# Characterization of the Portuguese SSS into the Europe: A Contribution

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**Abstract.** Nowadays, Short Sea Shipping (SSS) is an essential part in European multi-modal transport system, representing approximately thirty-seven per cent of intra-Community transactions in tonnes per kilometre (tkm). Since 2001, the European Shortsea Network (ESN) in partnership with the short-sea Promotion Centres (SPC) of each Member State of the European Union (EU) have managed to make significant progress in the promotion and development of this mode of transport.

This paper aims to assess and analyse the SSS of containerised goods in Portugal and its articulation with other EU routes and also other transport modes. The current SSS infrastructure, how the sector is organized, as well as the future perspectives for the sector are also analysed for the case of Portugal.

The analyses are based on a survey that was carried out on the logistics operators, navigation agents, freight forwarders, and the leading imports and exports manufacturers in Portugal.

**Keywords:** Sort Sea Shipping (SSS) · Intermodal transport · Containerized freight · Survey

## 1 Introduction

Freight transport is a vital component in any economy. It is an economic indicator on the contribution to the economic growth of each country or region. Transport networks facilitate good and people movement, being considered essential to the competitiveness and growth of the economies. As such, efficient transport networks generate savings for businesses, making the production and distribution more efficient and generating economies of scale. The recent trends at the global level, combined with the efficiency of transport networks, enabled the decentralization of production methods and leaded to a significant growth of freight transport flows, both at domestic and international levels. However, this growth raised several problems, mainly due to road mode increase, such as air pollution, road accidents, road congestion and the


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corresponding energy consumption, and social problems [3]. Also the concept of mobility drives the world economy. The mobility of people and goods allowed the massification of the transport sector. Distances became shorter than ever, new forms of business transactions and business strategies were developed changing the way companies are managed, and new services based on the transport sector were developed, thus creating numerous opportunities and challenges, leading to globalisation. In this way, the issues of mobility and, more specifically, sustainable mobility, became the main focus of the concerns relating to the fulfilment of the goals of the strategy Europe 2020 programme launched by the European Commission [1]:

- Reduction in at least 20% of the emissions of greenhouse gases;
- Increase in the use of 20% energy from renewable sources;
- Increase in energy efficiency 20%.

The concept of Short Sea Shipping (SSS) aroused in the beginning of last decade of last century, and its definition is not consensual among the various authors [4]. For Denisis [3] and Lombardo [15], the definition given by the U.S. Maritime Administration (MARAD) is considered the most consensual: the SSS is a means of transport of goods by waterway that does not exceed the limits of the ocean where navigates and uses the shorelines and channels for the carriage of goods. Yonge and Henesey [21] define the SSS as freight for distances considered short or to nearby coastal ports. Paixão et al. [23] define the SSS as containing certain criteria such as the type of ship, the markets in question, the logistical needs and the services offered. According to English et al. [6], SSS is based on commercial transportation of goods or passengers by national and international shipping, being a subsector of shipping which operates in coastal and inland waterways and that does not cross any ocean, competing often with road and rail networks. Musso et al. [21] proposed four criteria to define SSS:

- Geographic criteria, based on the size of the route;
- Supply criteria, based on the type and size of vessels or belonging to a longer path;
- Commercial criteria, in which it competes with land transport, distinguishing between feeder traffic, intraregional traffic and the nature of the load to be carried;
- Legal criteria.

In European Union (EU), SSS means the movement of goods and passengers by sea between ports situated in EU Member States (EU-28), or between these and non-European ports at the coast lines in the seas surrounding Europe: cases of the Baltic, Black Sea and the Mediterranean. It includes both shipping national and international transport feeder services and transport between islands, rivers and lakes [1].

The SSS sector is responsible for about 5% of European GDP, contributing to employ approximately 10 million people. The existence of efficient transport systems is essential for European companies to compete in the global economy. Many European companies operating in the transport sector are world leaders in traffic management systems, logistics, infrastructure and manufacture of transport equipment [5].

