JOURNAL OF MARITIME RESEARCH

Vol XIX. No. II (2022) pp 8–15

ISSN: 1697-4040, www.jmr.unican.es

Aspects that can be improved in the Ro-Ro terminals of the Port of Santander

L. Trueba-Castañeda[1,2,*], B. Blanco[1,3,4], L. Sánchez[1,3,5], E. Diez-Busto[3,6], A. Trueba[7]

ARTICLE INFO

Article history:
Received 8 Dec 2021;
in revised from 19 July 2022;
accepted 31 July 2022.

Keywords:
Maritime Transport, Santander Port, Ro-Ro Terminals, Port Logistics, Continuous Improvement..

ABSTRACT

The port of Santander is a modern and specialised port that stands out for its competitiveness in maritime traffic which, in turn, requires a high quality logistic offer. Santander port has especially fostered road freight traffic (Ro-Ro) due to its invaluable generation of wealth and jobs, directly affecting the competitiveness of the industrial and commercial area it serves. The port of Santander average accumulated annual growth rate over the last five years (2015-2019) was higher than that one of the Spanish state-owned ports, highlighting the increase experienced in the movement of general goods and, within this, Ro-Ro traffic, and consolidating the port of Santander as the best Ro-Ro port on the northern coast of Spain. The growth expectations of the port make it necessary to study the current situation of the vehicle terminals in order to be able to meet the demands of the logistics agents operating in the port. Therefore, the objective of this paper is to analyse the logistics of the port of Santander in order to detect the aspects that can be improved in relation to competitiveness, operativity and the quality of the service provided by the port in the Ro-Ro terminals. To this end, once the aspects related to Ro-Ro traffic in the port of Santander are known, the aspects related to competitiveness, operability and quality of service that can be improved are identified. Finally, some improvement proposals are made: initiatives aimed at eliminating incidents due to dirt and atmospheric phenomena in vehicles; the extension of spaces for the storage of vehicles; and the implementation of Technology 4.0 for the provision of port services..

1. Introduction.

Globalization has expanded markets, has extended the distribution of goods, and has increased the participation of different economic actors, making maritime transport the most used mode of transport in international trade and one of the supports of the global economy.

Maritime transport enables the transfer of large volumes of goods for commercial purposes aboard specialized ships. It represents 80-90% of the transport of goods worldwide, offering both the importer and the exporter a high load capacity, cheap freight, a wide coverage worldwide, and great security in the deliveries of the goods. In addition, the great variety of existing ships makes maritime freight transport the most versatile means of transporting items of any size, characteristics, and danger (Kanvel, 2018).

International trade is developed within a comprehensive logistic framework based on the evolution of exchange networks and logistics structures, both locally and internationally. Understanding that integral logistics allows the coordination and joint management of the supply chain logistics, production, storage, and distribution, from the business point of view, it offers a broad vision of the entire process to manage resources efficiently (Romero Serrano & León Arias, 2003).

[1]Coastal and Ocean Planning and Management I+D Group. University of Cantabria.
[2]PhD Student in Engineering Nautical, Marine and Naval Radio Electronics. University of Cantabria.
[3]Business Administration Department. University of Cantabria.
[4]E-mail Address: beatriz.blanco@unican.es.
[5]E-mail Address: lidia.sanchez@unican.es.
[6]E-mail Address: elsa.diezbusto@unican.es.
[7]Biofouling I+D Group. University of Cantabria. E-mail Address: alfredo.trueba@unican.es.
*Corresponding author: L. Trueba-Castañeda. E-mail Address: laura.trueba@alumnos.unican.es

In this scenario, although maritime transport is predominant in the world of logistics, ports cannot survive without the support of the rest of the logistics subsectors or agents such as land and air transportation which move the product from the factory to the ship or vice versa. Therefore, enhancing the intermodal transport systems seems to be a must. In addition, in a framework of growing competition between ports and/or between port regions that require greater competitiveness, the potential of the ports depends on the growth of merchant ship traffic, the concentration of shipping companies, the increase in the size of the ships, and the development of inland terminals and corridors (UPC, 2004: Romero Serrano, 2002). This process includes the integrated study of basic functions of the organization, such as supply management, production management, and distribution management (Dorta González, 2014).

Ports, as a place where different areas of circulation of goods and services converge, have become convergence points for transport systems and service providers. Additionally, they are integrated into a goods distribution system that requires logistical developments. In this sense, the port of Santander is a modern and specialized port that stands out for its competitiveness in traffic that require a high-quality logistics offer. This has especially been enhanced by the of Roll-on / Roll-off (Ro-Ro) traffic due to its invaluable generation of wealth and jobs.

