Multidisciplinary approach and solutions to development of intermodal transport in region

T 3.4.2
Guidelines for final users

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1. Introduction

This document fits within the framework of the Interreg ADRION 2014-2020 project MultiAPPRO and it is part of the Work package "T3 – Transport Performance Strategy" and its main goal is to provide the end users Guidelines (namely ports) for the successful implementation of the proposed port quality management system.

The guidelines report is the result of T3.4 regarding the development of a port quality management system under the project and it takes into account the results of all other sub-activities of the T3 activity. In this report the components of the transport system will be described, the Motorways of the sea (MoS) concept will be defined and the developed Port Quality Management System will be presented.

The Quality Management System (QMS) aims at managing the processes and the resources needed to contribute value to port activities and to increase customer satisfaction, both internal and the external ones (Port Community, end customers, etc.), by applying the system effectively, with the goal of continuous improvement and ensuring conformity with customers' requirements as well as applicable legal and regulatory requirements. Various certifications already are used to verify the effectiveness of the QMS obtained by organisations (ISO, Service reference standards) for various kinds of traffic and for Port Services in accordance with Service quality reference standards that are applicable.

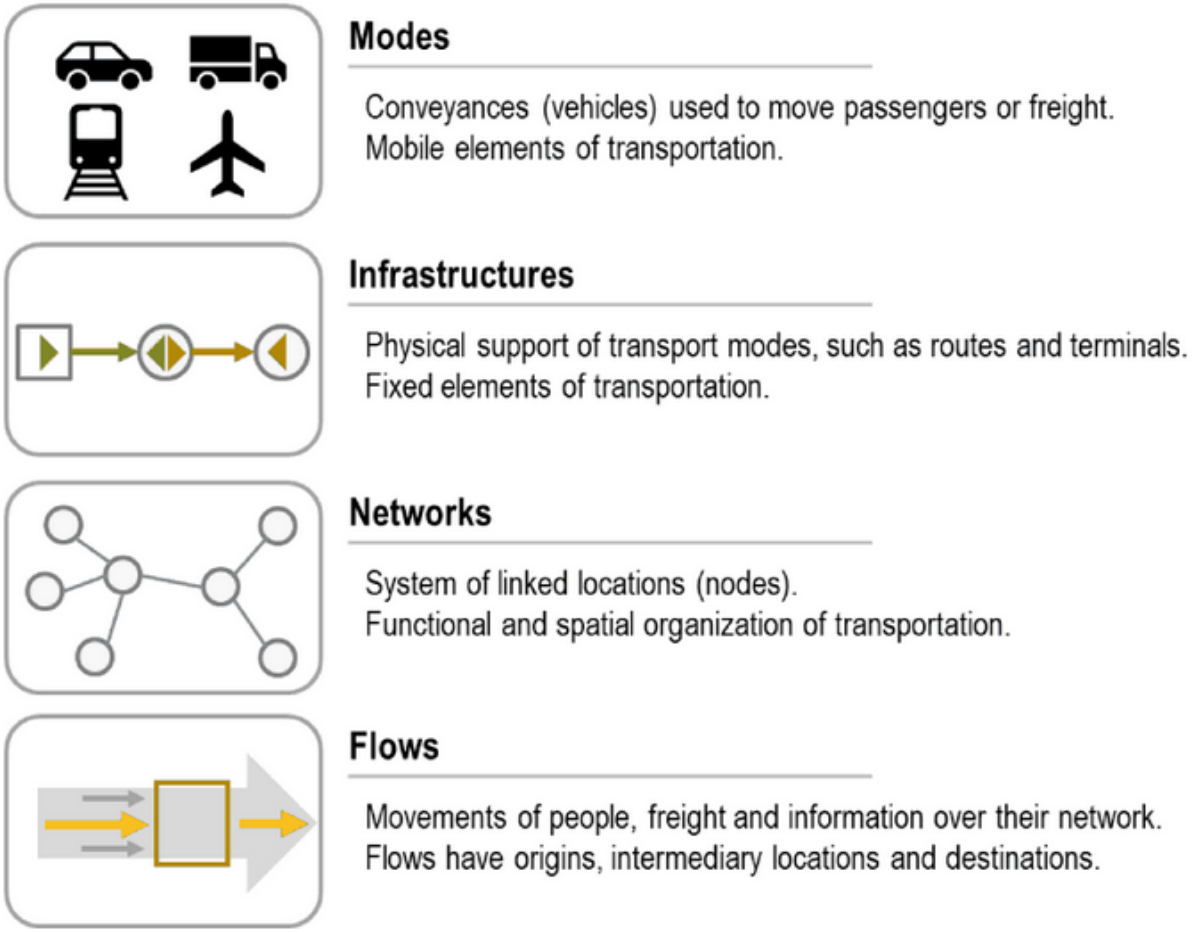
The QMS provides an Effective Management and Strategic Planning for Ports. The focus and direction for the port management and operating personnel is to align their business activities and port operations to the vision, mission, goals and strategies of the port.

While most of the Container Terminals throughout the world have highly standardized operations, systems, procedures and performance indicators and benchmarks; non containerized ports / terminals have a large variety of operations, handling systems, degree of mechanization and performance indicators. The variations in operations of such non-containerized ports and terminals necessitates adaptation of a system which facilitates defining operating parameters and monitoring performance and thereby providing direction for the management.

The results of T3 are essential for the implementation of the project and the development of an innovative Port Quality Management System.

2. Components of Transport System

The main components of transport system as Jean-Paul Rodrigue has presented in his book, Geography of Transport are:



Picture 1: Main components of transport system

2.1 Modes

Modes of the transport system are the essential components of transport systems since they are the means of supporting mobility. Modes can be grouped into three broad categories based on the medium they exploit: land, water, and air. Each mode has its own requirements and features and is adapted to serve the specific demands of freight and passenger traffic. This gives rise to marked differences in how the modes are deployed and utilized in different parts of the world. More recently, there is a trend towards integrating the modes through intermodality and linking the modes ever more closely into production and distribution activities. At the same time, however, passenger and freight activity is becoming increasingly separated across most modes.

Some modes are designed to carry only passengers or freight, while others can carry both. Regarding, maritime transport, ships are the most preferable monde for huge number of freight and passengers due to their big capacity.

The importance and configuration of maritime routes have changed with economic development and technical improvements. Among those, containerization changed the configuration of freight routes with innovative services. Before containerization, loading or unloading a ship was a costly and time-consuming task, and a cargo ship typically spent more time docked than at sea. While sailing time used to represent around 25% of the annual ship time for standard break-bulk ships, this figure is now around 70% for containerships. With faster and cheaper port operations, inter-range routes have emerged as a dominant configuration of containerized maritime networks.

2.2 Infrastructure

The physical support of transport modes, where routes (e.g. rail tracks, canals or highways) and terminals (e.g. ports or airports) are the most significant components. Infrastructures also include superstructures which are movable assets that usually have a shorter lifespan. So, for an airport the infrastructure would be assets such as the runways while the superstructure would be the terminals and control equipment. For a port, the infrastructure would be piers and navigation channels while the superstructure would be cranes and yard equipment.

The fluvial / land interface often relies less on transhipment infrastructures and is thus more permissive for the location of dependent activities. Ports are less relevant to fluvial transportation, but fluvial hub centres experience a growing integration with maritime and land transportation, notably with containerization.

Most major maritime infrastructures involve maintaining or modifying waterways to establish more direct routes (navigation channels and canals). This strategy is very expensive and undertaken only when necessary. Significant investments have been made in expanding transhipment capacities of ports, which is also very expensive as ports are heavy consumers of space.

The public sector is commonly responsible for guidance infrastructures (beacons and charts), public piers, dredging, security, and in several cases of the administration of ports (under the umbrella of port authorities). The private sector is mostly concerned about specific facilities such as piers, transhipment infrastructures, and ships, which are commonly owned by private maritime companies.

The satisfaction of customer requirements on port services depends on:

- The availability of efficient infrastructure and inland connections, as part of a global transport system
- The ability of logistics and transport operators to contribute to value creation and to accomplish qualitative attributes of demand (i.e., reliability, punctuality, frequency, availability of information, and security).

The container transport chain has experienced operational changes due to the rise of intermodal transports and ports having specialized in transhipment activities. The world has formed into a systemic transport chain in which individual ports are linked by hub and feeder relationships, as well as end-to-end shipping linkages that reflect increasing trade dependency among regions.

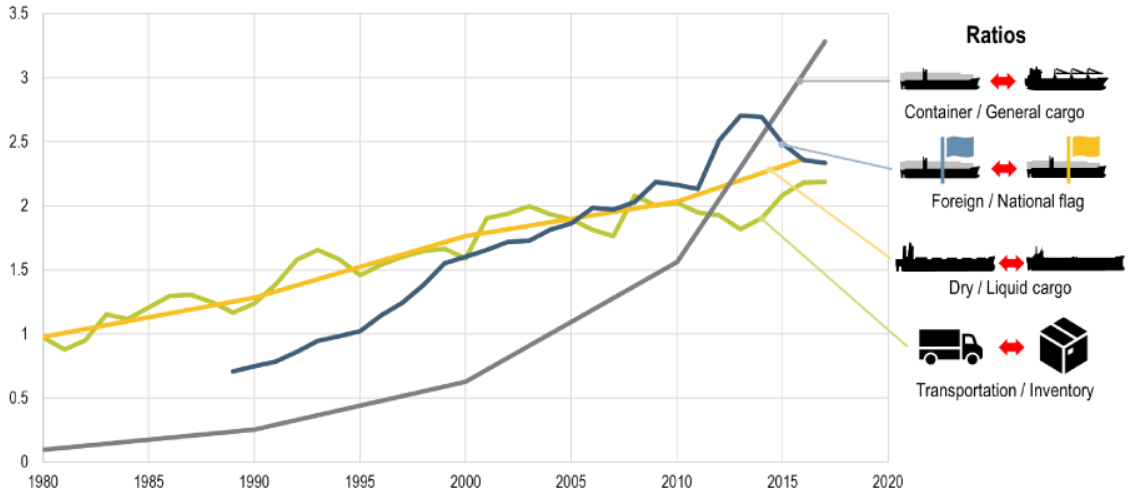
2.3 Network

A system of linked locations that are used to represent the functional and spatial organization of transportation. This system indicates which locations are connected and how they are serviced. Within a network some locations are more accessible (more connections) than others (less connections).