The SSS has become one of the priorities of EU transport policy, with the objective of reducing the use of road transport. The SSS has been seen as the only mode of

transport able to compete with road transport, minimizing the problems referred to, since it offers sustainable and value-added services (e.g. door-to-door) at competitive cost when compared with road transport. Since 2001, the European Commission (EC) has been trying to increase the use of the SSS through its use-friendly policies and funding programs to expansion of the SSS, in order to provide the desired services. Several EU countries have been transposing and implementing EU legislation and directives, aiming to exploiting the economic benefits offered by the SSS. United Kingdom, Italy and Netherlands are the best examples of countries that offer SSS services able to compete with road transport. These countries have in common the direct access to the sea, and long coastlines (except Netherlands). It is relevant that a country like Netherlands, with a coastline quite smaller when compared to most other European countries with coastline, is the country that uses sea transport that includes Deep Sea Shipping-DSS. The Netherlands is in fact a candidate to SSS leadership in Europe. In 2013, it ranked third in SSS cargo transportation, reaching 15% of all cargo via SSS in EU-28, following the United Kingdom (17.6% of the total cargo) and Italy (15.6%). Portugal represented only 2% of SSS [7].

The success of the SSS in one country cannot be merely measured by the coastline length and direct access to the sea. In order to conclude that there is a well-organised sea transport service in any country, other criteria/aspects have to be factored in. The SSS concept is much more complicated and its success depends on various other factors and variables that will be discussed throughout this paper.

SSS is an essential part in EU multi-modal transport system representing approximately 37% of intra-community transactions in tonnes per kilometre (tkm). Since 2001, the European Shortsea Network (ESN) in partnership with the short-sea Promotion Centres (SPC) of each Member State of the European Union (EU) have managed to make significant progress in the promotion and development of this mode of transport.

In Portugal, more than one-third of the primary energy is absorbed by the transport sector. It is argued that sustainable mobility is the way to reduce its energy intensity in order to promote competitiveness, as well as reduce the costs associated with moving from domestic to external markets of consumption. Once the transport and logistics sector represent high costs for companies, it becomes clear that the focus should be on using more efficient transport modes and integrated intelligent transport networks, as a means to enhance the competitiveness of these companies, capturing the attention of economic agents and investment.

This paper is organized as follows. Section 2 describes the SSS evolution and characterization. Section 3 describes the survey methodology used in this research. Section 4 reports and discusses the results of the survey. Finally, Section 5 summarizes the main conclusions and some suggestions for further work.

## 2 SSS Evolution and Characterization: A Literature Review

The SSS challenge is to be a low-cost component in the handling of cargo in intermodal and integrated transportation system. Medda and Trujillo [20] intended to assess what are the determining factors for the success of the SSS and its development.

The authors found that the use of alternative transport modes to road transport would only be significant if there was a clear benefit for the carrier in terms of cost, time, or both. In this way, these authors stated that the SSS would only be an alternative if the advantages for its use were familiar and since the SSS was able to adapt to the needs of demand of transport services, offering the same services door-to-door road transport offers, whereas only in this way the SSS would be a real and competitive alternative to road transport [20]. This concept attracted much attention in the EU over the last decade. Unfortunately, not all intentions and promises have yet to be met and the desired modal transfer, road-sea, is not held, despite the strong will and financial programmes implemented by the EU.

According to Perakis and Denisis [25] and López-Navarro et al. [16], the main motivation of the EU for the SSS promotion and its expansion was due to other environmental benefits that the SSS could offer when compared with the other modes of freight transport, mainly road transport. Due to high external costs of this mode of transport, the EU has supported firmly the SSS through various funding programmes that lead to modal shift from road transport to shipping. López-Navarro et al. [16] consider that, although it is desirable that the SSS constitutes an alternative to road transport, both modes of transport can be complementary, as long as EU policies to achieve sustainable mobility align accordingly.