The traffic of goods in the port of Santander, as in the group of "ports of general interest of the State" in Spain, depends on a series of characteristics inherent to maritime transport such as services supply and demand. Despite the irregularity inherent to maritime traffic, the accumulated average annual growth rate of the port of Santander during the years 2015-2019 was higher than that of the group of Spanish state-owned ports, highlighting the increase experienced in the movement of general goods and, within this, the Ro-Ro traffic that consolidates the port of Santander as the best Ro-Ro port on the northern watershed of Spain. Therefore, and given the growth objectives of the port, which aims to increase vehicle traffic from 482,120 vehicles per year (average in the above-mentioned years) to 600,000 vehicles per year in the short term while maintaining brand diversification (Puerto de Santander, 2020), it is necessary to study the current situation of vehicle terminals to meet the demands of logistics operators operating in the port. Therefore, the main objective of the work is to analyze the port logistics of the port of Santander to detect the aspects susceptible to be improved related to competitiveness, operability, and the quality of the service provided by the port in the Ro-Ro terminals.

2. The Port of Santander.

The Port of Santander opens to the Cantabrian Sea, and it is located in the Bay of Santander in the region of Cantabria (Spain). It is managed by the Santander Port Authority, dependent on the public entity Puertos del Estado, and in turn, managed by the Ministry of Development of the Government of Spain.

2.1. Port facilities and terminals

Port facilities are points of confluence that serve maritime and land transport, being decisive when it comes to cataloging the quality of the port service provided. Understanding that a port is a set of different terminals, facilities, and auxiliary systems that make its activity possible, a port terminal would be defined as the set of port facilities that constitute the interface between the maritime transport mode and the other modes of transport. For its proper functioning, a port terminal must have good maritime facilities (docking and mooring docks), appropriate land infrastructures that enable the development of port activities (loading and unloading, storage, or evacuation), means to carry out those operations (mobile and fixed cranes), as well as the human resources necessary to make everything work and the computer technology necessary to efficiently manage all activities.

The maritime facilities of the port of Santander are arranged in front of the bay and are mainly grouped around a north breakwater and a central breakwater based on their specificity (Fig. 1). It has two Ro-Ro terminals (Raos 7 and Raos 8) for loading and unloading vehicles, with Ro-Ro ramps and storage areas.

The storage area includes all the esplanades of the commercial use area of the port that do not have the status of manoeuvring area (immediate area to the berths of the ships, occupied by the crane tracks, railway tracks and traffic roads immediate to the quayside) or transit area (area that borders the manoeuvring area and extends parallel to the cliff that defines the radius of action of the quayside cranes, being 60 m at the Raos docks, 24 m on the North Bank, 22 m on Sections 10-11 of Maliaño and 30 m on the other piers, with the exception of the areas corresponding to the Raos 4, 7 and 8 piers in which their entire surface, with the exception of the necessary for the movement and manoeuvring of vehicles, it has the character of a storage area for general wheeled cargo) (Puerto de Santander, 2020).

Figure 1: Location of Santander Port´s terminals.

Source: Authors own elaboration based on Google Earth (2020).

The port of Santander extends over 264.27 land hectares,

with a storage capacity of 122,772 sq m covered and 758,651 sq m uncovered, of which 15,100 sq m are used for solids bulks and the rest for general merchandise, especially vehicle storage fields (Zona Franca Santander, 2020).

Having a good internal communication system and land access is as important as having modern and safe facilities. In this sense, the internal communications of the port of Santander have improved notably allowing a greater flow of traffic, both by road, through the bridge that connects the Raos docks with the rest of the docks, and by the rail network.

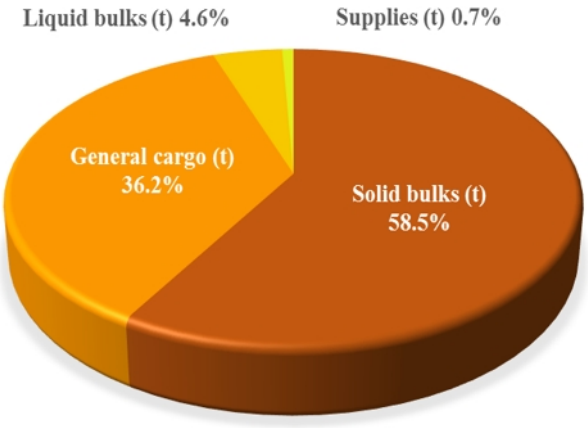
The port of Santander is a modern port whose main facilities are no more than twenty-five years old, which has allowed it to stand out for its competitiveness in traffic that requires a high-quality logistics offer. This has contributed to the constant growth of Ro-Ro traffic in its terminals, efficiently serving the growing and changing requirements of the ships and companies operating in the port. It is important to highlight the high-quality indices of the services provided by the port of Santander in general and by vehicle terminals in particular; having been named the best-valued Port of Spain for the last five years (2015-2019), consecutively, by the Spanish Association of Automobile and Truck Manufacturers (ANFAC).