A dependable global maritime trade network has been established from the 16th century. Most maritime shipping activities focused around the Mediterranean, the northern Indian Ocean, Pacific Asia, and the North Atlantic, including the Caribbean. Thus, access to trade commodities remains historically and contemporarily the main driver in the setting of maritime networks.

The degree of integration for fluvial transportation varies from totally isolated distribution systems to well-integrated ones. In regions well supplied by hydrographic networks, fluvial transportation can be a privileged mode of shipment between economic activities.

The global maritime transportation system has substantially evolved to form networks within networks, connecting systems of circulation and enabling global trade. Without maritime shipping, globalization could not have taken place to such an extent.



Picture 2: Selected Changes in Maritime Shipping

2.4 Flows

Movements of people, freight and information over their respective networks. Flows have origins, intermediary locations and destinations. An intermediary location is often required to go from an origin to a destination. For instance, flying from one airport to another may require a transit at hub airport.

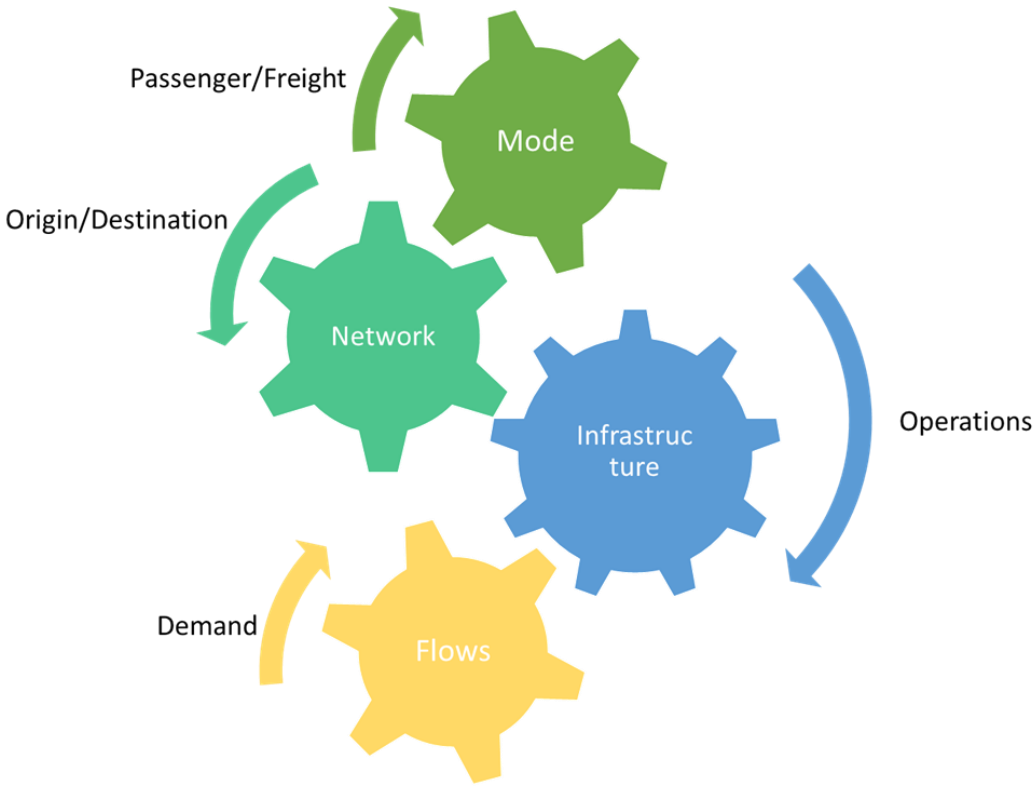
The massification of transport into regular flows over long distances is not without consequences when accidents affecting oil tankers can lead to major disasters. Fluvial transportation, even if slow and inflexible, offers a high capacity and a continuous flow.

Change in the balance of maritime trade flows has been associated with developing economies having more extensive involvement. Therefore, such cargoes can be temporary and subject to changes in their origins and destinations.

2.5 Interconnection of transport components

The components of transport system and their interconnections determines that the transport system is a complex system providing a huge number of choices/scenarios of intermodal transport for freight and passenger transport.

The components of transport system are interlinked and any change in one component influences also the rest either positively or negatively. Therefore, components of transport system should be handled such as one entity.



Picture 3: Interconnection among the main components of intermodal transport system

3. Motorways of the sea (MoS)

3.1 Definition – Identification of them

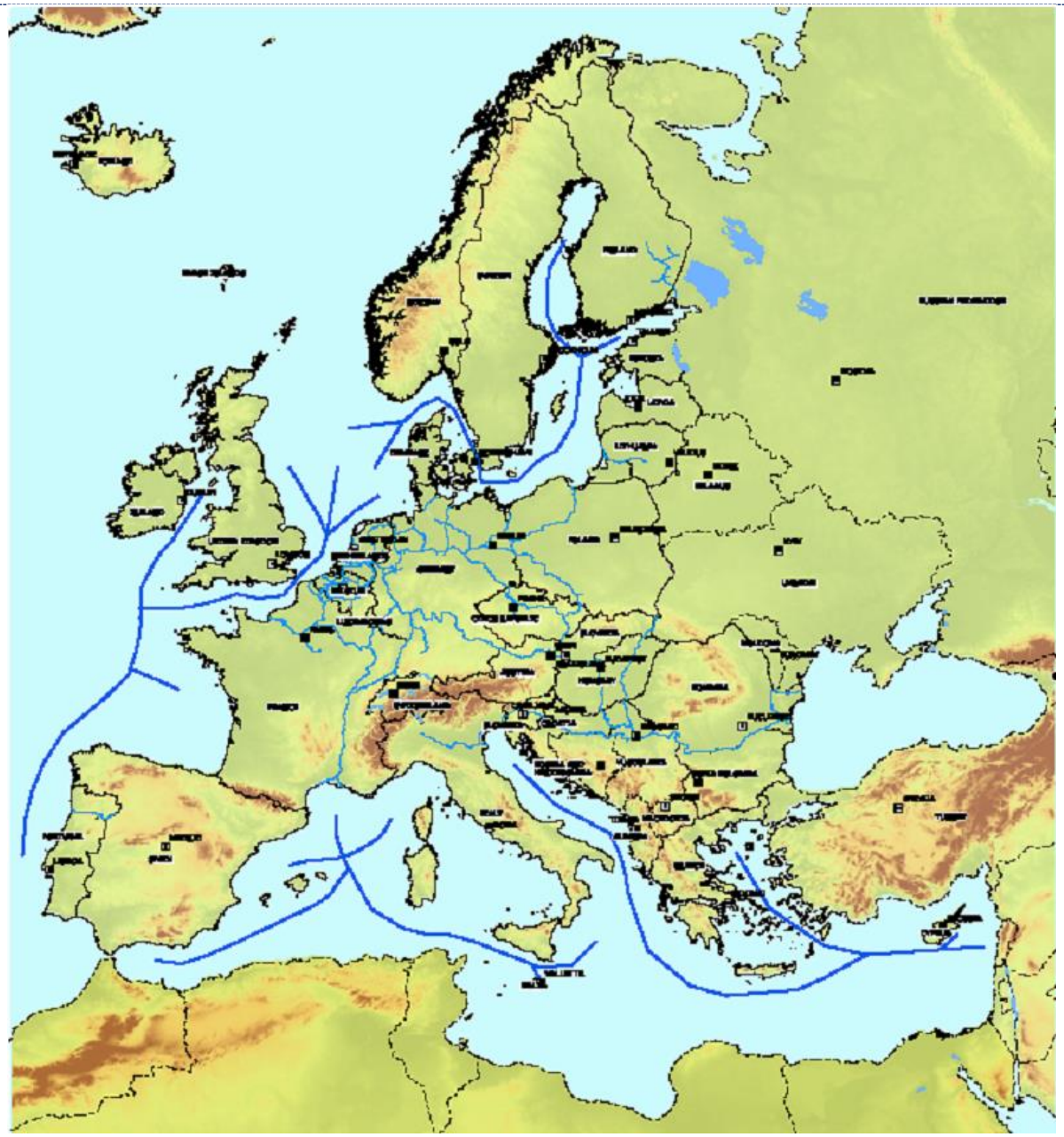
Motorways of the Sea are a concept in the transport policy of the European Union, stressing the importance of sea transport. The main aim of these Motorways of the Sea is to improve port communications with peripheral regions of the European continent and thus strengthen the networks between the EU candidate countries and those countries already part of the European Union.

The adoption of Article 12a of the TEN-T [2] by Council and European Parliament gave a legal framework for funding the Motorways of the Sea, while Article 13 of the same Programme defines the characteristics of this part of the TEN-T network.

The routes selected to be Motorways of the Sea should be able to maintain a series of quality criteria; these pertain to frequency, port to port costs, simplicity of administrative tasks. Future routes should compensate for congestion experienced, for example when crossing the Channel (as the similar road networks should do for routes crossing the Alps or the Pyrenees). One envisaged impact of the Motorways of the Sea is energy savings, pollution reductions and more capacity on current overland European transport networks.

Four main Geographic areas have been designated by the EC:

- Motorway of the Baltic Sea, linking the Baltic Sea and the North Sea-Baltic Sea canal.
- Motorway of the Sea of Western Europe, from Portugal and Spain via the Atlantic Arc to the North Sea and the Irish Sea.
- Motorway of the Sea of south-east Europe, from the Adriatic Sea to the Ionian Sea and the Eastern Mediterranean, including Cyprus.
- Motorway of the Sea of south-west Europe; western Mediterranean, connecting Spain, France, Italy and including Malta and linking with the Motorway of the Sea of south-east Europe and including links to the Black Sea.