Denisis [3] states that the road freight can and should be a partner and complementary mode to the SSS. Road mode would be a long distance partner, rather than competitor, leading thus to a higher growth of SSS operations. The SSS for long distances is more competitive due to efficiency in terms of fuel utilization and economy of scale. Port authorities, taking advantage of the SSS, began rerouting container cargo to smaller ports and satellites and increased their storage capacity, aiming to improve the efficiency of their terminals [3].

Perakis and Denisis [25] conclude that the trends in the logistics sector, in particular the decentralization of production and logistics services procurement logistics operators, would benefit even more the SSS. In fact, modern logistics has become an integral part of the production process, due to the needs of industry in adopting just-in-time production and fast transportation services, resulting in reduced inventory costs. These needs could be met only by door-to-door services for transport goods [3]. In general, industrial companies are not enabled to own and operate these transportation services with effectiveness and/or efficiently. For being effective and efficient, reliable and secure, these transportation services requires a combination of road transport with the SSS. For the intermodal transfer be done successfully, ports must offer efficient services in order to facilitate the transfer and the coordination of the goods by the various modes of transport. There are needs in terms of communication and exchange of information between the modes, since the routes and timetables must be synchronized between the parties. A quick and efficient transfer of goods from one mode to the other is crucial to the success of the SSS, as well as for the sustainability of freight transport [25].

López-Navarro et al. [16] refer that the SSS has success if it is developed and geared towards inter-modality, by encouraging cooperation between the shipping agents and freight transport companies. However, these authors believe that these

companies have the difficult choice of deciding which mode of transport to be used, since the use of SSS, for road haulage transport companies, implies a radical adjustment to their traditional way of operating. Good performances and corresponding success of SSS is only possible by means of long-term partnerships and cooperation. The two modes should not compete among themselves, as it is the case in most cases, but rather cooperate to multimodal transport chains [16].

Paixão at al. [23] explore the reasons why SSS operators continue to concentrate on the problems detected by various EU documentation concerning transport and SSS, proving not to be the solution required for the transfer of road traffic to the SSS. The authors conclude that, despite the huge effort of EU for the desired transfer of freight transport from road to sea mode, SSS is still short of the expectations generated by the EU and continues with plenty of delay with regard to the use of road transport. One of the reasons cited for this, according to the authors, is the fact that maritime operators of SSS have been specializing in port-to-port services, instead of door-to-door services, as do operators of road transportation. Another reason cited by the authors is the lousy marketing management, giving rise to a bad image about SSS service. This is seen as a disadvantage when compared with road transport. All these reasons eventually result in low investment in the promotion of SSS who perceive these short-term results to be due to the uncertainty of this market [23]. The empirical research conducted by the authors identified eight factors in which the SSS service could create a robust strategy and, what are the necessary attributes to integrate the SSS within a more competitive multimodal logistics chains. According to Paixão et al. [23] these factors are: cost, reliability and quality of service; guarantee of service; corporate image; investment policy; involvement in the industry; logistics network design and speed; post-market; and existence of policies for managing operational and commercial relations with freight agents.

García-Menéndez and Feo-Valero [9] found out that the determining factors for modal choice (truck with full charge or a freight container ship) used in Spain, when the goal was to carry cargo (motor vehicles, agricultural and ceramic products, and appliances) to the rest of Europe. Their findings reveal that variables such as the accessibility of ports, the distance travelled by land, the INCOTERM used, the value of the load, the amount of cargo transported and the type of company are important in the choice of transport mode. These as well as cost and time variables, are the main factors [20]. In contrast, Koi Yu Ng [14] found out that the competitiveness of the SSS was not affected by other factors but monetary and time related costs.

In order to achieve greater equality in modal shifts, the SSS is currently an important mode of transport in the European transport planning. However, despite all the attention and promotion given by the EU to the SSS, some issues have been raised regarding the real capacity of the SSS to compete with road transport, because it is necessary to overcome considerable obstacles, be satisfactorily efficient and cohesive across the multimodal chain [14].