2.2. *Goods traffic.*

Goods traffic at the Port of Santander exceeded 5.7 million tonnes on average during the 2015-2019 period. Specifically, 3.3 million tonnes were of solid bulks, 0.3 million tonnes of liquid bulks, and 2.1 million tonnes of general merchandise.

The solid bulks represented 58.5% of the goods moved during the 2015-2019 period (Fig. 2), reaching 3,646 Mt in 2019 (Fig. 3) with an Accumulated Average Annual Growth Rate (TCMAA) of 0.90%. This shows that the port of Santander is eminently specialized in bulk traffic. The traffic of agri-food products, scrap metal, cement, iron ore, coal, sodium carbonate, or fertilizers stands out.

Figure 2: Average percentage distribution of freight traffic in the port of Santander in the period 2015-2019.



Source: Authors own elaboration based on Puertos del Estado (2020).

General cargo traffic represented 36.2% of the total goods moved during the 2015-2019 period (Fig. 2), reaching 2.586 million tonnes in 2019 (Fig. 3) with a Annual Accumulated Average Growth Rate (AAAGR) of 9.95%. This shows that this type of good is in continuous growth, increasing the added value, diversification, and activity of the port. This concept includes Ro-Ro traffic and containerized traffic. Ro-Ro traffic accounted for 80.6% of total general cargo traffic, representing 29.2% of total goods moved during the 2015-2019 period, reaching 2.187 million tonnes in 2019 with a AAAGR of 11.93%, which shows the consolidation of the port of Santander as the best Ro-Ro port on the northern watershed of Spain, moving twice as many tonnes as its main competitors (Vigo or Bilbao). Regarding container traffic, it only represents 4.2% of total general cargo traffic and 1.5% of total goods moved during the 2015-2019 period, reaching 0.178 million tonnes in 2019 with a AAAGR of 75.81%, which indicates that, although it is not a significant type of transport in the port of Santander, its growth in the analyzed period has been remarkable, going from 1,165 moved containers in 2015 to 14,326 in 2019 (Fig. 3). The movement of containers in Santander occurs in Ro-Ro ships, not being a competitive port in this type of maritime traffic as it does not have a container terminal.

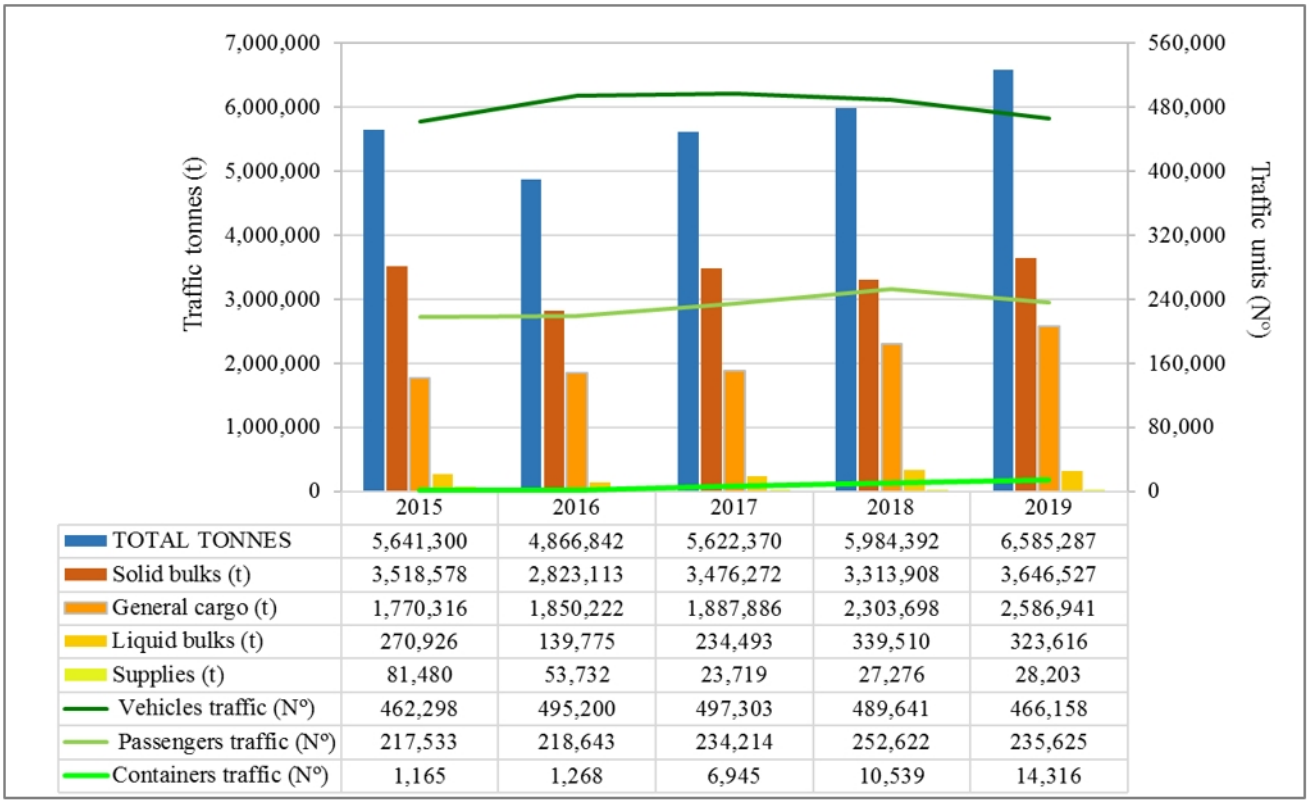
The liquid bulks accounted for 4.6% of the goods moved during the 2015-2019 period (Fig. 2), reaching 0.323 million tonnes in 2019 (Fig. 3) with an AAAGR of 4.54%. Although historically it is a type of merchandise whose movement has decreased notably, it has experienced a certain rebound in the analyzed period mainly due to the traffic of bioethanol, chemical products, and biofuels.