Picture 4: Map of Motorways of the Sea

The 2011 Transport White Paper "Roadmap for a single European transport" stressed anew the importance of Motorways of the Sea. The 2013 TEN-T Guidelines (Regulation (EU) No 1315/2013) redefine the Motorways of the Sea as the maritime dimension of the trans-European transport network which shall contribute towards the achievement of a European maritime space without barriers and shall include:

(a) Maritime links between maritime ports of the comprehensive network or between a port of the comprehensive network and a third-country port where such links are of strategic importance to the Union;
(b) Port facilities, freight terminals, logistics platforms and freight villages located outside the port area but associated with the port operations, information and communication technologies (ICT) such as electronic logistics management systems, and safety and security and administrative and customs procedures in at least one Member State;

(c) Infrastructure for direct land and sea access.

While the Commission defines the policy aspects of the Motorways of the Sea form which the eligibility criteria for funding derive, the Innovation and Networks Executive Agency (INEA) as the successor of the Trans-European Transport Network Executive Agency (TEN-T EA), manages the technical and financial implementation of the programme.

3.2 Key factors for selecting them

The European Transport Policy that has been developed over the last two decades has always considered the fundamental importance of having a European transport system that covers effectively the requirements of industry, but at the same time be sustainable. The development of the Trans-European Transport (TEN-T) lies at the heart of the European initiative for mobility and transport, while there are several other initiatives that aim at extending the TEN-T network beyond the geographical constraints of the European Union and connecting it with neighbouring networks, such as the Motorways of the Sea, the Trans Mediterranean Network and the Black Sea Cooperation. The creation of such networks and related initiatives are affecting all EU designated MoS offering increased potential for the EU coastal areas to participate actively in the re-development of the map of infrastructure and traffic flows.

Primary challenge is to enhance the maritime transport sector. To win this challenge, all ports should collaborate and set their stakes on co-operation and strategic alliances. The general goal is to improve the maritime transport network, through restoring/modernising existing and developing suitable port infrastructure to cater for both passenger and freight transport demand and improving services towards efficient intermodal transport system.

With supply chains becoming increasingly long and international, efficient supply chain management and logistics are prerequisites for the competitiveness of a port in the international transport and trade arena. Consequently, another key challenge lies to a significant extent in the quality and effectiveness of the port's logistic services and transhipment capabilities. In addition, focus should be placed on the need for efficient logistic services, and investments in the creation of intermodal "interfaces", such as logistic centres, dry ports, inland container terminals and freight villages. Intermodal transport and services have significant positive influence on two levels:

- Effects on logistic costs for shippers
- Effects on costs for transport operators

Based on previous research and conclusions, quality criteria that each port must satisfy (in terms of infrastructure and administration) will be made, in order for the service to be reliable and satisfy a certain level of quality. One of the features of the Motorways of the Sea service, is that they have to be reliable, and this can be achieved only if there are clear quality criteria that each link of the chain must satisfy. A port is a crucial link, as it connects all parts of a system in one point. It is a very complex system, so it needs specific supervision. Currently, these criteria don't exist and they will develop with this activity. If one of the EUSAIR goals is the Motorways of the Sea and Short Sea Shipping development, then the establishment of a Quality Management in ports, is a comparative advantage of this area.

Therefore, ports must team up with their respective "natural" hinterlands to serve the logistics and entrepreneurial fabric of their individual countries. Technological evolution and development of ITS is also mandatory and present opportunities for significant growth advantages.

Finally, the realisation of an efficient port transport network requires foremost political will and commitment, since transport is a strategic responsibility of Governments, which can play a major role through the implementation of transport infrastructure together with a regulatory framework within which transport services can be developed. Rules and regulations must be brought up to date for ports to benefit of conditions that will enable them to rise above their European competitors. The stakes are each country's share of Mediterranean transhipment and a share of the European destination markets. To this end, coordinated action is required at the national level to address these significant opportunities and challenges.

3.3 Key Priorities of MoS

MoS has a dual effect:

- It improves access to markets throughout Europe
- It reduces the strain upon already over-stretched European road systems

The MoS concept builds on the EU's goal of achieving a clean, safe and efficient transport system by transforming shipping into a genuine alternative to overcrowded land transport. MoS aims to introduce new intermodal maritime-based logistics chains to bring about structural change to door-to-door integrated transport systems. To this end MoS:

- Helps implement policy initiatives on the European maritime space without barriers and the maritime transport strategy for 2018
- Positively contributes to greenhouse gas (CO2) reductions, which is of paramount importance in the context of climate change
- Introduces new intermodal maritime based logistics chains contributing to door-to-door integrated transport systems

MoS taps into the huge potential of maritime transport as the backbone of international trade. MoS removes bottlenecks in the EU transport system, thus supporting more efficient and high-quality maritime links and services between Member States. Based upon successful shipping routes, MoS is designed to remove bottlenecks in the EU's transport system. This will be achieved through the establishment of more efficient and frequent high-quality maritime-based logistics services between Member States.

The main bottlenecks and missing links are:

- Compliance with 2015 MARPOL Annex VI (Regulations for the Prevention of Air Pollution from Ships) across fleets operating in Sulphur Emission Control Areas (SECAs)
- Establishment of viable network for alternative fuels, including development of relevant technologies, infrastructures, safety provisions, and regulatory frameworks for alternative fuels
- Development of technologies to tackle operational pollution such as exhaust gas cleaning systems and on-board water treatment systems
- Implementation of critical port infrastructures and intermodal links, both sea side and land side

Adriatic ports need to gain recognition as the key multi-port cluster of Europe, particularly along selected corridors (MoS of the Eastern Mediterranean, links with the Black Sea, Middle East, etc), in order to encourage the ships that enter the Mediterranean through the Suez Canal to sail up the Adriatic. To this end, the active participation of the countries of the Adriatic region in the development of the Trans-European, Trans-Mediterranean, and Euro-Asian transport links ought to be sought, and efforts should be directed

towards integrating their national transport networks with each programme's identified routes and corridors.

MoS strategic policy dimensions are:

- Environmental Protection
- Human Element
- Maritime Integration in the Logistics Chain
- Ten-T

Concluding, MoS aims to contribute towards the achievement of a European Maritime Transport Space without Barriers, connect Core Network Corridors by integrating the maritime leg and also facilitate maritime freight transport with neighbouring countries. In this context, they shall also promote sustainable shipping concepts which contribute to reducing negative impacts of heavy fuel oil powering in support of the implementation of the requirements of Annex VI of the IMO MARPOL Convention and of Directive 2012/33/EU as well as reduction of CO2 in maritime transport.

3.4 Short Sea Shipping (SSS) concept

According to the EU, Short Sea Shipping is defined as "the movement of cargo and passengers by sea, between ports situated in geographical Europe or between those ports and ports situated in non-European countries having a coastline on the enclosed seas bordering".

SSS has environmental and economic benefits over traditional modes of transport. SSS has a geographical advantage over other transport modes facilitating the door to door transport of specific cargoes by sea. This advantage can have an important impact on the European economy, since SSS can contribute to the integration, cohesion and economic development of the peripheral regions of the EU. SSS is an integral part of global transportation network and mean of expanding freight capacity.

SSS offers:

- Economical and cost effective transport
- Consistent, reliable and timely services with guaranteed transit times
- Geographical coverage across Europe
- Energy efficient and environmental friendly services
- Reduced road and traffic congestion
- Safer per ton mile mode

Moreover, Short Sea Shipping activity includes "the domestic and international maritime transport, including feeder services along the coast, to and from the islands, rivers and lakes. The concept of short sea shipping also extends to maritime transport between the Member States of the Union and Norway and Iceland and other States on the Baltic Sea, the Black Sea and the Mediterranean.

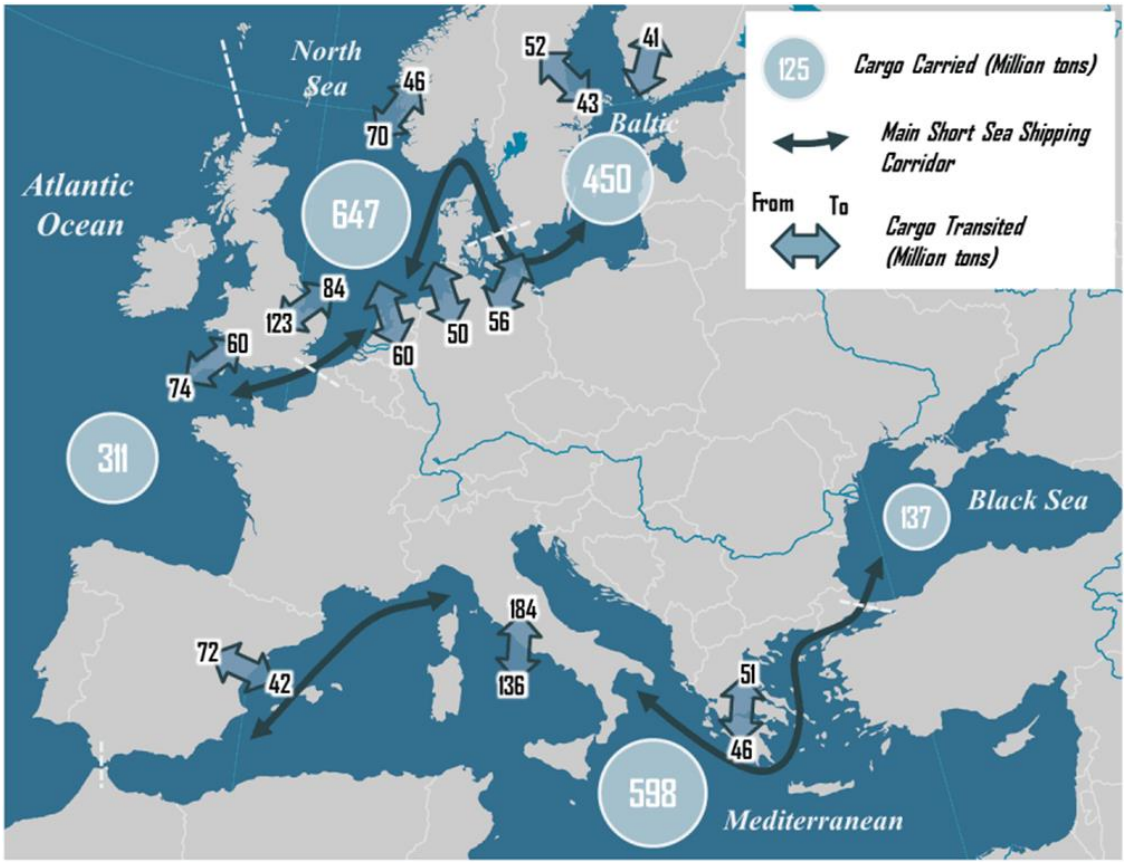
Traditionally, the concept of the SSS is the result of the concepts of logistics chains and intermodality. Its main advantages are the low price, the potentially lower emissions, the available infrastructure and the significant capacity of the ships. Although maritime transport is seen as an ecological alternative to the road transport and the considerable advantages offered by the SSS concept, there are significant challenges. These are, above all, related to the high costs of fuels and harbour taxes; high risks associated with its application;

new regulations and environmental charges. As a consequence can be expected an increase in the cost of shipping.