In order to compete with road transport, the maritime highways began to be promoted by the EU latter in the last century. However, according to Gouvernal et al. [10], other factors represented a decisive role in the success or failure of maritime highways. Their success depends on the maritime distance to be travelled,

the road transport costs, the costs necessary for the promotion of SSS and competition with road transport, transported volumes, the places where are held between transfer modes, as well as regulatory issues relating to the rest of the truck drivers represent an important role for sustainable maritime highways viability [10]. Despite having the potential to be an alternative way to the road mode, the SSS mode has challenges that prevent a greater use, since most ports do not have the necessary capacity for intermodal SSS operations. A greater integration of the SSS in the supply chain requires some important progress in the logistics sector [20].

As described, the development of conventional SSS still faces a set of problems, limiting this mode of transport to be an efficient alternative to road transport in terms of delivery cost and time.

The SSS presents benefits and constrains. Denisis [3] refers the benefits of SSS:

- Improving energy efficiency in the countries;
- Reduction of air pollution;
- Reduction of congestion on the roads;
- Reduction of road accidents;
- Reduction of noise caused by road traffic of trucks;
- Infrastructure costs lower than construction and maintenance of roads;
- Increase the capacity of the transport networks;
- Increased productivity of ports;
- Possibility for companies to be socially responsible.

Medda and Trujillo [20] identified the following constrains:

- Unfavourable image, in the sense that it is considered an antiquated mode of transport;
- Low frequency;
- Low reliability, due to non-fulfilment of departure and arrival;
- Quality and safety, since there is an increased risk of damage to the goods transported;
- Complicated transport logistics, being required their integration into door-to-door service;
- Documentary and administrative complex procedures;
- Need for efficient ports, port services and connections to the hinterland.

## 3 Survey Methodology

The methodology used in this research includes a literature review on the characteristics of the SSS transport sector, primary data collected from a survey (enquiry), and secondary information gathered from official statistics of EU-28 and Portugal (in particular).

The survey has been focussed on the Portuguese SSS characterization. The enquiry comprised the following main questions:

- (Q1) – What are the most important factors influencing modal choice for freight?
- (Q2) – In particular, what are the most important factors to choose SSS mode, and what are the main factors/attributes of a sea port that guarantee the success of SSS?
- (Q3) – What are the most important factors to promote a better integration between SSS and other modes?

The questionnaire is divided into three sessions: (1) enterprise and respondent characterization, logistics and sea partners; (2) Portuguese SSS characterization (used ports for import/entrances, for exports and for transhipment of Portuguese trade), transport mode selection, type of cargo traded, cargo unit used, transport modes used, main factors considered important to each mode, mode service assessment, used ports; and (3) reasons to use SSS and intermodal modes, and factors that are important to promote a better integration of SSS and intermodal mode.

The Q1 main question is based on the criteria extracted from the work of Pereira et al. [27], which factors are cost, lead time, transit time, service level, frequency, reliability, flexibility and environmental impact.

Main questions Q2 and Q3 were built on previous works [e.g., 19, 20, 23, 24, 27].

The answers to qualitative nature questions of the survey used a 1-5 Likert scale (1-less important to 5- extremely important).

*Data Collection and Sample*

The analysis of the survey population and the definition of the survey data collection strategy were based on the 2013-2014 Ports and Shipping Directory [29] and other online sites [e.g., 26], and the SABI database [30]. The survey was developed in *Google Docs* and an email list was built from [26, 29, 30], composed by all 50 listed sea shipping operators (SSO), all the 55 logistics operators (LO), all 171 forwarders, all 267 transporters and other related companies operating in Portugal. The email list was completed, from [30], by adding 494 major exports/imports manufacturing companies (preferred contact: logistics head responsible of each company). The population was composed by around a thousand (987) companies operating in Portugal. Due the population is stratified, the sample size should be slightly above 100 in order to achieve 95% confidence level and a margin of error not higher than 9%.

