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The port of Sines:

contribution for the emergence of a regional cluster

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ABSTRACT

The design of what is outlined in this paper is not confined to study the port of Sines in a logic of pure port management, not even only as the decomposed observation of flows originated by the so-called industrial complex, since until now, the economic history was charged of such anatomical structural analysis. What is called for is beyond the mere circumstances prevailing or the sum of the parts and aims to look Sines in a multidimensional way as an open system, characterized by how parts are organized and how together they can contribute to economic revitalization, sustainable development and social cohesion of a considerable portion of the national territory. In other words, we assume the possibility of the occurrence of a regional cluster supported on the global networks of the maritime chain.

Keywords: Sines; maritime chain; logistic gateway; maritime clusters.

JEL R1

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EXECUTIVE SUMMARY

Four major outcomes as drivers in the export sector breakdown of our economy for the last (lost) ten years, were identified: i) the euro as national currency caused an appreciation of the exchange rate and the correspondent loss of competitiveness; ii) the euro effect has raised the unitary costs of work; iii) weak added value incorporation to products and services and, iv) emphasis given to non-tradable sectors of the economy. Plus, with the WTO entry of China and other emerging and EU accession in 2004 of Eastern Europe countries, where labor costs are lower than the national average, trade imbalances have worsened. Accordingly, and facing the current state of the economy, it is of paramount importance to look at the export sector as subject of the greater attention, as a way to reduce the external deficit and debt, in order to promote for increasingly competitive and innovative companies to arise.

Such design necessarily involves identifying **which** (companies), **how to** (achieve this goal) and **where** (to locate them). This is part of the contribution this paper proposes to discuss about Sines as a cluster consisting of firms able to incorporate high-tradable value. Now that re-emerges in the economic analysis, the importance of the economy of the sea and the demand for new export markets, the maritime component of the economy appears as an inevitability and as a challenge to the adoption of a policy, for an industry that presents itself as strategic. In this sense, Sines is configured as a key asset in the context of the national economy due to the process of globalization.

The economic future and further development of Sines region, is actually connected to the dynamics of the port which must produce centrifugal forces that encourages, through **ripple effect**, the benefits beyond the natural boundary contradicting the level of disconnection that can exist, especially in a region where the coastline continues to be the main interface zone. Access to the interior will be certainly improved, implying that most of the economic activities will be located further inland and not, as has conventionally been the case, in the vicinity of its terminals. With the increase of the port influence on the regional socio-economic fabric, the next announced phase will be the **regionalization** of the port hinterland, a process that describes the enlargement of a seaport activity in the hinterland. According to this model (Notteboom and Rodrigue, 2005), the regional port activity expands through the adoption of various strategies, linking it more strongly to logistics centers for distribution in the inland, which increases the geographic scale of port activity beyond the boundaries of the port.

This new condition and new role gives to port a higher dimension in geostrategic terms which requires talking about port infrastructure, the supply chain and associated transport modes. Sines it is therefore included in the scope of the geostrategic economic areas and global networks of **maritime chain** analysis, understanding by that the sea, the port and the logistics markets.

With the widening of **the Panama Canal** and facing a possible increase in trans-Atlantic shipping routes by this waterway, it should be anticipated which are the

potential in terms of attracting cargo flows to the port, without turning Sines into a mere intermediary transshipment hub.

A **regional cluster supported on the economy of the sea** as defined by the EC, "is devoted to the development of marine economy through innovation and approach between research, training and industry. Accompanying research projects, promote SME access to new markets and is thus fully inscribed in the objectives of the Lisbon strategy - which attaches great importance to innovation policies".

Innovation is a necessity in the maritime domain (as well as national) and provides the embryonic ability for the gestation of a regional cluster of this nature, giving special attention to the shipbuilding and logistics, energy and exploitation of marine biological resources, including the bet on renewable energy produced by currents, waves and tides, the development of new medicines from marine biodiversity, risk prevention, security, monitoring and combating the effects of climate change and to developing sustainable tourism that integrates the shoreline protection. We should look at projects of the same order of strategic importance raised in Finland, where skills that arises across industrial area of nanotechnology to the technology of paper production, through research in artificial intelligence and in to alternative energies are developed.

Following this programmatic line, Sines should be seen as both a **geostrategic platform**, with regard to the direct action of port authority on the power delegated by the national government and as a **geo-economic asset**, according to the overall national policy.