Vehicle traffic in the Port of Santander has reached a high degree of specialization that allows it to offer a high quality and efficient service to the automotive sector compared to its more direct competitors. In the period 2015-2019, an average of 482,120 vehicles per year were moved (Fig. 3), maintaining the diversification of brands thanks to the confidence of the different car manufacturers in the services provided. As a result, the port continues playing an important role as a car distribution center, both importing and exporting.

Passenger traffic has consolidated in the 2015-2019 period with an average of 231,727 passengers per year (Fig. 3) due to the reinforcement of its regular passenger, vehicle, and ro-ro cargo services between Santander and the United Kingdom. In fact, the Brittany Ferries shipping company added a new service to the Irish port of Cork in 2018, adding to the already existing lines to Portsmouth, Plymouth and Poole. The great increase experienced in stopovers and the number of cruise passengers is also noteworthy, reaching a historical record in 2019 with 30,691 cruise passengers (+149.38% compared to 2018).

Keeping the irregularity inherent to maritime traffic in mind, the AAAGR of the port of Santander during the 2015-2019 period was 3.94%, higher than the rest of the ports located in the Cantabrian coast (Avilés (-0.13%), Gijón (-4.91%), Bilbao (1.98%) and Pasajes (-3.83%)) and above all the Spanish state-owned ports (2.96%). With cumulative traffic of 6.585 million tonnes, 2019 has been the second-best year in freight traffic in the history of the port, only behind the 6.636 million tonnes in 2005. The improvement produced is concentrated in the traffic of solids bulks and general goods, the most relevant types of

Figure 3: Evolution of maritime traffic in the port of Santander between 2015 and 2019.



	2015	2016	2017	2018	2019
TOTAL TONNES	5,641,300	4,866,842	5,622,370	5,984,392	6,585,287
Solid bulks (t)	3,518,578	2,823,113	3,476,272	3,313,908	3,646,527
General cargo (t)	1,770,316	1,850,222	1,887,886	2,303,698	2,586,941
Liquid bulks (t)	270,926	139,775	234,493	339,510	323,616
Supplies (t)	81,480	53,732	23,719	27,276	28,203
Vehicles traffic (N°)	462,298	495,200	497,303	489,641	466,158
Passengers traffic (N°)	217,533	218,643	234,214	252,622	235,625
Containers traffic (N°)	1,165	1,268	6,945	10,539	14,316

Source: Authors own elaboration based on Puertos del Estado (2020).

goods in the port of Santander (Puertos de Estado, 2020).

3. Aspects for improvement in the Ro-Ro terminals of the Port of Santander.

Maintaining the competitiveness of the Ro-Ro terminals means efficiently meeting the requirements of the ships and the companies operating in the port, which demand the continuous improvement of port services related to competitiveness, operability, and quality of service.

3.1. Related to competitiveness.

Port competitiveness measures the ability to capture, concentrate, handle and distribute goods (González Laxe, 2018). In this sense, the capacity of the Ro-Ro terminals of the port of Santander was calibrated taking as a reference the sectoral study carried out annually by ANFAC. This study evaluates the maritime-port logistics in the vehicle traffic of Spanish ports based on the valuation issued by the associated companies that operated in the port of Santander in 2018. Although the automotive brands valued the port service of the port of Santander as the most competitive of the Spanish ports, they requested some improvements in the storage areas services directed to minimize damage to stored vehicles, mainly those related to dirt on vehicles and those caused by atmospheric phenomena.