The survey was both distributed at the participants of the "ShortSea14- European Conference" realized in 12-13 of May in Lisbon and send by e-mail, at the same period. The e-mail was resubmitted twice to non-respondents at begin of June and middle of September. At the end, 106 valid responses had been obtained (147 emails were returned with an error or changed address alert; 71 companies have referred not used the SSS mode; 32 companies have informed that do not respond due reasons of security or confidentiality of business data; the remaining do not reply at all).

Statistical analyses were performed by the SPPS software tool pack, version 21. Descriptive statistical analyses were used for quantitative nature data. For the qualitative data, main questions Q2 and Q3, with eight and twelve variables respectively, it was used the Components Analysis (CA) and Factors Analysis (FA). MacCallum et al. [18] recommend a minimum sample size of 100 responses and Guadagnoli and Velicer [12] refer a minimum of 100 to 200 observations, which is

also recommended by several authors [e.g., 12]. MacCallum et al. [17] define that, as a rule, for the sample size a ratio of valid responses per existing variables should be greater than 5 (in this case, it was greater than 8).

CA and FA are exploratory multivariate analysis techniques that turns a set of correlated variables into a smaller set of independent variables, linear combinations of the original variables, known as components and factors. After performing the Varimax matrix rotation, the CA becomes FA. Both of these techniques are usually seen as a data reduction methods but, beyond this goal, one of the main advantages of each one is that they allow to reduce the information of multiple correlated variables into one or more independent linear combinations (components or factors), representing most of the information present in the original variables [19, 28].

## 4 Survey Results and Discussion

### 4.1 EU and Portuguese Context

Portugal has 7 freight sea ports: Sines, Setúbal, Lisbon, Figueira da Foz, Aveiro, Leixões and Viana. The ports of Sines, Leixões and Lisbon are, by this order, the main container ports, followed by Setúbal port. The port of Viana has a very small expression in the Portuguese sea freight, except for bulk cargo. According to the Portuguese Office of Mobility and Transports (IMTT) [31], regarding the type of cargo, container cargo concerned 76.7% and the fractional cargo 22.3% of total freight, reflecting the high level of containerisation that Portuguese ports move. The movement of containers by the Portuguese ports, in 2013, was approximately 2.2 million TEUs, corresponding to an increase in its drive to 25.8%. Concerning container cargo, in 2013, Sines port represented 42.5 %, Lisbon port represented 24%, and Leixões port represented 28.6%. These ports accounted for 96% of the total TEUs handled by Portuguese ports, in 2013.

According to Eurostat [7], EU-28 SSS represented, in 2013, 1.75 billion tonnes, represented around 60% of all sea transported cargo [7]. Considering the EU-28 SSS total amount in that year, United Kingdom accounted for 17.6%, Italy 15.6%, Netherlands 15%, Spain 10.8%, as the countries that accounted for more than 10% of the total amount; Portugal represented 2.25% only [7]. The main European users of the SSS are Netherlands, United Kingdom, Spain, Italy, Turkey and Germany. The main European SSS ports are Rotterdam, Antwerp and Hamburg. The main cargo transported corresponds to solid bulk cargo.

The SSS in Portuguese ports reached a total of 78.8 million in 2013 and, of these, 66 million tonnes moved into international transactions [32]. The ports reached 26.8 million tons that had international destination. The represented a growth of 29% for 2012, continuing the recovery observed since 2010 (15.2% in 2010, 14.4% in 2011 and 13.3% in 2012). The most significant growth was recorded in the port of Sines, growing 27.8%, followed by the port of Aveiro, Figueira da Foz and Setúbal, with growth rates of 20.2%, and 15.7% 19.7%, respectively. In the ports of Lisbon and Leixões, the growth was below the double digits, with 8.6% and 3.4%, respectively. Only the port of Viana do Castelo has a loss, when compared with the same period of the previous year, registering -1.3% [31, 32].

### 4.2 Survey Results

The sample is composed by 106 valid responses to the enquire (10.1% of the population): 27% are manufacturing companies, 25% are SSO, 16% are transport operators, 15% are forwarders and 14% are logistic operators (others: 3%); adjusted to the strata of the population in percentage, being the SSO 20% higher.