Stringent environmental regulations are essential to achieve a significant reduction in atmospheric emissions from ships, but they also need to take into account the desire to encourage modal shift from road to the sea.

The SSS concept makes special requirements for rapid and effective transhipment between sea and road or rail transport, which may be technically difficult to achieve in smaller ports. Another problem is the different infrastructure capacity in different ports, which leads to a risk of delays or increased transport time. Problems with load speed and capacity differences also have an impact on the integration of the entire transport system.

The SSS concept includes the transport of cargo between ports and intermodal port hubs with a fixed timetable. Accuracy and frequency are essential factors as they allow the transport at sea of time sensitive goods which are currently transported by other means of transport. The growing importance of maritime transport in future transport systems means increasing requirements for efficiency, sustainability, and economic stability. Implementation of this concept may in the future lead to problems related to the capacity of rail and/or road infrastructure and to open up additional markets.



Picture 5: The European Short Sea Shipping Market

During the last 20 years, the EU has encouraged the promotion of Short Sea Shipping corridors (short sea routes) as a more sustainable alternative to road transport. The need to establish an even environment between different transport modes, as well as the need for reducing congestion and other environmental harmful impacts from road transport, have been the main motivations.

In European history, maritime transport has been a significant catalyst for economic development. Almost 75% of the European external freight trade volume is seaborne. Already, SSS transports 33% of inter European ton-kilometers, and the tendency to ship via SSS is rising.

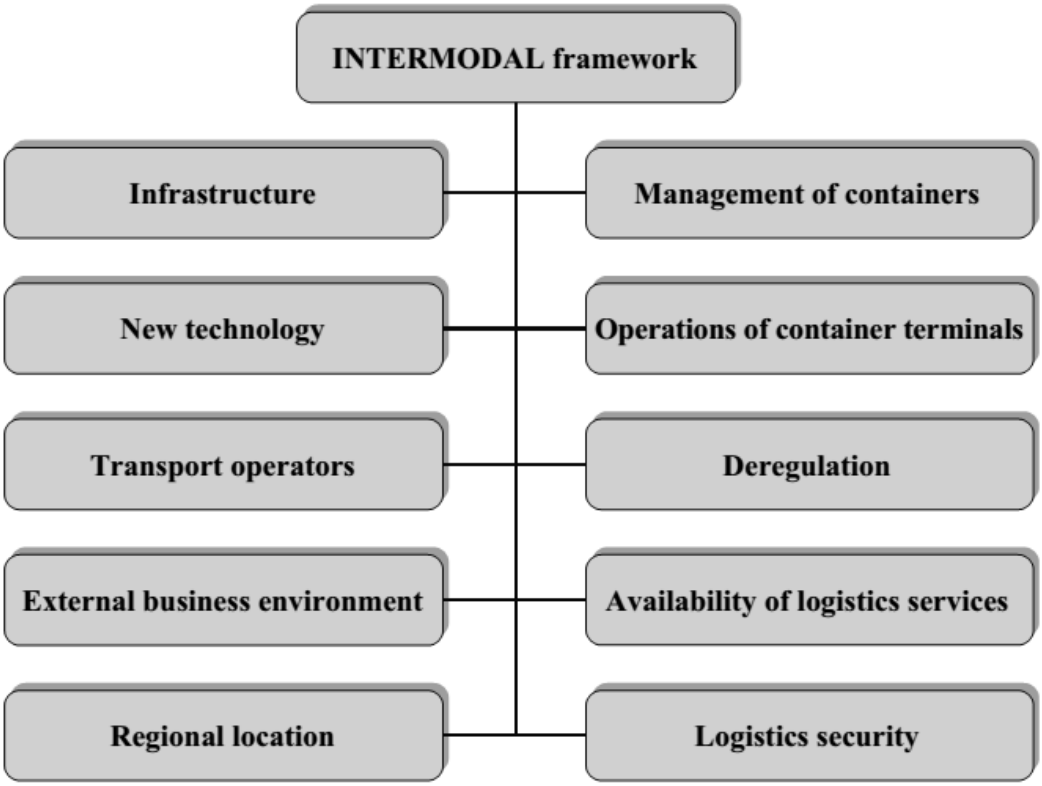
Due to increasing need and the demand for alternatives to road and rail transport within Europe, incumbent shipping line major MSC has jumped on the SSS bandwagon, extending its fleet for the inter European transportation network. For MSC, combining shipping services with inland operations has helped it provide a seamless door-to-door delivery solution for businesses of all sizes. The MSC network alone stretches all over the Mediterranean Sea and the northern part of Europe.

The network between Europe and Asia is also under continuous expansion. Eight countries in the Arabian Gulf have been linked over the last decade. Southeast Asia is following this trend by connecting different ports, e.g., in Thailand. Short sea shipping as a transport niche has grown in relevance, and it is about time it gains more mainstream adoption – considering its promise in reducing global trade's overall carbon footprint.

3.5 Ports – main intermodal transport nodes

Regarding transport operations and connectivity among the modes, efficient transport nodes should be able to identify which processes require improved performance in order to remain competitive, attract and retain users and increase profits. Moving cargo from one mode to the other has always been a challenge since the size of conveyances commonly exceeded the ability to load and unload them in a timely fashion.

An intermodal transport system consists of various components. The key components of the system are categorised in ten elements:



Picture 6: Key elements to the intermodal transport system (Lun et al. 2009)

Maritime transport is considered an environmentally friendly way of transportation. Maritime transport is the main mode of global transport and is one of the globalization cornerstones. Almost 80 percent of global trade in goods is transported by sea. Seaports, as a part of MoS, are the main nodes of maritime transport as well as basic links in the sea to land transport chains, and are essential for supporting the economic activities in the surrounding areas.

Multimodal logistics (including maritime transport and port handling) presents a continuous challenge for freight owners, because it affects both the costs and delivery time, therefore affecting transport sustainability. Multimodal maritime cargo transport encompasses cargo loading at the port of origin, transportation to its destination, including a sequence of at least two transportation modes (transfer from one mode to the next being performed at an intermodal terminal).

The three core values of sustainable transport have been identified as:

- Should provide safe and consistent access to the basic needs of both the individuals and the society, while securing both human and ecosystem health to ensure stability for the future generations.
- Present “value for money” by efficient operations and affordability while offering alternative means of transport
- The core goals of sustainable transport must be the global waste management and emissions control. The overall goal of sustainable transport should be providing mobility that ensures regional economic development and long-lasting future for natural resources.

Sustainable maritime transport and sustainable logistics are declared as key areas in which sustainable interventions could have the largest impact in terms of enabling more sustainable trajectories. In the context of transport, a focus has often been put only on economic outcomes, with less consideration being given to the social and environmental aspects.

Maritime transport is regarded as one of the most important sectors of the European economy. The creation of an effective multimodal transport network, which integrates sea and inland waterways, land transport, has been recognized as a very important aspect of sustainable development of the EU transport sector. This should embody smartness, sustainability and inclusiveness, the key drivers of a Blue Economy. Blue Economy refers to the use of seas and coasts for economic activities.

Based on these principles, the EU has created the Trans-European Transport Networks (TEN-T), consisting of two layers of planning: the Comprehensive Network (covering all European regions) and the Core Network (most important connections within the Comprehensive Network linking the most important nodes).

Modern ports operate in an increasingly complex and sophisticated transport and logistics environment, embedded within multi-scalar planning regimes. Port actors have difficulty acting beyond the port perimeter but some port terminal operators have begun to demonstrate successful investments in inland terminals in order to manage their container throughput more strategically. Inland logistics markets tend to be centralised and focus heavily on domestic flows, thus the efficiency of intermodal freight services is challenged by the need to combine port and domestic movements which have different product, route and equipment characteristics. Collective action is an arena where port actors can be influential due to the role of informal networking in managing freight corridors; however, institutional constraints limit their ability to act directly.

Seaports are located in a unique embedded position in the transport chain, enabling them to provide incentives to industry stakeholders in their effort to improve the sustainability of the industry. Furthermore,

sustainable business is inevitable for seaports due to the customers which require green supply chains initiatives that strengthen the sustainability of the ports. The sustainable seaport business can be achieved by appropriate planning and management of seaports and balancing economic, environmental, and social interests through mediation and open dialogue. Managing different stakeholders and stakeholder interactions is of crucial importance in improving sustainable seaport business.

4. Port Quality Management System

4.1 Key port operations

Ports as a part of the Global transport system provide not only facilities for berthing or anchoring ships, but are also the location where there is handling of equipment used to handle cargo transfer from ships to shore, shore to ships, or ships to ships.