INTRODUCTION

The content of this paper is described as it follows: **Section 1** presents a comprehensive overview on the port of Sines as a national strategic asset. Analyzes the sea-land interface macrostructure and set out some crucial principles to the survival in the war that exists in terms of cargo attraction: competitiveness and centrality. This section is also dedicated to study the importance of port performance measured in terms of efficiency (productivity) and effectiveness (loyalty, or customer driven). In this context, there is the concern to raise its performance for the effective management control and the consequent strategic reorientation in order to increase competitiveness;

Section 2 casts a glance at Sines as a logistic platform (logistics gateway) and multiplier effects on the regional socio-economic fabric. Thus, to railroad freight should be attributed a fundamental core importance in the context of the supply chain continuity. It is in this context that an analysis about the urgent adoption of the European gauge and the direct rail link to the region of Madrid is conducted, so to not convert Sines as a mere branch line connection to Spain. Therefore interconnectivity outweighs, something that constitutes the "backbone" of the regionalization process of port activity and the sole way to gain market share at land;

Section 3 is devoted to quantitative studies. In this aspect were performed two analyzes: the degree of specialization / diversification by calculating an index and its relationship in terms of asymmetries - Gini coefficient applied to disaggregated cargo volumes in the main Iberian ports - which is an attempt to assess the current level of dependence of Sines over the peninsular port system. A second, which regards the development of cargo handling in the last ten years through the Location Coefficient, in order to understand trends in convergence / divergence of Sines compared with four ports: the port range B-B; Barcelona, Valencia, Algeciras and Bilbao, with which it requires greater peninsular inter-port competition, as an indicator of the extent of the overall port performance;

In Section 4, the potential of Sines as the outbreak of a regional cluster supported by the maritime chain emerges, framed in a setting designed in the 2030 prospective horizon, set in the context of global trends in maritime trade, on a basis of the demand scenarios for transport and energy produced by iTREN-2030, and the OECD macroeconomic forecasts for the same period: Moderate Recovery Scenario, although these scenarios have been formulated with post economic crisis assumptions;

At last, in **Section 5**, we proceed to present the final conclusions that synthesize the results obtained in all analyzes performed along the different sections and which will be exhibited in the form of a final report.