Respondents are administrators or CEOs (22.6%), logistics head chiefs (18.9%), 9.4% owners (9.4%), logistics department collaborators (9.4%), operation management head chiefs (8.5%), sales head chiefs (7.5%), marketing head chiefs (3.8%).

About 65% of the respondents has a business volume higher than 5 million euros per year, about 13% between 2.5 and 5 million euros, 5% between 1 and 2.5 million, and the remaining has less than a million. Concerning the number of employees, 18.5% referred less than 25, 19.8% between 26 and 50, and 62.3% more than 50. Concerning the companies' location, 34% of the companies are located in great Lisbon, 32.2% in great Porto, 7.5% in the north and 24.5% in the centre of Portugal. More than 70% of the companies are located in the hinterland of the ports in the north region of Portugal (e.g. Leixões) and in the centre-south (e.g. Sines specialized in petroleum products and container cargo; Lisbon and Setúbal ports, both specialized in container cargo). About 25% of respondent companies are located in the hinterland of the ports of Aveiro, specialized bulk cargo, near Porto at 75 km, and Leixões, specialized in container cargo, Ro-Ro and bulk cargo. The Leixões and Lisbon ports are the most used (for about 70% of the companies).

Concerning the freight responsibility, 31% of the companies enquired uses third part logistics for the cargo transport. Approximately 31% companies appealed, in 2013, the services of transport undertakings for the carriage of their goods, 23.6% used its own fleet for freight, 7.5% used a logistics operator, 3.8% used navigation agents and 8.5% referring that the question is not applicable.

Concerning the type of cargo transported in 2013, 33% of the companies referred that operates machines and vehicles while, 30% operates metallurgical products, 30% operate as payload type, textiles and garment, foodstuffs and fodder, 5.7% operates auto parts.

The main Portuguese SSS partners of enquired companies are Spain, Netherlands, United Kingdom and France, in accordance with governmental statistics. The main types of cargo are the liquid and solid bulk and container cargo of 20, 40 and 45-feet.

*Question 1 – What are the most important factors influencing modal choice for freight?*

Concerning Q1 – transport mode used: 23.6% of enquired companies use the road mode in more than 80% of the cases, 20.8% between 50%-80% of the cases, 20.8% between 20%-50% of the cases, 18.9% less than 20% of the cases and 13.2% do not use the road mode. Concerning rail mode, 66% of enquired companies do not use this mode, 23.6% referred the rail mode usage in less than 20% of the cases, only 1.9% has referred to use rail mode in more than 80% of the cases. Considering SSS, 10.4% of enquired companies use the SSS mode in more than 80% of the cases, 6.6% between 50%-80% of the cases, 18.9% between 20%-50% of the cases, 28.3% in less

than 20% of the cases and 25.5% do not use this mode. The companies that reported having used the SSS during the year of 2013 for the carriage of goods, at least 84% of these companies, used the road mode as complementary transport. It should be noted that about 7% of the companies that used the SSS, used another mode.

Around 70% of the enquired companies uses the Leixões, Lisbon, Setúbal, Sines ports. The main ports used by undertakings, for incoming and outgoing goods by order of importance, are: Leixões, Lisbon, Setúbal, Sines, Aveiro, and the Spanish Vigo, Algeciras and Barcelona ports. The port of Leixões is the main port used for the movement of goods to be used by about 85% of the Portuguese companies, followed by Lisbon (about 50% of the companies surveyed) and Sines is the third most used port to be referenced by 36% companies. Refer that two Spanish ports are used for the entry and exit of goods: Algeciras by 14% companies and Barcelona by 10%. The main ports used by undertakings, for the transhipping entrance of goods, are in this order of importance, Rotterdam (61%), Algeciras (42%), Antwerp (28%), Barcelona (26%) and Hamburg (18%), confirming the statistical characterization performed the main ports of the SSS, with the presence of 3 European ports identified in the Top-20 of the European ports in the year 2013 (except Barcelona). For incoming and outgoing goods, Germany, Benelux, Spain, France, United Kingdom, are European countries with whom Portugal has the largest commercial transactions, confirming, statistics pertaining to 2013 year. According to the results and, as expect, the road transport is the most widely used mode of transport, in year 2013, with 84% companies surveyed have referred to this mode for goods receipt and 74% for goods exited. In contrast, the transport mode less used is rail transport (approximately 20% companies). SSS is the second most widely used mode for freight by enquired Portuguese companies. At least 70% companies uses this mode for sending goods, while for the goods receipt, its use down to 55%. Access to the inland port is mainly outland, effected by road transport. Intermodal mode of transport presents a low use by Portuguese companies in the cargo movement. About 40% uses this mode for goods exit and 21% uses for the goods receipt. Concerning intermodal transport, the most commonly used modes are the combination of road transport with rail and road with the SSS.