The following roles of ports have been distinguished:

- Ports as places: They are places that handle ships and cargoes.
- Ports as operating systems: They are places that handle ships and cargoes with operational efficiency.
- Ports as economic units: They are places that handle ships and cargoes within an economic efficiency framework.
- Ports as administrative units: They are places that handle ships and cargoes within an efficient administrative and policy framework.

Ports are a vital part of the transport infrastructure. The most important functions of ports include:

- Their acting as nodes for linking with other inland transport modes such as highways, railways, and inland waterway systems;
- Their acting not only act as gateways for trade, but also attracting agents of commercial infrastructure such as banks and insurance agents, as well as industrial activities.

Regionalization represents a new development in port systems, which involves a higher level of integration with intermodal transport systems and requires port terminals to accommodate new port–inland linkages. The development of rail hubs and barge networks in the hinterland contributes to the transfer of the distribution function from road transport to rail and barges. There are several functions of inland terminals, including:

- Cargo bundling points in extensive transport networks. They can help load centre ports gain economies of scale and preserve their attractiveness.
- Cargo consolidation and deconsolidation centres, as well as depots for empty containers. They have become crucial in optimizing container logistics.
- Offer other related logistics services, such as value-added logistics services, distribution centres, shipping agents, and container management services.

There is a tendency towards logistics integration in the port and maritime industry while Inland access cost could be reduced significantly with appropriate regionalization strategies. Ports have evolved from a cargo loading/unloading point to a distribution centre with physical infrastructure serving as transport hubs in the container transport chain. Ports act as an interface between the areas of production and consumption, which attracts the strategic attention of market players in the port-related business.

The use of ports as dedicated container terminals and the need for transhipment operations have led to an increase in the terminal costs for shipping lines. Together with the inadequacy of terminal capacity in some congested areas, shipping lines have considered securing the control of a number of terminal facilities all over the world. Other drivers for shipping lines to acquire control over terminals are the reduction in stevedoring costs and improvement in schedule reliability. Pioneer liners have invested in container terminals. For port authorities, dedicated terminals are a means to facilitate the development of integrated services and to engage the commitment of shipping companies to the terminals. Dedicated terminals can be

a useful strategy if there is competition between terminal operators. Dedicated container terminals offer carriers greater flexibility and reliability, shorter turnaround times, and enhanced efficiency in the management of global container movements. The level and scope of accessibility to a dedicated container terminal are determined by agreement between carriers and port operators. The deal between shipping lines and terminal operators can involve the use of berths for other container terminal operations such as stacking areas, as well as inland connections.

The main facilities in container terminals are a quay, a container yard, a container freight station, an interchange area, a gate facility, a railhead, and possibly others.

The key port operations are considered:

- Loading - unloading of containers. Container Terminal operations include:
  - Crane operation
  - Trucking, drayage trucks, yard hustlers
  - Rail car operations
  - Vessel discharge containers and backload containers
  - Truck delivery containers and pickup containers
  - Project cargo that is larger than normal cargo and requires special cranes
  - Maintenance of cranes and trucks
  - Vessel wastes – bilge
- Transport of containers from quayside to stack and vice versa
- Container yard operations
- Interterminal transport / other modes of transport
- Cargo Loading & Off-Loading - Commodities are loaded and off-loaded from vessels, trucks, rail cars, warehouses. Cargo Handling Equipment include cranes, Drayage trucks, Yard Hustlers, fork lifts, rail cars, etc. Typically powered by diesel engines.
- Storage
  - Dry Bulk Storage
  - Liquid Bulk Storage
  - Chemical Storage & Handling
- Fuelling of vessels, trucks, and other equipment
- Ship repair and maintenance activities
- Marinas

Additional activities may include ballast water management, waste recycle management, dredging, fish pier - seafood processing building, maintenance of port facilities etc.

One of the features of the Motorways of the Sea concept, is that they have to be reliable, and this can be achieved only if there are clear quality criteria that each port of the logistic chain must satisfy. Based on the previous steps, a set of quality criteria that each port must satisfy (in terms of infrastructure and administration) will be identified, in order to ensure reliable services and satisfy a certain level of quality.. One of the EUSAIR goals is the Motorways of the Sea and Short Sea Shipping development, therefore the establishment of a Quality Management in ports, is a comparative advantage of this area.

4.2 Customers' needs and expectations

Port efficiency is an important factor that affects the intention of users to use a port. Inefficient port operations incur additional costs for shippers, increase operating costs for transport operators, and reduce the profitability of the port. Hence, there is a need for ports to operate as an "agile port" to cope with the uncertain operating environment while being responsive to customers' demands.

Ports are critical parts of the logistics system along a supply chain. The supply chain builds upon this framework and seeks to achieve linkage and coordination between players to enable the product flow activities. Supply chain management is defined as "the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole." Hence, the focus of supply chain management is "the management of relationships" to achieve a more profitable outcome for all players in the chain. Key players in the container transport chain are shipping companies, inland transport operators, terminal operators and freight forwarders.

Nowadays, there is also a need to transform ports to create value by providing value-added services such as cargo consolidation or crossdocking activities in addition to the basic operations of handling and storage of cargoes. Furthermore, ports begun to realize the importance of customer services and of keeping a long term relationship with customers.

Ports unload cargos from ships for distribution by inland transport modes such as rail, roads, or inland waterways. At the same time, ports also receive cargoes from inland transport modes and load these cargoes onto ships. Because of the bidirectional logistics systems, ports' operations have become far more complex than the simple loading and discharging operations in the past. In addition, the need for effective information flow is growing as users are keen to know the status of their cargoes.

As in other logistics systems, port operations consist of two key flows: the physical and the information flows. The information flow relates to the interchange of operational information on cargoes, ships, and other transport modes. On the other hand, the physical flow relates to the movement of cargoes to and from the ports. Port operations are structured as a functional entity where all the activities are performed by all the parties involved together. With the development of the intermodal transport system, the port operations system is made up of three subsystems: movements from ship to land (including road and rail transport), movements from land to ship, and movements from ship to ship (including inland waterway and feeder shipping). In addition to the port operations, the container transport chain has linkages to form an international network, which has expanded to include logistics and distribution services.

Ports have been made more responsive in tailoring services to satisfy individual customers' needs characterized by more agile operations. An agile port system is an operational system capable of handling various types and numbers of containers while minimizing operation interruptions within the container terminal. It applies information technology and modifies business practices to improve efficiency and flexibility in terminal operations.

Ultimately, the efforts to improve port performance should result in increased customer satisfaction. All the departments should incorporate "to meet customer demand" as a key objective in their work and establish goals that are specific and capable of being measured. The set goals are to be realized through understanding the requirements of customers, followed by effective use of the port resources to meet those requirements. Examples of these initiatives are customizing services to meet specific customer needs, enhancing value for customers by offering flexible services, reducing order processing, and being responsive in handling customer enquiries.

Ports must also improve their service quality by giving them a way to communicate to management the difficulties they encountered in actually implementing the agile port concept. Listening to feedback from employees and initiating positive changes are important because implementation of an agile port concept might cause an increase in the daily workload of the staff.

By enhancing its performance, an agile port becomes more efficient and effective as waste and defects arising from the service provided are largely removed. This represents a reduction in operational cost and higher profitability. With more revenues, the port should be able to invest in technologically advanced systems to further improve its efficiency and customer services. It also contributes to a higher ability in delivering innovative services and capturing a larger market share from its competitors.

Finally, it is notable that shipping lines have considered securing the control of a number of terminal facilities all over the world. Other drivers for shipping lines to acquire control over terminals are the reduction in stevedoring costs and improvement in schedule reliability. Pioneer liners have already invested in container terminals such as Maersk, Evergreen and COSCO, while the world's top three shipping firms, i.e., Maersk Line, MSC, and CMA CGM, had collectively increased their global market share to 28% in 2008 in terms of TEU carrying capacity.

4.3 Current ISO

Ports, terminals and marine infrastructure have been developed to cater to the needs of a variety of ships. The function and role of the ports has evolved from earlier concept of "gateways" to "crucial interface of land-sea in the logistic supply chain". Changing role, emerging technological trends and value-migration / greater service expectation of the customers; necessitates the ports and terminals to adopt standardized systems.

Most of the ports have opted to adopt standards and obtain ISO certifications for different aspects of their operations and services.

- **ISO 9001**

ISO 9001 is the international standard defining systematic requirements for Quality Management Systems. It covers topics such as commitment to quality, customer focus, employee competence and process management. It promotes a system focused on management by processes, which develops, implements and improves the effectiveness of a quality management system based on the cycle of continuous improvement: Plan Do, Check and Act.

The adoption of a quality management system is a strategic decision for an organization that can help to improve its overall performance and provide a sound basis for sustainable development initiatives. The potential benefits to an organization of implementing a quality management system based on this International Standard are:

a) the ability to consistently provide products and services that meet customer and applicable statutory and regulatory requirements;
b) facilitating opportunities to enhance customer satisfaction;
c) addressing risks and opportunities associated with its context and objectives;
d) the ability to demonstrate conformity to specified quality management system requirements.

This International Standard can be used by internal and external parties.

It is not the intent of this International Standard to imply the need for:

- uniformity in the structure of different quality management systems;
- alignment of documentation to the clause structure of this International Standard;
- the use of the specific terminology of this International Standard within the organization.

The quality management system requirements specified in this International Standard are complementary to requirements for products and services. This International Standard employs the process approach, which incorporates the Plan-Do-Check-Act (PDCA) cycle and risk-based thinking.

Risk-based thinking enables an organization to determine the factors that could cause its processes and its quality management system to deviate from the planned results, to put in place preventive controls to minimize negative effects and to make maximum use of opportunities as they arise (see Clause A.4).

Consistently meeting requirements and addressing future needs and expectations poses a challenge for organizations in an increasingly dynamic and complex environment. To achieve this objective, the organization might find it necessary to adopt various forms of improvement in addition to correction and continual improvement, such as breakthrough change, innovation and re-organization.

This International Standard is based on the quality management principles described in ISO 9000. The descriptions include a statement of each principle, a rationale of why the principle is important for the organization, some examples of benefits associated with the principle and examples of typical actions to improve the organization's performance when applying the principle.

