mainly liquid bulk) included in the Ten-T “Core” network, and that of Catania, a comercial (mainly Ro Ro and container) and tourist-cruise port included in the Ten-T “Comprehensive network”, located,located on the Eastern coast of Sicily and distant from each other about 23 nautical miles. In 2022 [10], Pozzallo, has also been included in the system; it is a commercial port, located on the southeast coast of Sicily, about 74 nautical miles from Catania, in a strategic position for trade routes. Its main traffics are passenger, merchant and Ro-Ro ships, in particular towards Malta and North Africa, which have further enriched both the product categories handled and the commercial connections of the port system.


Palermo
Catania
Trapani
Marsala
Mazara del Vallo
Sciacca
Agrigento
Licata
Gela
Augusta
Siracusa
Pozzallo
Ragusa
Modica
Noto
Messina
Milazzo
Cefalù
Termini Imerese
Castelbuono
Parco delle Madonie
Parco dei Nebrodi
Cesarò
Randazzo
Taormina
Etna
Bronte
Nicosia
Troina
Gangi
Leonforte
Enna
Caltanissetta
Piazza Armerina
Ramacca
Caltagirone
Scordia
Lentini
Mazzarino
Canicattì
Sambuca di Sicilia
Partanna
Castelvetrano
Campobello di Mazara
Petrosino
Corleone
Ficuzza
Partinico
Alcamo
Castellammare del Golfo
Calatafimi
Favignana
Marettimo
Adrano
Paternò
Giarre
Riposto
Acireale
Mascali
Porto Salvo
Scilla
Reggio Calabria
Barcellona Pozzo di Gotto
Patti
Capo d'Orlando
Sant'Agata di Militello
Santo Stefano di Camastra
Cammarata
Mussomeli
Sciacca
Ribera
Canicattì
Palma di Montechiaro
Niscemi
Vittoria
Scoglitti
Marina di Ragusa
Palazzolo Acreide
Marzamemi


Italia
Roma
Napoli
Bari
Palermo
Catania
Messina
Trapani
Marsala
Siracusa
Sicilia
Sardegna
Corse
Mar Tirreno
Mar Ionio
Mar Adriatico
Mar Mediterraneo
Malta
Tunisia
Tunisi
Tripoli
Algeri
Monaco
Genova
Bologna
Firenze
Pisa
San Marino
Montpellier
Marsiglia
Tolosa
Andorra
Barcellona
Saragozza
Valencia
Palma di Maiorca
Murcia
Alicante
Almeria
Bilbao
San Sebastian
Pamplona
Girona
Tarragona
Castellon de la Plana
Mare delle Baleari
Cagliari
Salerno
Matera
Taranto
Lecce
Erzegovina
Sarajevo
Serbia
Zara
Spalato
Montenegro
Kosovo
Bulgaria
Sofia
София
Plovdiv
Пловдив
Macedonia del Nord
Tirana
Albania
Salonicco
Θεσσαλονίκη
Grecia
Atene
Αθήνα
Smirne
Patrassо
Πάτρα
Bucarest
Craiova
Nis
Niш
Burgas
Бургас
Distretto di Edirne
Distretto di Çanakkale
Giannina
Ιωάννινα
Bodrum
La Canea
Χανιά
Heraklion
Ηράκλειο
Creta
Misurata
Bengasi
Sirte
Marsa Matruh
El Oued
Gabès
Batna
Djerba
Adjoran

Ports of the System of the Eastern Sicily Sea. (Source: https://www.google.com/maps).

Port	Total	Ships	Ro Ro Ships	Private vehicles moved	Ro Ro and Ro Pax Passengers	Cruise Passengers	TEUs
Augusta	24.747.500	2.464			28.893		
Catania	7.978.049	1.406	296.069	42.812	5.672	131.459	52.142
Pozzallo	1.366.216	281	663	82.334	307.027		5.100

Traffic data handled (t). Elaboration by the authors with non-definitive 2022 data. (Data Source: Port System Authority of the Eastern Sicily Sea).

The strategies of the Port System Authority of the Eastern Sicily Sea aim to the enhancement of traffic, in particular: in the solid bulk and container sector and the enhancement of project cargo and general cargo in Augusta; general cargo consolidation in Catania and general cargo expansion in Pozzallo. For the Ferry sector, the increase and optimization of traffic on Catania is planned with progressive concentration of the same on the New Dock, Nuova Darsena, in addition to the confirmation of the Ro Ro of Pozzallo. For the cruise sector, the reorganization of the spaces in Catania and the renegotiation of the existing concession are envisaged.
Thus, numerous and various infrastructure upgrading works are in progress, financed under the NRRP, in the ports of Catania (including consolidation of the breakwater, completion and structural restoration works of the New Commercial Dock serving Ro-Ro and container traffic) and Augusta (including completion of the mantellata breakwater, construction of a new container terminal, of approximately 120,000 square meters of space and a depth of approximately 15 meters), for a total amount of approximately 327 million euros.



View of the Port of Pozzallo. (Source: SER.M.I SRL_https://www.sermi-srl.it/).