Concerning the SSS mode choice, relatively to other transport mode, by the enquired companies, 38.7% have referred that they choose SSS mode for the environmental impact, 35.8% by the cost, 22.6% by the service level, 17.9% by the intermodal integration, 17.9% by reliability, 17% by the frequency, 13.2% by the transit time and 13.2% by the service availability. Despite Road mode 60% by the frequency, 58.5% by the service availability, 50% referred the by transit time, 42.5% by the service level, 41.5% by reliability, 37.7% by the cost, 31.1% by the intermodal integration, and 6.6% for the environmental impact. Intermodal and rail mode as very low values, less than 5.7% and 15.1%, the higher values, both in the intermodal and rail modes by the environmental impact, the other are less than 2.8%.

*Question Q2 – In particular, what are the most important factors to choose SSS mode, and what are the main factors/attributes of a sea port that guarantee the success of SSS?*

The main factors referred were:

- Road/train mode accessibility
- Inter-modal infrastructures
- Port operations availability
- Effectiveness of the pier
- Consortia with ship-owners
- Lower port costs.

The three main factors referred as the most important in a sea port to guarantee the SSS success were: 76.6% referred the port operation available (76.6%), the road/train mode accessibility (75.5%), intermodal infrastructures (50.0%), 36.8% has referred the effectiveness of the Pier, 14.2% the consortia with ship-owners and the others with less than 6%.

Concerning the Q2 second part - the important factors to use SSS as freight transport, we used CA to extract them because, as referred in the session 4, the sample size is considered statistically acceptable. As explained in Session 3, the 8 variables presented in this question, were extracted from previews work from [27], reduced to the eight referred variables as important: environmental impact, Cost, Service level, Intermodal integration, Reliability, Frequency, Transit time and Service availability, we use the FA of CA. Normality Kolmogorov-Smirnov and Shapiro-Wilk tests has been used with a significance level of 5%, considered as normal distributions all eight variables, not requiring any issued any transformation on data obtained. The Bartlett's sphericity test provided a result very significant ($\chi 2 \approx 588.421$; df28), featuring a p-value less than 0.001, value by which we reject null hypothesis, concluding that all the variables are significantly correlated. The results obtained have granted legitimacy to the use of the CA method, showed that the matrix contains a significant correlations between the eight variables. We have a 0.86 Kaiser-Meyer-Olkin measure (KMO) that is considered good between 0.8-0.9 values [28]. Factors with eigenvalue greater than 1 were retained, as well as one factor that cumulatively explained a 64.399% variance in the original data. The rotation was not possible due the variance values. The correlation between Reliability, Flexibility, transit time and frequency are the ones that have correlation with the largest single factor retained with a value exceeding 0.8. Thus the main factor in the choice of the SSS as mode of transport is its reliability.

*Question Q3 – What are the most important factors to promote a better integration between SSS and other modes?*

These 1-5 Likert questions were composed by twelve factors:

- Ports and terminals with logistical services privatized;
- Appropriate land access;
- Reduction of tariffs applied to SSS;
- Creation of new infrastructures; Ro-Ro services;
- Frequency of service;
- Cargo track and tracing;

- Providing door-to-door delivery services;
- Entry into new markets;
- Provision of new services;
- Logistics strategic inventory management (just in time, quick response, lean);
- Less bureaucracy.