Ports are places where the traffic of all kinds of goods is very high. Dust is often generated that, depending on its origin, can be oxidizing and/or corrosive to the vehicle's sheet metal. Additionally, together with bird droppings, it produces superficial dirt on the exterior of the vehicle. In the port of Santander, the concessionaire of the storage field is responsible for the maintenance and cleaning of its facilities, as well as the stored vehicles. Complementing the excellence of the port service provided to the manufacturer brand depends on this, as well as minimizing the tasks before the delivery of the vehicle in stock. Overall, it can be considered an aspect that can be improved and in which a possible investment is justified.

Rain and hail storms are the most common atmospheric phenomena that produce damages to stored vehicles. The rain drags the solid particles suspended in the atmosphere, depositing them on the exterior surface of the vehicle, contributing to its fouling. Hail hits the vehicle's body directly and can cause damage in the form of dents.

3.2. Related to the operability of the terminals.

Operation in a Ro-Ro terminal is directly related to the physical operations of loading/unloading the vehicles and with the flow of documentation between all the links of the port logistics; the first in turn depends on the agility in the fulfillment of the documentary process.

The flow of information occurs between the port community and customs (issuance of cargo and customs declaration),

shipowners and consignees with the stowage terminal and between port agencies (inputs and outputs of goods).

The unloading operation consists of moving the vehicles to the terminal. While modern ships have at least one Ro-Ro ramp to do it, older ones may need a terminal that has a ramp on its berthing line. A team of drivers massively unloads the vehicles from the ship's hold to the transitory zone of the terminal where it is identified and passes a status check. Later it is moved by another driver to the storage or stock area, their position being recorded in the computer system.

The massive arrival of vehicles at the terminal requires large storage areas that allow absorbing all the vehicles entering the port since the terminal knows when each vehicle has entered but does not know when it will be removed. The problem of storage space can limit the growth objectives of the port, so it can be an area that can be improved and in which a possible investment is justified.

3.3. Related to quality of service.

The Fourth Industrial Revolution *(industry 4.0*) has changed the way industry in general and port industry in particular operate, introducing advanced production and operation techniques based on intelligent technologies integrated into organizations (robotics, analytical technology, artificial intelligence, cognitive technologies, nanotechnology or the Internet of Things). *Industry 4.0* improves the management and operation mode, having a direct impact on the quality of the service provided by the port system in general and by the Ro-Ro terminals in particular.

In a system as competitive as the port system, the Port Authorities are increasingly investing in the automation of their processes. However, regarding the management of the ship's port operations and goods processes in the port, 60% of logistics professionals believe that coordination is not effective, 50% estimate that there is little information transparency and 37% indicate that the process is inefficient (Alonso, 2019). Therefore, in order to put innovative equipment, products, services, and processes at the service of the logistics-port community that promotes the practical application of innovation strategies in the Port Authorities and companies of the Spanish logistics-port community, *The Ports 4.0* program was created to accelerate innovation in the port sector in 2019. Aware of the importance of this program, the Santander Port Authority, in collaboration with the Government of Cantabria and companies related to port activity, is working on the creation of an ecosystem that promotes and puts into practice this innovative thinking. However, there is no implanted project.

4. Improvement proposals.

From the analysis of the above-mentioned aspects susceptible to be improved by the port operators related to the Ro-Ro terminals of the port of Santander, the following improvement proposals emerged.

4.1. Reduce incidents due to dirt and atmospheric phenomena in vehicles.

Current situation: vehicles stored in the port fields remain outdoors, exposed to different sources of surface dirt and inclement weather.

Objective: safeguard vehicles from dirt caused by suspended dust (often oxidizing and/or corrosive) and from atmospheric phenomena (rain and hail) during their stay in the storage field, thus avoiding the task of washing before the delivery of the vehicle by the concessionaire of the campaign and hiring qualified personnel for the subsequent repair of damage caused by hail in the vehicle body; for instance, denting.

Improvement proposal: zone 2 of the vehicle storage field 8.3.2 of the central breakwater was taken as a reference because it is the one destined to the parking of long-stay vehicles in stock. It is proposed to fully cover it by building a roof (without walls) of galvanized sheet equipped with artificial lighting and a rainwater evacuation system.