1. The port of Sines: past, present and future

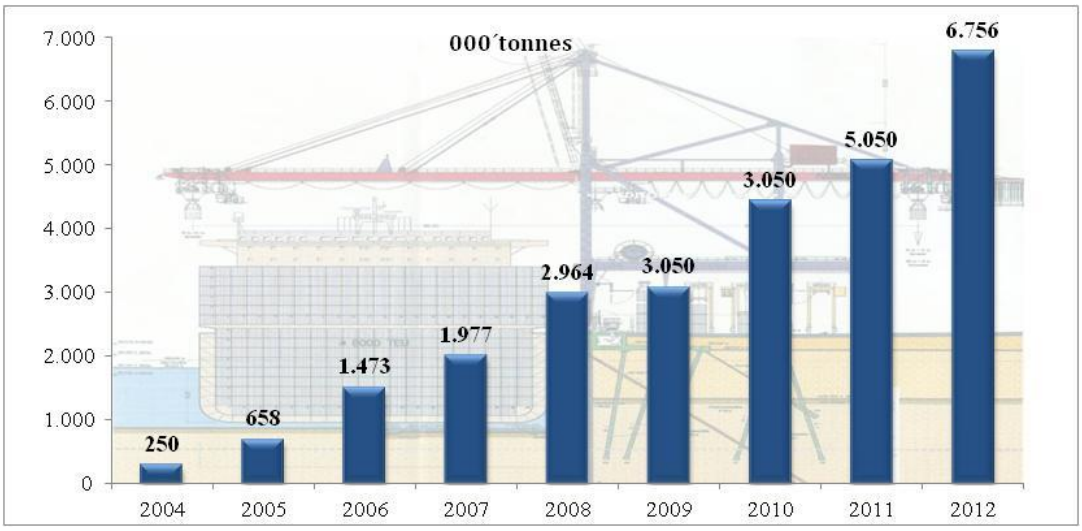
Past

In 1971 the option to build a large new refinery in the south of the country was taken, in a deepwater site with special conditions to receive large oil tankers, to make feasible re-exportations of refined petroleum products. This project would make country´s refining capacity increases, with which it would lay the foundation of a diversified petrochemical industry. It was a project that was intended to be built and equipped with appropriate facilities and equipment in order to attract the installation of other industrial activities. The underlying vision was "**concentrationist**", based in the principles of the best land use and supported in the harmonious and balanced progress of all regions. Sines represents an attempt to create a pole of development which susceptibility would lead to mitigate the strong attraction exerted by cities as Lisbon and Oporto and counteract the generator effects leading to diseconomies that these regions, already congested at the time, began to show. However, Sines effectively represented a situation of local industrialization without promoting regional development of the south neither for the Alentejo region. The effects of its presence were felt only in the coastal strip, providing economic indicators surprisingly a-consentaneous with the reality of the interior: it is a region with a GDP per capita or either a GDP per person employed even above Lisbon´s region average. What these indicators translate into welfare and economic development is what we advocate to reply in a regional dimension.

Present

Until recently, Sines, in the strict sense, assumed the role of an industrial complex and at the same time was synonymous of a port whose energetic vocation allowed to be considered as a strategic asset, though far from truly contributing to the decrease of cyclical dependency that characterizes Portuguese economy. A new configuration, which started in 2003 with the commitment of the containerized segment, came to give a new life and allow it to have been released from the extreme dependency as petrochemical port, creating new business opportunities through cargo diversification (Figure 1). In the short term, a new nature as a port open to different markets can drive, through the participation of **new actors** into the creation of industrial and logistics hubs along the distribution chain - *action* - to which the effects of a dynamic port spreads to hinterland - *reaction* - reformatting Sines in a privileged axis at the crossroads of maritime routes.

Figure 1: Container throughput in the port of Sines (2004-2012)



Source: Own elaboration (from APS statistics).

The **Port of Sines Authority** (APS) manages the infrastructure and space delivering the operation and maintenance of terminals to private concession - the superstructure. This scheme, called *Landlord port* in the jargon of international port management, reveals a structural framework that, as Ng and Pallis (2010) point to the case of Greek ports, involves the ownership and government intervention: the concept of public good is prevalent and public ports are undirected controlled by States (through *board of directors*), in contrast to British ports, (tended private), or northern European, administered by joint city council (*board of advisors*), in the Hanseatic model tradition.

The **Landlord port model** presents the utmost trend towards adoption (Tovar, Trujillo and Jara-Díaz, 2004; Verhoeven, 2009). In the case of Sines, property assumes the public nature and the activities of loading and unloading at its terminals, delivered to

private operators. However, even working within this specific legal framework, APS performs functions simultaneously as Landlord port, as a regulator and as operator. As a Landlord port, manages the assets under its jurisdiction. It refers in particular to the provision of infrastructure such as docks and mooring jetties or dredging. As a regulator, the APS sets the regulatory framework in terms of tariffs, customs and security procedures. As operator, provides daily supplies to ships – towage and bunkering as well as salvage if needed.

The most valuable asset of a port, for its intrinsic value and scarcity, is **land**. In the Landord model, the land is owned by a public body or the Port Authority itself, while the management of superstructures is delivered to private sector, giving the result that the focus of competitive strategy has moved from the port itself to its terminals. In Sines, the container terminal is operated by PSA, a specialized global player in the market of global container terminals, which fixed the prices for services performed. The determining factor behind the choice of concessioning these activities was the reduction of the bureaucracy and the application of labor flexibility and entrepreneurship (Ng and Pallis, 2010), because the port authorities typically have poor levels of performance in managing these structures, (The World Bank, 2007), for reasons of public financial effort reduction (Tovar, Trujillo and Jara-Díaz, 2004) and the change of corporate culture (Verhoeven, 2011), although economic theory cannot unequivocally prove these assumptions (Tonnegzon and Heng, 2005).