The quality management principles are:

- customer focus;
- leadership;
- engagement of people;
- process approach;
- improvement;
- evidence-based decision making;
- relationship management.

The focus on processes involves the systematic administrative definition of the processes and their interactions, with the objective of reaching the results anticipated in accordance with the quality policy and strategic management of the TPA.

ISO 9001 certifies integral management of Port Authority operative, technical and administrative processes for the rendering of services to stakeholders, including the coordination and control of the commercial activities and services directly related to port activity. This certification is an international recognition demonstrating to society and to companies that the available work system is consistent, reliable, in accordance with the applicable regulations and that meets the requirements of its customers, and that it is capable of adapting.

- **ISO 14001**

ISO 14001 is the international standard for Environmental Management Systems. It addresses specific environmental aspects to find a balance between maintaining profitability and reducing environmental impact.

ISO 14001:2015 specifies the requirements for an environmental management system that an organization can use to enhance its environmental performance. ISO 14001:2015 is intended for use by an organization seeking to manage its environmental responsibilities in a systematic manner that contributes to the environmental pillar of sustainability.

ISO 14001:2015 helps an organization achieve the intended outcomes of its environmental management system, which provide value for the environment, the organization itself and interested parties. Consistent with the organization's environmental policy, the intended outcomes of an environmental management system include:

- enhancement of environmental performance;
- fulfilment of compliance obligations;
- achievement of environmental objectives.

ISO 14001:2015 is applicable to any organization, regardless of size, type and nature, and applies to the environmental aspects of its activities, products and services that the organization determines it can either control or influence considering a life cycle perspective. ISO 14001:2015 does not state specific environmental performance criteria.

ISO 14001:2015 can be used in whole or in part to systematically improve environmental management. Claims of conformity to ISO 14001:2015, however, are not acceptable unless all its requirements are incorporated into an organization's environmental management system and fulfilled without exclusion.

- **ISO 45001 (replacing OHSAS 18000)**

ISO 45001 is the international standard for Occupational Health and Safety Management Systems. ISO 45001:2018 specifies requirements for an occupational health and safety (OH&S) management system, and gives guidance for its use, to enable organizations to provide safe and healthy workplaces by preventing work-related injury and ill health, as well as by proactively improving its OH&S performance.

ISO 45001:2018 is applicable to any organization that wishes to establish, implement and maintain an OH&S management system to improve occupational health and safety, eliminate hazards and minimize OH&S risks (including system deficiencies), take advantage of OH&S opportunities, and address OH&S management system nonconformities associated with its activities.

ISO 45001:2018 helps an organization to achieve the intended outcomes of its OH&S management system. Consistent with the organization's OH&S policy, the intended outcomes of an OH&S management system include:

a) continual improvement of OH&S performance;
b) fulfilment of legal requirements and other requirements;
c) achievement of OH&S objectives.

ISO 45001:2018 is applicable to any organization regardless of its size, type and activities. It is applicable to the OH&S risks under the organization's control, taking into account factors such as the context in which the organization operates and the needs and expectations of its workers and other interested parties.

ISO 45001:2018 does not state specific criteria for OH&S performance, nor is it prescriptive about the design of an OH&S management system.

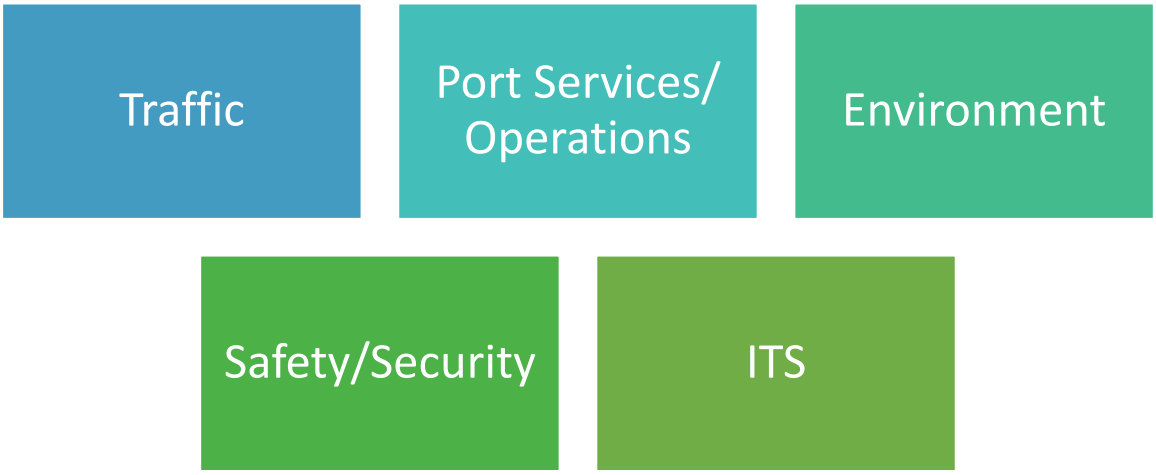
ISO 45001:2018 enables an organization, through its OH&S management system, to integrate other aspects of health and safety, such as worker wellness/wellbeing.

ISO 45001:2018 does not address issues such as product safety, property damage or environmental impacts, beyond the risks to workers and other relevant interested parties.

ISO 45001:2018 can be used in whole or in part to systematically improve occupational health and safety management. However, claims of conformity to this document are not acceptable unless all its requirements are incorporated into an organization's OH&S management system and fulfilled without exclusion.

4.4 Service reference standards – Key Performance Indicators

The Port Quality Management System introduces several tools that allow improvements in the quality of service. Among these instruments of service quality, specific service quality reference standards are used to evaluate Traffic, Port services/operations, Environmental performance, Safety/Security and ITS services.



Picture 7: The categories of the selected KPIs

These standards and Key Performance Indicators establish a level of quality that the customer can expect from ports and highlight the issues that need to be verified in order to ensure compliance with the characteristics by means of a certificate issued by a certifying body.

The following standards and Key Performance Indicators have been developed and categorised:

4.4.1 Traffic

1. Service Quality Reference Standard for bulk solid and liquid cargo traffic

Bulk cargo can be divided into two categories:

— Liquid bulk: The majority of the liquid bulk being carried is petroleum LNG (Liquefied Natural Gas) represents an emerging segment. Liquid bulk ships are commonly referred to as tankers.
— Dry Bulk: Concerns a wide variety of materials such as coal, iron ore, grains, bauxite, and sand

The Service Quality Reference Standard for bulk cargo traffic endorses the availability of equipment and facilities to handle bulk solid and liquid cargo, meeting customer's requirements in terms of time for processing cargo, reliability of the transit time, responsiveness of transport operators, adaptability of existing processes flexibility of operations, accuracy of information regarding status of shipment, compliance with legal requirements, notification of any changes in the multimodal processes, level of damage to the shipment, overall transport cost and employee interaction with customers.

2. Service Quality Reference Standard for container traffic

The Service Quality Reference Standard for container traffic establishes the quality of service characteristics, related to the services provided to containerized merchandise. It also establishes the methods, registers or indicators to use to check the compliance with the quality characteristics, the conformity assessment system and issuance of certificates, and a system of review and continuous improvement of the quality level.

The quality of service characteristics is applicable to the providers of port services, regarding the handling of goods in the ports' areas, whose activity focuses on the traffic of containers and containerized merchandise that voluntarily wish to undergo the certification.

When the provider of the port goods handling service is also the holder of a concession or authorization of a maritime terminal for containerized merchandise all the characteristics of the Reference will be applied.

3. Service Quality Reference Standard for vehicles as goods

The Service Quality Reference Standard for vehicles as goods evaluates the quality of the services provided in the case of trafficking vehicles as merchandise, taking into consideration similar quality parameters as in the case of handling cargo.

4. Service Quality Reference Standard for conventional goods in general

The Service Quality Reference Standard for conventional goods in general evaluates the quality of the services provided in the case of conventional general goods handled by the Port Authorities and uses the same quality parameters as in the case of handling cargo.

5. Service Quality Reference Standard for cruise ship traffic

The Service Quality Reference Standard for cruise ship traffic evaluates the quality of service using selected characteristics as implied by cruise vessels, and requested by international organisations for obtaining the respective certifications verifying the compliance of Ports Authorities with the conventional obligations to cruise ships in terms of waiting time for services, reliability, responsiveness, adaptability of existing processes, flexibility of operations, communication, compliance with legal requirements and costs.

4.4.2 Port services/ operations

1. Service Quality Reference Standard for piloting

To evaluate the quality of the services provided in the case of the piloting port services, the parameters that will be taken into consideration are the Resources and Equipment Management plan, availability and readiness to provide services, Cost efficiency and Customer service support. The aforementioned characteristics will provide the assessment for the Service Quality Reference Standard for piloting.

2. Service Quality Reference Standard for mooring and unmooring

The Service Quality Reference Standard for mooring and unmooring refers to the level of quality for services while berthing and unberthing. The parameters that will be taken into consideration are the Resources and Equipment Management plan, availability and readiness to provide services, Cost efficiency and Customer service support.

3. Service Quality Reference Standard for tugging

The Service Quality Reference Standard for tugging establishes the methods, standards or indicators in the case of services provided by tugboats. Compliance with the quality characteristics requires a system of review and continuous improvement of the quality conditions for tugging services. Standards assessment includes the existence of a Resources and Equipment Management plan, availability and readiness to provide services, Cost efficiency and Customer service support.

4. Service Quality Reference Standard for waste reception

The Service Quality Reference Standard for waste reception contains quality characteristics of applicable services by the providers of the port service for the reception of waste generated by ships. To undergo the necessary third-party certification to obtain a certificate for quality of service for ship generated waste reception the quality standards that must be satisfied are the existence of a Resources and Equipment Management plan, availability and readiness to provide services, Cost efficiency and Customer service support.