Budget: vehicles would be distributed into five blocks of five parking rows occupying 4.940 sq m (190 x 26 m) each and a sixth block of three parking rows of 2.470 sq m (190 x 13 m). The estimated costs would be as follows:

1. Construction and installation of garage (168x190 m) with galvanized sheet: €353,210
2. Electrical installation (lights, sensors, wiring, connection): €60,453.55
3. Rainwater (gutter, downspouts, drain, scuppers): €35,398.85
4. Taxes (21%): €94,303.10
5. Total: €543,365.50

Net Present Value (NPV): investment criterion calculated by Eq. (1), which updates the cash flows in order to know the profit or loss obtained with said investment.

$$VAN = -I_0 + \sum_{t=1}^{n} \frac{F_t}{(1+k)^t} \quad (1)$$

where:
I_0 = investment made in the initial moment ($t = 0$).
n = number of time periods.
F_t = cash flows in period t.
k = required interest rate.

For the calculation of Eq.(1), I_0 was taken without tax as it is deductible. On the other hand, n was calculated according to the amortization tables for buildings and constructions, which stipulate that the huts, sheds, sheds, barracks, and the like of fixed light construction must be amortized with a maximum annual coefficient of 7% or for a period 30 years maximum. Regarding F_t , it was calculated as the total annual savings the company would have once the roof is built. On the one hand, the number of the rodmen who are dedicated to eliminating the impacts of hail, estimating a cost per vehicle of €75 (Cacho Borras, 2020), an average daily occupation of the field of 1,900 vehicles, and an annual average of six days with hail in Santander (Meteocantabria, 2019). This calculation indicates that in rodmen the company will save €855,000 per year. On the other hand, the

need to wash the vehicle thoroughly before leaving the field would be eliminated, although a superficial wash will continue to be necessary. The annual cost of cleaning each vehicle, estimating that 45,000 vehicles pass through the port annually and that the cost of cleaning each one is €0.5, represents a saving of €22,500, which added to the amount for rodmen represents savings of €877,500 per year. Finally, k was obtained by calculating the average return generated by the best-fixed income accumulation funds in 2020 (Finect, 2020).

Therefore:

$$VAN = -449.062,40 + \frac{877500}{(1+0.05)^1} + \frac{877500}{(1+0.05)^2} + \cdots + \frac{877500}{(1+0.05)^{25}}$$

The value of the NPV obtained was €11,918,373.96 (> 0), which indicates that the proposed improvement generates a benefit and therefore can be considered profitable.

4.2. Expansion of areas for vehicle storage.

Current situation: The current configuration of the port of Santander has exhausted the reserve spaces located in the port area of Raos and, therefore, the reserve of vehicle storage surface, leaving in evidence the inability of the current infrastructure to operate a greater number of vehicles, limiting the operation capacity of this type of good of the port. The storage area for vehicles, both import and export, is 600,000 sq m (Castanedo Ruiz, 2018) for an average movement of 482,120 vehicles/year during the last five years. Considering that the current vehicle operation area is insufficient and that the growth forecast for this type of good in the port is to reach 600,000 vehicles per year, it is essential to increase the vehicle storage and port operation area by adapting its capacity to medium-term growth objectives. Taking as a reference that the port of Barcelona, the one with the highest Ro-Ro traffic in Spain, has an area of 934,000 sq m for vehicle storage with a movement of 838,176 vehicles in 2019 (Port de Barcelona, 2019), the port of Santander would have to increase its operating area for vehicles by 100,000 sq m in order to meet its growth objectives in this type of maritime traffic.

Objective: strengthening road traffic as a strategic pillar of the port of Santander by expanding the vehicle storage capacity in the central Raos breakwater. This would make it possible to meet the needs of logistics operators and achieve the port's growth objectives for this type of medium-sized merchandise.

Improvement proposal: due to the lack of space near the vehicle terminal, one option to increase vehicle storage capacity is to build vertical vehicle storage silos.

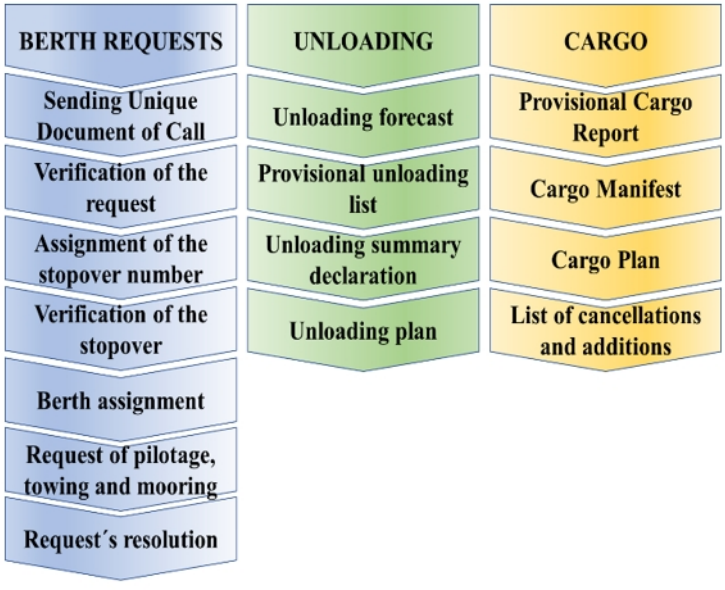
The Santander Port Authority plans to formalize the contract for the drafting of the project and the construction of a vertical vehicle storage silo in the Central Raos Breakwater. The infrastructure proposes the construction of an area of about 73,000 sq m with a first forging plant that will allow storing 3,000 vehicles. Additionally, the possibility of expanding the silo with two more plants in the future should be maintained and would depend on the flexibility required by the evolution of automobile traffic and general merchandise in semi-trailers. The budget will be €19,311,701.20 (without taxes), which will overcome the shortage of vehicle storage space in the port area.