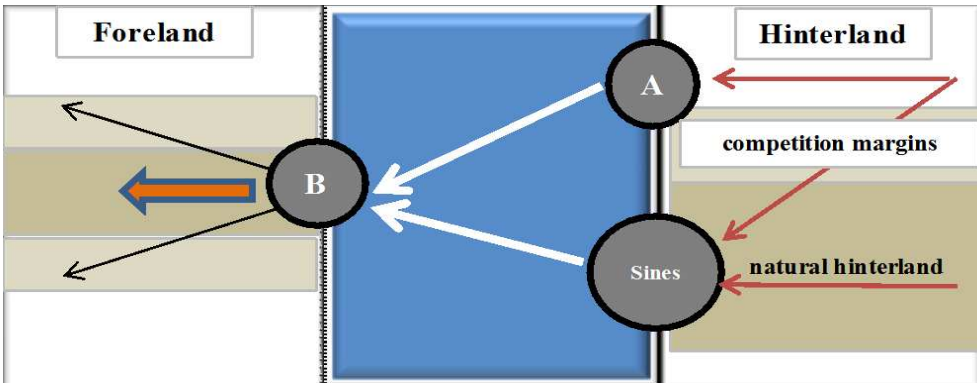
As an entity dependent on the authority of the Ministry of Economy, major programmatic lines are issued by this governing body. Thus it is interesting to unveil what it proposes to implement in terms of port related policies. **The Strategic Transport Master-Plan 2011-2015** (PET) approved in October 2011, highlights the importance now attributed to the sea, hence emphasizing its status as a natural border and as a resource throughout our EEZ, and indeed the only sector of the economy to which is assigned an investment effort for years to come (PET: 70). Under this Plan, the port and maritime sector plays a key role for the development of the country; exports by sea should be therefore improved and strengthen the country's competitiveness in this sector.

The Maritime Chain and port macrostructure

The four main functional elements that define a sea-land interface are: foreland, hinterland, modes of transport and port system. The first, foreland, is above all the maritime space in which a port trades and can be identified with the point of origin of the maritime networks (*maritime chain*). Networks represent all maritime movements, port logistics and distribution. The second, hinterland, it is the space within a port has trade relations. This can be divided into primary hinterland - the geographical space of the market for which a terminal is the closest - and competitive hinterland, used to describe the market areas over which the terminal has to compete with others for business. The notion of primary hinterland with well defined limits has dimmed because many hinterland became discontinuous, a process facilitated by the development of

corridors and inland terminals (Rodrigue, Comtois and Slack, 2006). Yet, competitive hinterland tends to be discontinuous due the density of the source or destination of loads be smaller, the effect of the accessibility of transport corridors and inland terminals (Figure 2).

Figure 2: Sines and the maritime chain (outbound flow).



Source: Adapted from Rodrigue, Comtois e Slack, 2006.

Each mode of transport is structured as a corridor that provides access to the hinterland and the inland logistics platforms (inland hubs) which act as intermodal and transmodal centers. As to the latter concept, the port system in this case can be seen as a set of intermodal infrastructure serving the port operations.

Future

The expansion of the Panama Canal, with a direct link from the Pacific to Atlantic for **larger ships**, with the consequent efficiencies of scale, may lead to an increased flow of trade between the Pacific basin, both coasts of North America, the Mercosur and Europe. Sines emerge as an Atlantic front in this battle as it wants to capture part of this traffic. The question that arises is if whether its geostrategic position and capabilities will allow, and how, to achieve this goal.

Contrary to what has been anticipated for the ports of the North American coasts and the Caribbean transshipment triangle, studies made by PCA (Panama Canal Authority), do not focus on the growth trends in cargo volume in the Asia-Europe route but on America-Europe-Asia and the Americas. With regard to ports of Europe, it is assumed the continuity of main traffic via Suez which presents the shortest path between Asia and Europe (-2100 km, approximately). The effects of enlargement will be dependent on several conditions, including **growth trends** in the world economy (which contributes to, the higher or lower degree of trade protectionism adopted by each country), the **price of fossil fuels** (bunker prices) and the amount of **fees** to be applied

per TEU transiting the Canal[1]. The first condition has a higher grade on the other (direct effects on trade volume), the second acts on shipping costs (which may involve the choice of land routes such as the Trans-Siberian as an alternative) and the third, more dependent at the willingness of investors, can erode the gains achieved by ship-owners in the option Panama over Suez and to its attractiveness.

In the case of Sines seen as a hub port, the constraints are not limited only to the variables listed above. The ports are not chosen by chance, several factors are contributing to this. Ducruet and Notteboom (2010) points out eleven factors affecting the inter-port competitiveness, Tongzon (2005) suggests eight while Vitsounis (2009) points nine and Zondag (2008) cites seven. If some of these factors are endogenous and result from the effort that port authorities should proceed within the major national policy options, yet others are exogenous in nature and as such, not subject to be controlled. One fact is certain: the lack of these qualities can reverse the ability of Sines in attracting traffic flows that will be absorbed by competitors and lead inevitably to a neutral result in what is expected from the new trans-Atlantic potential routes.