5. Service Quality Reference Standard for Aids to Navigation

The Service Quality Reference Standard for Aids to Navigation evaluates the level of quality of ports to provide Aid Services to Navigation. The provision of the service is evaluated based on the existence of Resources and Equipment Management plan, availability and readiness to provide services, Cost efficiency and Customer service support.

4.4.3 Environment

1. Environmental monitoring program

Monitor most emissions and effluents ensuring sanitary wastewater, contaminated drainage and stormwater discharge quality. The environmental monitoring program for this sector should be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during normal operations and upset conditions. Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analysed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken.

The system must be based on appropriate performance indicators and apply to both their EMS and the quality of the environment itself. 79% of all EcoPorts members (75) indicate that the port authority has an Environmental Monitoring Programme, and 64% respond that Environmental Performance Indicators (EPIs) have been identified and selected. The following table from the EcoPorts database shows the ranking of Monitoring Programmes

Rank	Monitoring Programme	%
1	Energy consumption	67
2	Waste	65
3	Water consumption	61
4	Water quality	58
5	Noise	55
6	Air quality	53
7	Sediment quality	52
8	Carbon footprint	48
9	Soil quality	40
10	Terrestrial habitats	36
11	Marine Ecosystems	34

Picture 8: Ranking of environmental monitoring programmes in EU ports

2. Uptake of alternative fuels for waterborne transport

Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure establishes a common framework of measures for the deployment of alternative fuels infrastructure in the EU in order to minimise dependence on oil and to mitigate the environmental impact of transport. Alternative fuels serve, at least partly, as a substitute for fossil oil sources in the energy supply to transport, contribute to its decarbonisation and enhance the environmental performance of the transport sector.

3. Energy Management System

Availability of energy management system to monitor, measure, and control energy consumption is vital for the integration of modern technologies (such as Cold Ironing, Battery swapping, Energy Vehicle charging stations etc.) in port operations. A Power Management System (PMS) is needed in order to coordinate, control and monitor all these subsystems in the terms of efficiency maximisation.

4. Waste Management System

The waste management system to manage waste from its inception to its final disposal offers not only environmental benefits for the port and the surrounding area, but it is also significant for the provision of ship generated waste disposal as part of the port's provided services and its level of quality.

Several types of waste are generated on board ships. Oily wastes, sludge, drainage from the bilges, sewage and garbage, among others, are produced, along with cargo residues during loading and unloading operations. The type and quantity of wastes generated depend on various factors such as the type and size of the ship, the duration of the journey and the speed of the ship, the type of fuel and, at last but not least, the waste management practices on board.

The EU Directive 2000/59/EC on port reception facilities for ship-generated waste and cargo residues, which aligns with the IMO Convention MARPOL 73/78 (International Convention for the Protection of Pollution from Ships, 1973, as modified by the Protocol 1978), aims to reduce pollution from the waste produced by ships.

5. Pollution Recovery System

Prevention of pollution is a very important concept in port operations. All ports should take actions to contribute to pollution reduction in port city areas. The use of processes, practices, materials or products that avoid, reduce or control pollution, which may include recycling, treatment, process changes, control mechanisms, efficient use of resources and material substitution offers a flexibility for any Port Authority to develop and apply a Pollution Recovery System to satisfy the needs of local societies and their operational profile.

4.4.4 Safety/Security

1. Occupational Health and Safety

Occupational health and safety performance should be evaluated against internationally published exposure guidelines to prevent accidents and health problems for employees and customers using port's services. The working environment should be monitored for occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professionals as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents.

2. Accident and Fatality Rates

Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. Facility rates may be benchmarked against the performance of facilities in this sector in developed countries through consultation with published sources.

3. Compliance with ISPS Code

The International Ship and Port Facility Security (ISPS) Code is an amendment to the Safety of Life at Sea (SOLAS) Convention (1974/1988) on Maritime security including minimum security arrangements for ships, ports and government agencies. Having come into force in 2004, it prescribes responsibilities to governments, shipping companies, shipboard personnel, and port/facility personnel to "detect security threats and take preventive measures against security incidents affecting ships or port facilities used in international trade".

ISPS Code is a comprehensive set of measures to enhance the security of ships and port facilities, developed in response to the perceived threats to ships and port facilities.

4.4.5 Intelligent Transport Systems (ITS) services

1. Vessel Traffic Management

Vessel Traffic Management Systems offer safe and efficient navigation in the ports, harbors and coastal areas. These systems allow managing vessel traffic flow and provide communication of vessels entering the port and port authorities. Contemporary Vessel Traffic Management systems use advanced multi-sensor tracking algorithms and secure 24/7 all-weather monitoring of the surveillance areas providing the operators with comprehensive traffic picture superimposed maritime professional navigation charts.

The Vessel Traffic Management Information System (VTMIS) is an extension of the Vessel Traffic Service (VTS), in the form of an Integrated Maritime Surveillance, which incorporates other telematics resources to allow allied services and other interested agencies in the direct sharing of VTS data or access to certain subsystems in order to increase the effectiveness of port or maritime activity operations as a whole, but that do not relate to the purpose of the VTS itself.

2. Electronic procedures/payments

The existence of electronic forms, such as the single administrative document (SAD) used for customs declarations in the EU Switzerland, Norway, Iceland, Turkey, the Republic of North Macedonia and Serbia, and the availability of electronic payment methods and electronic bill of lading, ensure secure and fast process procedures for the users of the port services.

3. Information and communications technology (ICT)

Information and Communication Technology (ICT) Systems have been a main driver of technological innovation during recent decades and now play a pivotal role in all aspects of modern life. The integration of ICT systems to port activities require a combination of technical, managerial and interdisciplinary skills.

Regarding ICT systems integrated to port operations, these systems incorporate automated identification systems, terminal operating systems, automated machine guidance, image processing systems, fleet management systems and port community systems, providing remote real time information access and exchange.

4. Electronic Data Interchange (EDI) system

Electronic Data Interchange (EDI) is the electronic interchange of information using a standardized format; a process which allows a user to send information to another user electronically rather than with paper. EDI implies a sequence of messages between two parties, either of whom may serve as originator or recipient. The formatted data representing the documents may be transmitted from originator to recipient via telecommunications or physically transported on electronic storage media.

Many port documents can be exchanged using EDI, but the two most common are purchase orders and invoices. EDI standardizes the information communicated in business documents, which makes possible a "paperless" exchange.

EDI makes it possible to minimize or even eliminate the manual steps involved in a document transfer, offering significant improvements in port operations in terms of time and money savings.

5. Cyber Security System

The availability of cyber security system for protecting transport systems, networks, and programs from digital attacks is a critical aspect for the safe operation of a Port Authority, but also for the ships using of the port’s services. An important aspect related to the cyber-security is that systems are technologically in permanent evolution requiring additional hardware and software upgrades in order to provide a fully secured solution for the port and the vessels.

Furthermore, cyber security systems are configured individually without a holistic approach to provide safe use of digital means and exchange of information between ports and vessels. Network resources (Wi-Fi, bandwidth) are not separated between individual critical systems, for ports, passengers or personnel. Thus, malicious actors can easily target remote assets on a ship or a port to gain access to the main network and compromise their systems.

Picture 9: Main challenges to achieving sustainable transport (UNECLAC)

4.5 Port Quality Management Committee in every port

The introduction of a Port Quality Management Committee will ensure the adaptation from Port Authorities to the service reference standards. The committee is the body that oversees compliance with the evidence, indicators and records arising from the application of specific quality reference standards for Port traffic and services in the period between certifications or in the phase prior to obtaining these quality certifications for the first time. Members of the Port Quality Management Committee will be:

- Interlocutors authorised in quality matters appointed by the respective companies, in accordance with that envisaged in the respective Reference Standards.
- Representatives of the Port Authority, of the managements/departments involved in the reference standards.

Using a Port Quality Management Committee to improve quality of the provided services will be assigned with the task of positively influencing the strategic success of the port with the help of the aforementioned instruments. The Port Quality Management Committee will be charged with the task to regularly review and assess policies, strategies and port processes, securing the operational quality of the port in accordance with the standards described.

4.6 Measuring Methods

The following Table presents the Measuring Methods of the selected Quality Indicators used to evaluate Traffic, Port services/operations, Environmental performance, Safety/Security and ITS services of Ports.

QUALITY INDICATOR	MEASURING METHOD
TRAFFIC	
Bulk Solid And Liquid Cargo Traffic	Certification
Container Traffic	Certification
Vehicles As Goods	Certification
Conventional Goods In General	Certification
Cruise Ship Traffic	Certification
OPERATIONS/SERVICES	
Piloting	Certification
Mooring And Unmooring	Certification
Tugging	Certification
Waste Reception	Certification
Aids To Navigation	Certification
ENVIRONMENT	
Environmental Monitoring Program	Report
Uptake Of Alternative Fuels For Waterborne Transport	Certification
Energy Management System	Certification
Waste Management System	Certification
Pollution Recovery System	Certification
SAFETY/SECURITY	
Occupational Health And Safety	Certification
Accident And Fatality Rates	Report
Compliance With ISPS Code	Certification
ITS SERVICES	
Vessel Traffic Management System	Technical Specifications of the System
Electronic Procedures/Payments	Means of payments/ e-forms
Information And Communications Technology (ICT)	Certification
Electronic Data Interchange (EDI) System	Certification
Cyber Security System	Technical Specifications of the System

Table 1: Quality Indicators & Measuring Methods

4.7 Measuring Range

The following Table presents the Measuring Units and Value Range of the selected Quality Indicators used to evaluate Traffic, Port services/operations, Environmental performance, Safety/Security and ITS services of Ports.