Projects and Opportunities of the Eastern Sicily Sea Port System

In addition to projects to upgrade infrastructure, the Eastern Sicily Sea Port System Autorithy has numerous projects and measures in place to enhance the current application architectures, to encourage digital cooperation between the many and different public stakeholders.
The Eastern Sicily Sea Port System Autorithy was among the first to join, in 2020, a *ADM* Project, by signing an Agreement [11] with the *Excise, Customs and Monopolies Agency* for the definition of the project *Digitalisation of customs procedures in the port system of the Eastern Sicilian Sea*. The objective is to automate customs procedures and logistical operations connected to the entry/exit and loading/unloading flows of goods in the three ports. Also for the purpose of a better and more efficient use of port spaces, contributing to a greater development of traffic in ports thanks to the use of advanced technologies and simplifications for

operators thanks to cooperation with the various actors involved (Port System Authorities, Guard of Finance, Ministry of Infrastructure and Transport, Excise, Customs and Monopolies Agency).
In order to promote and encourage the digitization and simplification of procedures, the Port System Authority of the Eastern Sicilian Sea has activated, in collaboration with the *ZES (Special* [12] *Economic Zone)* Eastern Sicily and with the Sicily Region, a pilot version of the territorial information system; thanks to the data provided by the Local and Territorial Authorities, it will be possible to facilitate the consultation of the areas belonging to the ZES, being able to know the geographical positioning, the cadastral data, the infrastructural characteristics, the distances from the main logistic nodes, the constraint regimes.
1.8 million euros have been invested to create the Single Administrative Desk, *Sportello Unico Amministrativo (SUA), for the Pilatform Zes*, which will be active online from January 2023, and 2.4 million euros in Cyber Security making Augusta and Catania the first ports in Italy and in Europe. In fact, already in 2019, the Port System Autorithy has begun a process to make the site and the entire ICT system more secure, protecting it from cyber attacks. The project made it possible to comply with the Nis and European regulations on Cyber Security, making the Organization the first PSA in compliance with this legal provision [13].



The Bay of Augusta Port. (Source: Port System Authority of the Eastern Sicily Sea).

The *Project Smart Port Digital Ecosystem*, amounting to €5,221,123.88 proposed by the Eastern Sicily Sea Port System Authority, was conditionally [14] admitted, in 2021; it will automate all loading/unloading of goods in the ports of Augusta and Catania. The objective of the project is to complete the digital transition with the completion of its own Digital Ecosystem starting from the infrastructure it has and is equipping itself with through the aforementioned SUA e Cybersecurity projects; also thanks to optical fiber distribution and installation of network equipment and rack server room in Augusta, cloud computing and digitization of administrative

processes / transparency, revamping security control room Catania.
The goal is to provide the PSA with a versatile technical application infrastructure strongly oriented towards the digitization and integration of heterogeneous entities and systems inside and outside the port area itself.

Conclusions

Therefore, investing in port digitalization today can undoubtedly strengthen and enhance the attractiveness and competitiveness of the Port System. It is the Authority's duty to know how to seize these opportunities and make them a driving force for development of the ports and the context. The main benefits for the PSA, brought about by the aforementioned projects, will be the speeding up and simplification of the processes for ascertaining the position of the goods within the customs area and the effective conclusion of the customs control operations for the goods leaving the port; the immediate availability of detailed data on the port taxes collected on its behalf by the Customs Agency and on the nature, origin and destination of the goods. This will make the passage of goods in the port logistics nodes of the system more fluid, managing in real time the routing of goods flows in the port itself and reducing bottlenecks; automating the procedures for entry/exit from the gates, loading/unloading of passengers/vehicles/goods on Ro-Pax/Ro-Ro or Lo Lo ships; controlling their transit in port areas in real-time; computerizing the customs administrative procedures connected to the passage of goods, monitoring of container handling in/out of payment depots and tracking of the customs status of the goods. Thus, making the port system digital, interconnected, energy efficient.

HEAD IMAGE | *Catania Port: view of the old port. (Source: Authors).*

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Notes

[1] Approved on 3 July 2015by the Council of Ministers.

[2] Legislative Decree “Reorganisation, rationalization and simplification of the discipline concerning the Port Authorities”.

[3] Monitored by the competent Ministry of Infrastructure and Transport.

[4] The other two strategic priorities are ecological transition and social inclusion.

[5] Approved in July 2020 by the European Council to support member states affected by the COVID pandemic.

[6] The six Missions of the Plan are: digitalisation, innovation, competitiveness, culture and tourism; green revolution and ecological transition; infrastructure for sustainable mobility; education and research; inclusion and cohesion; health. The Plan is consistent with the six pillars of the NGEU and satisfies the parameters set by the European regulations on the quotas of “green” and digital projects.

[7] In particular, the *Strategy for intelligent and sustainable mobility* published on 9 December 2020.

[8] Reform 2.1: Simplification of import/export transactions through the effective implementation of the Sportello Unico dei Controlli.

[9] Reform 2.2: Interoperability of the National Logistics Platform (NLP) for the port network, in order to introduce the digitization of passenger and freight transport services.

[10] With an amendment to National Law 108 of 5 August 2022, which modified annex A of National Law 84/94, the port of Pozzallo was included in the district of the Port System Authority of Eastern Sicily.

[11] According to the Article 15, Law n.241/1990.

[12] Established by Article 4, Law n. 91/2017, in order to favor the creation of favorable conditions in economic, financial and administrative terms, which allow the development, in some areas of the country, of companies already operating, as well as the establishment of new companies in these areas.

[13] Regulation (EU) 2019/881 of the European Parliament and of the Council of 17 April 2019.

[14] In the context of the Action and Cohesion Program “INFRASTRUCTURE AND NETWORKS” 2014-2020, call for the formulation of project proposals in the context of Axis A “Digitalization of logistics” aimed at carrying out interventions for the development and/or strengthening of solutions to support integrated and intermodal transport and the management of flows of people and goods.

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