4.3. Implementation of Technology 4.0 to the provision of port services.

Current situation: the exchange of documents between port agents and public bodies (Fig. 4) is one of the most important reasons for delays of ships in ports.

Before entering the port, the ship must issue a *Berth Request* by sending the consignee agent the *Unique Document of Call* to the Port Authority twelve hours before the arrival of the ship. This document unifies the information to be provided and the procedures to be carried out for the request for stopover and berthing before Port Authority, and before Maritime Captaincy to obtain the dispatch of the ships. Afterward, the Port Authority verifies the request and assigns a stopover number. Before entering the port, the consignee agent confirms the stopover to the Port Authority and the latter verifies the content. Subsequently, the berthing department assigns and authorizes the requested berth serving as authorization for the ship to enter the port. Before to the ship´s entry to the port, its Maritime Agent requests pilotage, towing and mooring service to Santander Port Control (SPC), indicating the name of the ship, the estimated time of arrival, the ISPS level, or International Code for the Safety of Ships and of the port facilities, and if you transport dangerous goods or if there are deficiencies in the ship or the goods. The pilot on duty, tugs, and mooring lines will confirm to SPC the availability of service.

Figure 4: Exchange of documents between port agents and public agents.



Source: Authors own elaboration.

Once the ship is moored and before unloading the cargo, the following documents must be managed: *Unloading forecast*, *Provisional unloading list, Unloading summary declaration, and Unloading plan.* In the case of the ship carries out cargo operations, the documents to be delivered are: *Provisional Cargo Report, Cargo Manifest, Cargo Plan, and List of cancellations and additions.*

During the ship's stay in port, it can request fuel or drinking water supply and waste reception services. The port service for the reception of waste generated during the service of ships, as well as in their maintenance and cleaning operations, included sewage and waste other than cargo, is governed by the MARPOL Convention. This Convention groups together a set of international standards for the prevention of marine pollution from ships, due to operational or accidental causes. The procedure for applying for the waste management port service in the port of Santander is as follows (Puerto de Santander, 2020):

1. Waste notification. The consignee company, shipping company, or the captain of the ship must notify the Maritime Captaincy and the Port Authority the quantity and type of MARPOL waste that it will deliver and/or the quantity that will remain on board, as well as the maximum storage capacity. To do this, it will use the template "Notification model before entering the destination port". The notification will be made at least 24 hours before the arrival of the ship to port.
2. Request for the collection service. The consignee company, shipping company, or the ship's captain must request the waste collection service from one of the authorized companies that operate in the port at least 24 hours in advance, indicating the moment when the ship will be ready for delivery. In the communication, all the necessary data for the provision of the service will be detailed to the receiving facility and the ideal moment for the collection of the waste will be agreed upon.
3. Provision of the service. Once the provision of the service has been confirmed, the company authorized to receive the waste will have the human and material resources necessary to carry out the service, according to the agreed conditions.
4. Certification of the service. The delivery and reception of waste will be recorded on a delivery note signed by the officer on duty on the ship. Subsequently, the waste reception facility will issue the corresponding MARPOL certificate duly stamped and signed by the authorized company and the Maritime Authority.

In the case of a request for Shipment of the ship, verification by the Maritime Administration that the ships meet the requirements of the legal regulations to carry out the navigations and traffic they intend to carry out and the issuance of the corresponding authorization, the consignee agent can initiate the process using the *Unique Document of Call* and attaching the documentation required by the Maritime Captaincy (captain's declaration, crew list, and waste declaration). The Port Authority communicates the dispatch request to the Harbor Master's Office and the information is verified, issuing an acceptance or rejection. Finally, the Maritime Captaincy issues the "*Ship's Clearance*" to the consignee. At the same time, customs procedures are carried out to declare the goods before Customs and comply with customs formalities, both import and export, through the *Single Administrative Document*.