Service lines, ports choice and the concept of centrality

Cullinane and Wong (2012) state that: *"the position of a particular port within the network port hierarchy relies upon the number of significant flows connected to the port and the origins/destinations of those flows"*. In fact, the main lines of container traffic around the world include in their scales, some 10 to 15 ports considered the most important (Rudel and Taylor, 2000), the global maritime network is strongly polarized in a few major ports (Ducruet and Notteboom, 2010). Ports are not chosen by chance or apparent advantages that the observer, careless or unaware of the global shipping network, can perhaps assign. Ducruet and Notteboom (2012) state that *"the choice of a port is a function of the costs and performance of global network"*, a definition that refers to the analysis of both costs and port performance. Lines determine the ports to scale based on partnerships and logistics networks they integrate, giving ship-owners obviously preferences to ports where they operate their own terminals. Given the incursion of these agents in logistics activities on land, their role in the selection of ports has become even more prevalent than previously (Brooks and Pallis, 2008). This means that the ports today have less power in their relationships with customers (Brooks, Schellinck and Pallis, 2011: 17). According to Wilsmeier and Notteboom (2009), the configuration of the maritime service lines are not just the result of exogenous factors related to the development of trade and the dispersal of economic activity in the hinterland; the endogenous factors related to the local environment of the port, access to the hinterland, the strategies of market players and **government policies** have a clear impact on how regions are connected. The public investment made in basic infrastructure and interconnectivity of the hinterland throw a key card in allowing fast, efficient and reliable land connections.

[1]http://www.porttechnology.org/technical_papers/the_panama_canal_expansion_business_as_usual_or_game_changer

About **distance**, the physical measure in which lies the concept of centrality - *"proximity to markets of origin / destination"* - (Ducruet and Notteboom, 2012), contrary to popular belief, is not the criterion that has more weight in the choice of ports or to trace routes. The reliability and overall quality of services (passing by the interconnectivity between modes and the speed and efficiency of operations) have a higher weight (Rudel and Taylor, 2000: 6). These two constraints are overcomed primarily through vertical integration of operations at ground on its own compliance or through the formation of strategic alliances.

The centrality one attributes to Sines results of the **geographic position** at the crossroads of several east-west shipping routes (or equatorial), north-south and diagonal. The Strait of Gibraltar is a strategic waypoint of the global beltway which would certainly be an advantage for the location of Sines, if the investment in containerized cargo had been carried out decade and a half before. For this metamorphosis have passed several Mediterranean ports where the lack of technological adaptation was transformed into competitive advantages for the major northern ports, which do not despise the opportunity to increase their dominance. This scenario however suffered major changes and several ports along the main route gathered great benefits of its restructuring. This new role allowed some ports to transform quickly into new hubs dedicated to transshipment, by coastal feeder and inland railroad, having consecutively won market share in container market and rekindled the theme of the best option for flows inside the European continent. Saying so, Sines have not only lost the "boom" growth signed out in this segment as it allowed settling near two major intermediate hubs; Algeciras and Tanger Med. Thus, service lines evidently opted for these ports and created the conditions for the possession of all or part of operational resources, *soît*, the terminals.

The choice of ports and their importance and centrality no longer obeys the equation where the service line (the ship-owner) chose the port and the cargo (the shipper), chose the service line. *"This competition no longer has the character of a struggle between ship-owners and ports to one that involves supply chains"* (Meersman, Van der Voorde and Vanelslander, 2002), or, between the supply chains that connect the source to the destination.

From the above it can be inferred that the ports will be chosen because of the overall weight of players and conditioned by vested interests. This leads us to the issue of competition within and between ports.