QUALITY INDICATOR	MEASUREMENT UNIT	VALUE RANGE
TRAFFIC		
Bulk Solid And Liquid Cargo Traffic	Level of service quality	Advanced, Good, Satisfactory, Limited, Poor
Container Traffic	Level of service quality	Advanced, Good, Satisfactory, Limited, Poor
Vehicles As Goods	Level of service quality	Advanced, Good, Satisfactory, Limited, Poor
Conventional Goods In General	Level of service quality	Advanced, Good, Satisfactory, Limited, Poor
Cruise Ship Traffic	Level of service quality	Advanced, Good, Satisfactory, Limited, Poor
OPERATIONS/SERVICES		
Piloting	Level of service quality	Advanced, Good, Satisfactory, Limited, Poor
Mooring And Unmooring	Level of service quality	Advanced, Good, Satisfactory, Limited, Poor
Tugging	Level of service quality	Advanced, Good, Satisfactory, Limited, Poor
Waste Reception	Level of service quality	Advanced, Good, Satisfactory, Limited, Poor
Aids To Navigation	Level of service quality	Advanced, Good, Satisfactory, Limited, Poor
ENVIRONMENT		
Environmental Monitoring Program	Availability	Yes, No, Under Development
Uptake Of Alternative Fuels For Waterborne Transport	Availability	Yes, No, Under Development
Energy Management System	Availability	Yes, No, Under Development
Waste Management System	Availability	Yes, No, Under Development
Pollution Recovery System	Availability	Yes, No, Under Development
SAFETY/SECURITY		
Occupational Health And Safety	Compliance with National and International regulations	Advanced, Good, Satisfactory, Limited, Poor

Accident And Fatality Rates	Number	0≤
Compliance With ISPS Code	Compliance ISPS code	Yes, No, Under Development
ITS SERVICES		
Vessel Traffic Management System	Availability	Yes, No, Under Development
Electronic Procedures/Payments	Availability	Yes, No, Under Development
Information And Communications Technology (ICT)	Availability	Yes, No, Under Development
Electronic Data Interchange (EDI) System	Availability	Yes, No, Under Development
Cyber Security System	Availability	Yes, No, Under Development

Table 2: Quality Indicators, Measuring Units & Value Range

4.8 Reporting Period

The following Table presents the preferable Reporting Period of the selected Quality Indicators used to evaluate Traffic, Port services/operations, Environmental performance, Safety/Security and ITS services of Ports.

QUALITY INDICATOR	REPORTING PERIOD
TRAFFIC	
Bulk Solid And Liquid Cargo Traffic	Year
Container Traffic	Year
Vehicles As Goods	Year
Conventional Goods In General	Year
Cruise Ship Traffic	Year
OPERATIONS/SERVICES	
Piloting	Year
Mooring And Unmooring	Year
Tugging	Year
Waste Reception	Year
Aids To Navigation	Year
ENVIRONMENT	
Environmental Monitoring Program	6 months

Uptake Of Alternative Fuels For Waterborne Transport	Year
Energy Management System	Year
Waste Management System	Year
Pollution Recovery System	6 months
SAFETY/SECURITY	
Occupational Health And Safety	Year
Accident And Fatality Rates	Year
Compliance With ISPS Code	Year
ITS SERVICES	
Vessel Traffic Management System	Year
Electronic Procedures/Payments	_
Information And Communications Technology (ICT)	Year
Electronic Data Interchange (EDI) System	Year
Cyber Security System	Year

Table 3: Quality Indicators & Reporting Period

4.9 Key Actions for improving quality levels

The following Table presents the suggested Improvement Actions of the selected Quality Indicators used to evaluate Traffic, Port services/operations, Environmental performance, Safety/Security and ITS services of Ports.

QUALITY INDICATOR	IMPROVEMENT ACTIONS
TRAFFIC	
Bulk Solid And Liquid Cargo Traffic	Improve volume capacity and safety measures
Container Traffic	Upgrade of facilities and reduce handling time and/or cost
Vehicles As Goods	Reduce handling time and/or cost
Conventional Goods In General	Improve volume capacity and handling time and/or cost
Cruise Ship Traffic	Improve waiting time for services, reliability and responsiveness
OPERATIONS/SERVICES	
Piloting	Improve Resources and upgrade Management plan
Mooring And Unmooring	Improve availability and readiness to provide services
Tugging	Improve Resources availability and readiness to provide services
Waste Reception	Improve availability and readiness to provide services, cost efficiency and customer service support
Aids To Navigation	Improve volume capacity and safety measures
ENVIRONMENT	
Environmental Monitoring Program	Upgrade monitoring systems and monitored port operations
Uptake Of Alternative Fuels For Waterborne Transport	Provide alternative fuel solutions to vehicles and local residents
Energy Management System	Integration of modern technologies
Waste Management System	Improve management plan and volume capacity
Pollution Recovery System	Add processes, practices and products that avoid, reduce or control pollution
SAFETY/SECURITY	
Occupational Health And Safety	Address health and safety issues relevant to port operations primarily including physical hazards, chemical hazards, confined spaces, exposure to organic and inorganic dust and exposure to noise.
Accident And Fatality Rates	Reduce the number of accidents to a rate of zero, especially accidents that could result in lost work time, disabilities, or fatalities
Compliance With ISPS Code	Enhance the security level of the Port

ITS SERVICES	
Vessel Traffic Management System	Upgrade of the VTMS
Electronic Procedures/Payments	Adoption of additional electronic procedures and payment means
Information And Communications Technology (ICT)	Integrate additional port operations to the ICT system
Electronic Data Interchange (EDI) System	Upgrade of the EDI system
Cyber Security System	Continuously upgrade of the Cyber Security System

Table 4: Quality Indicators & Improvement Actions

5. Transport Performance Tool

The development of a Port Quality Management System is most commonly recommended by researchers of supply chain in order to evaluate the quality of port services, focusing on customers' needs, processes effectiveness, information and technology services, coordination and level of human resources. Quality dimensions will help stakeholders in supply chains manage major flows including material, finances and information smoothly, seamlessly, and with minimal costs and errors.

Today, the quality of products and services is of strategic importance to not only Port Authorities but also to the national economy. Quality of service is a key component especially to a Port's ability to compete effectively, remain profitable and survive in a competitive environment. Technological advancements in the maritime sector and port operations have increased competition and globalization trends have been accelerated in ports, driving the necessity of adopting the changing conditions in the port service market.

Ports as important actors of maritime cargo transportation are directly affected by the changes of international service trade, flexibility of supply and demand for services and also changes in customer expectations. In such a competitive atmosphere, ports have to cope with competitive forces such as costs, service quality, customer demands and expectations to maintain their existence. In this regard, the port authorities must face new challenges, originated from the changes in the port environment, in shipping, in port management and in port user's requirements.

Customer satisfaction and service quality measurement is necessary for modern Port Authorities. While the strategic importance of quality is widely acknowledged by maritime stakeholders, there is not a common approach defining the quality assessment and its associated dimensions.

The improvement of provided services is a profitable strategy for Port Authorities resulting satisfied customers, additional business opportunities, advantages against competition and upgraded performance.

The main dimensions by which the service quality is defined have been indicated to be:

- reliability – consistency of the performances, no errors, no delay
- accessibility – readiness to provide service by employees
- competence – knowledge and ability of the contact personnel
- access – accessibility and simplicity in contacts
- courtesy – decency, companionship, gentleness, respectability
- communicability – informing and listening to customers
- credibility (support) – trustworthiness, honesty
- safeness – absence of danger and risk
- understanding the user's needs
- appearance – the service user's perception of the service, equipment and
- Human resources

The implementation of a successful Port Quality Management System will provide the tools to improve the provided services and in addition it will offer the possibility for:

- The development of comprehensive quality plans and procedures
- Regularly reviewing and assessing of policies, strategies, processes
- Time and cost losses in all processes
- Tracking and fixing root causes and quality problems
- A comprehensive goal-setting process for quality
- Identify strength and weakness

- Using reports from internal and external audits for quality improvement
- Effective policy on safety
- Effective policy on security
- Effective policy on environmental management
- The obligation of making a contribution to the public interest
- Social responsibility to the regional community
- Exceeding customer and stakeholder expectations
- More value added services to customers
- Using customer complaints and feedback for quality purpose
- Employee's participation in quality decision making
- Maximising employee's skill, knowledge and expertise
- Enhancing cooperation among employees in the supply chain

A performance tool is qualified as the key component for the quality of services and will especially enhance a Port's ability to compete effectively and increase profitability.

6. Conclusion

In this study, service quality dimensions of port operations were investigated. The main aim of the research is to determine fundamental service quality dimensions of Port authorities. In other words, it was investigated which port service reference standards and performance indicators are important and can be seen as a competitive advantage for ports implementing a Port Quality Management System.

The main components of the transport system, with respect to Port operations, have been described, namely modes of transport, infrastructure, network, transport flows and the interconnection of transport components. Furthermore, the key factors and priorities of the Motorways of the Sea (MoS) concept have been identified and analysed to present the overall framework of the European Union's transport policy regarding port operations.

Lastly, the Port Quality Management System developed under the project has been presented in respect to key port operations, customers' needs and expectations and the current ISO standards applied to Port Authorities. The service reference standards are described along with their measuring methods, measuring range, period of verification/certification and the key actions to improve the quality levels of performance. The utility of a Port Quality Management Committee is also stressed in this report.

Most of the studies available have determined service quality of port operations to be affected by five factors including responsiveness, assurance, reliability, tangibles and empathy, while technological advancements appear to enhance service quality which ultimately satisfies customers in the port services industry.

When the new trends and technologies of the global transport system is considered, ports as an important actor of maritime cargo transportation, are obliged to meet their customers' requirements with all sorts of modern facilities and services in order to retain a competitive advantage. In such a competitive environment ports have to cope with competitive forces such as costs, service quality, customer demands and expectations to maintain their existence. Service quality standards are used as a competitive advantage tool to meet the expectations of the port users in the international transport network.

The Port Quality Management System will positively influence customer satisfaction, in which the outcomes of port service performance has the greatest impact. In addition, items relating to social and environmental responsibility have been taken into consideration.

Findings from the application of service reference standards will enhance port Authorities' understanding on areas of quality performance to improve and meet or even exceed their customers' satisfaction. The impact of service quality on customer satisfaction in the port sector is under research in various studies around the world, taking into consideration local specific features and port characteristics. The development of a service quality performance tool applied globally is of high interest in both qualitative and quantitative methods.

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