Objective: streamline the documentary process between the agents involved to facilitate port administrative procedures and avoid delays in the ship's stay times in the port due to delays in document management.

Improvement proposal: implement a new model of technological transformation that allows interoperability between the agents involved, the management of Big Data, decentralizing decisions, carrying out operations in real-time, and knowing which machines and people can interact to obtain an interconnection network of the agents involved and with a high level of automation in the port.

The Bergé company leads the *4.0 revolution* in port operations with the design of the *KeyPort* project to digitize port services and operations through *Blockchain* technology. The purpose is to extrapolate the project to transform port operations, establish new ways of providing services and create new services, improving efficiency and reinforcing sustainability.

The concept of *Port 4.0* consists of the digitization and automation of port services and operations, responding to the port's environmental commitment, and making it smarter and more sustainable. Among the multiple applications offered by this digital frame, the following is proposed:

1. Implementing a technology that allows the agents involved in port operations to be placed online so that they all communicate online and the information flows truthfully, reliably, and transparently.
2. Pilot phase. Automation of waste management operations following the MARPOL International Agreement to avoid contamination, with the involvement of the port of Santander with the support of State-owned ports, the Santander Port Authority, the Maritime Captaincy, service providers MARPOL, and the consulting firm specializing in logistics and technology Conceptual KLT.

Conclusions.

International trade is developed in an international framework based on comprehensive logistics and the evolution of exchange networks and logistics structures, both locally and internationally. This allows the coordination and joint management of supply, production, storage, and distribution logistics, offering a broad view of the entire process to manage resources efficiently.

Ports, as a place where different areas of circulation of goods and services converge, have become spaces of convergence between transport systems, service providers and are integrated into a supply distribution system that requires logistical developments.

Although the automotive brands value the port service of the port of Santander as the most competitive of the Spanish ports, it is necessary to implement improvements in the services of the storage areas aimed at minimizing damage to the stored vehicles, mainly those related to dirt in vehicles and those caused by atmospheric phenomena.

Additionally, the current configuration of the port of Santander has exhausted the vehicle storage spaces in the central

breakwater of Raos, showing the inability of the current infrastructure to operate a higher number of vehicles, limiting the operating capacity of this type of merchandise from the port. As a result, building a vertical storage silo for vehicles is justified.

Finally, implementing a new technological transformation model that allows the digitization and automation of port services and operations, responding to the port's environmental commitment and making it smarter and more sustainable, is necessary to simplify and streamline the document process between the agents involved in order to facilitate the port administrative procedures and avoid delays in the ship's time in the port due to delays in document management.

References.

Alonso, L. 2019. Las predicciones de la industria 4.0 optimizarán las cadenas logísticas en los puertos. El mercantil. (http://elmercantil.com/).

Cacho Borrás, A. 2020. Varilleros, artesanía milimétrica. https://cadenaser.com/emisora/2020/08/19/ser_ciudad_real/1597-839838_140006.html.

Castanedo Ruiz, N. 2018. Tecnología Blockchain aplicada al tráfico Ro-Ro en el puerto de Santander. Trabajo Fin de Grado. Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos. Universidad de Cantabria.

Dorta-González, P. 2014. Transporte y logística internacional. Universidad de Las Palmas de Gran canaria.

Finect. 2020. Los mejores fondos de acumulación 2020. (https://www.finect.com/).

González Laxe, F. 2018. La competitividad portuaria: un análisis de los principales criterios. Universidad de A Coruña.

Kanvel. 2018. Características, ventajas y tipos de buques en el transporte marítimo de mercancías. KANVEL Logistics & Business Worlwide. (https://kanvel.com/transporte-maritimo-de-mercancias/).

Meteocantabria, 2019. Estadísticas meteorológicas. (https://-www.meteocantabria.es).

Port de Barcelona. 2019. Memoria anual. Autoridad Portuaria de Barcelona.

Puerto de Santander. 2020. El puerto de Santander. (http://-www.puertosantander.es/).

Puertos del Estado. 2019. Guía de procedimientos administrativos en puertos españoles de interés general. Ministerio de Fomento.

Puertos del Estado, 2020. Puertos del Estado. (http://www.-puertos.es/).

Romero Serrano, R. 2002. El transporte marítimo. Introducción a la gestión del transporte marítimo. Ed. Marge Books.

Romero Serrano, R; León Arias, A. 2003. Logística del transporte marítimo. Ed. Marge Books.

UPC. 2004. El futuro tecnológico de las terminales marítimas de vehículos: la integración de sus sistemas de información. Departament de Ciència i Enginyeria Nàutiques. Barcelona.

Zona Franca Santander. 2020. Infraestructuras. (https://www.-zonafrancasantander.es/).