As Q3 are qualitative nature, we also use FA of CA to analyse the. Normality Kolmogorov-Smirnov and Shapiro-Wilk tests has been used with a significance level of 5%, considered as normal distributions all twelve variables, not requiring any issued any transformation on data obtained. The Bartlett's sphericity test provided a result very significant ($\chi 2 \approx 596.256$; df66), featuring a p-value less than 0.001, value by which we reject null hypothesis, concluding that all the variables are significantly correlated. The results obtained have granted legitimacy to the use of the CA method, showed that the matrix contains a significant correlations between the twelve variables. We have a 0.849 KMO value, which, as referred is considered good. The measures of Adequacy of sample (MAS) in the anti-image matrix are between 0.8-0.9, showed that all variables should be considered in the AC. The commonalities analysis showed that all variables have a strong correlation with the extracted factors, since the percentage of common variance of variables extracted factors is greater than 50% for all variables, explaining at least 54.4% of the total variance. Factors with eigenvalue greater than 1 are detained, were detained three factors that cumulatively explain variance 67.175% of the original data. While the total variance explained by three factors (67.175%) does not vary with the rotation, the same happens with the variance explained for each factor. The first factor, Provision of new services, explains the variance 44.828%, the second factor, Ports and terminals with logistical services privatized, explains 13.587% and the third, reduction of the tariffs applied to SSS, explains 8.760%. Cumulatively, those explain the 67.175% variability of the twelve original variables.

## 5 Conclusions

The survey suggest that the success of the SSS may be possible if it is integrated into the intermodal transport and logistics chain. The SSS offers plenty of advantages, however, also presents drawbacks. SSS offers many benefits as it allows withdraw trucks from the roads, thus reducing congestion on the roads, causing fewer traffic accidents and contributing to improving air quality. The SSS allows lower infrastructure costs than the construction and maintenance of highways, increasing the productivity of the seaports, mainly the secondary ports, offering also the possibility for companies to become socially responsible. The disadvantages of the SSS are: it offers low frequency of the services and low completion of hourly windows (unlike road transport). The complexity of service integration into the logistics chain, the bureaucracy and the need for the existence of efficient ports with connections to the hinterland are other disadvantages.

Despite having the potential to be an alternative way to road mode, SSS has challenges that prevent its greater usage, since most maritime networks do not have the

necessary intermodal capacity for this, except in specialized ports in this kind of services. To combat this problem, the maritime highways and investment in modern and efficient port platforms play a preponderant role to the EU panorama of SSS. The perspectives of the SSS service are thus quite promising, in that the many advantages outweigh the obstacles to their growth, offering enough benefits for the transport sector to national economies, society and environment.

Most companies surveyed are located in the hinterland of these ports the main Portuguese ports: Leixões, Lisbon, Sines and Setúbal, reflecting the general geographical location of the entire population (of companies).

The survey has leaded to conclude that road freight transport is selected because it offers fast services, low cost for short and medium distances, high frequency, high capacity for various types of cargo, door-to-door services, high flexibility and mobility, as well fast cargo loading and unloading, despite its high polluting rate per ton-km. SSS and rail are basically selected by the most socially responsible companies.

The three main factors referred as the most important in a sea port to guarantee the SSS success are the port operation available, the road/train mode accessibility and the intermodal infrastructures.

A better integration of SSS with other transport modes will require the development of new services, the privatization of ports and logistics terminals services, as well as the reduction of SSS rates.

Future research may extend the analyses herein presented to other EU countries, contributing to the findings for EU policy-making concerning the promotion of SSS. Optimization and simulation techniques can be used in order to confirm that the success of SSS can be achieved with an appropriated integration of intermodal transport into leader companies' logistics chains. This may be accomplished by optimizing or simulating intermodal supply chains with different scenarios and under competition with different transportation modes.

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