Inter-port competition, transshipment, hubs and gateways

Even if these conditions are not insurmountable, it is not sufficient to collect and redistribute cargo. This activity (**transshipment**), even when significant, interacts little with the hinterland (Rodrigue, 2011: 15) and does not add value to the goods. It is essentially attractive in financial terms for terminal operators´ and to Port Authority's, reason why all container ports try to uptake this type of activity. However, are flows that are in need of multiplier effect in regional terms. The transshipment is the maritime

equivalent of the wholesale activity on land; serves the continuity of the supply chain enabling the delivery of goods to distributors or final customers. The transshipment activity is not bound to a specific port, but to markets, as opposed to a gateway that is connected to the distribution of goods within. The incidence of transshipment is the portion of the total income of the port that is transferred from ship to ship, implying that the final destination of the container is another port. The larger, more a port can be considered as a transshipment center and an incidence above 75% puts the port as a "pure" transshipment hub (Rodrigue, 2011) wich, in theory, does not have hinterland but yes a vast foreland (Rodrigue, Comtois and Slack, 2009). A pure transshipment hub is more unstable with respect to a gateway port: as the volume of traffic to the gateway ports are sufficient, the hubs will no longer be scaled and may even become redundant, although several authors state that in many cases the differences between hubs and gateways have been blurred (Ducruet and Notteboom, 2010; Notteboom, 2012). This means that the scale of throughputs together with logistics networks and transport infrastructure can convert a racking port into a port of distribution of goods, if conditions arise.

But, for Sines, not even the mere transshipment activity is guaranteed once the competition is close and strong. Hubs that compete directly with Sines are mainly located along the **southern coast of Spain**, were one can identify especially the port of Algeciras. Maersk, the reference worldwide shipping company calls Algeciras not only because of the comparative conditions this port has, but because Maersk operates its own dedicated terminal container.

Other important ports as Huelva (mostly grain), A Coruña (small and shallow) and Gijón (main peninsular ore dedicated port) are not seen as immediate "threats" to the direct capture of cargo from the port of Sines, albeit there has been some new activity in the port of **El Ferrol**, which seems to be an attempt to anticipate the (expected) effects with the widening of the Panama Canal? Whatever the underlying strategy, it is nonetheless impressive the fact that they have expressly relocated several gantry cranes transported by ship from the port of Algeciras.

Furthermore, there is a new hub in North Africa, **Tanger-Med**, which offers very low deviations and arises as a direct competitor to Sines in the attraction of traffic and cargo. It is a port built from scratch to become a pure "low cost" transshipment hub and competes through tariffs, which are based on low labor costs prevailing in the country, among others, such as tax breaks and financial incentives to firms to settle. In strategic terms, Tanger can be seen as a platform granting access to the European continent for cheap goods produced in North Africa, serving the Mediterranean ports as gateways. Very concretely, this port can arise as a direct competitor due to the presence of MSC and PSA, in which port they operate. PSA we had talked already, about MSC it is simply the main service liner operating in Sines.

Competitiveness and new flows of commerce

This study is focused on the port range B-B (Barcelona-Bilbao), with which it admits greater Iberian competition. It was proceeded to collect available documents on the websites of the respective ports and also from various sources. The proposed conceptual model led to the drafting of a preliminary matrix (Table 1), which can constitute as a **sieve** and initial starting point for more detailed analysis in terms of competitive strengths and weaknesses.

Table 1. Inter-port competition factors. Preliminary matrix of *port range* B-B.

	Geograph.		Efficiency		Rail connections		Main Hinterland		Depth		Service Lines		Financial Performance (2010)		Degree of Congestion		
Unit of measure	Distance to Panama (km in straight line)	Rating	Terminal productivity (see append. 1)	Rating	Rail distance to Madrid (Km)	Rating	Number of consummers (millions)	Rating	Meters ZH (Container Terminal)	Rating	(Regular SL excluding short-sea)	Rating	Net revenues by tonne (Euros)	Rating	Land availability; Bad (3), Week (4) & Good (5)	Rating	
Weight (%)	*20*		*15*		*12*		*12*		*10*		*10*		*8*		*6*		Total
Algeciras	8.143	4	33%	4	756	2	c. 8 million (Andaluzia)	5	16	3	63	5	0,49	4	Mau	3	3,54
Barcelona	8.804	1	-13%	3	665	3	c. 7,5 million (Cataluña)	4	16	3	55	4	0,72 (2009)*	5	Fraco	4	2,83
Bilbao	8.385	3	-74%	1	579(a)/441(b)	4	c. 3 million (Basque C.)	2	21	5	20	2	0,41	3	Fraco	4	2,65
Sines	7.850	5	-44%	2	1063(c) / 867(d) / 921(e)	1	c. 2 million (Districts of Setúbal, Beja, Évora & Faro)	1	17,5	4	8	1	0,24	1	Bom	5	2,42
Valência	8.593	2	82%	5	464	5	c. 4,7 million (Comunidad Valenciana)	3	14	2	39	3	0,33	2	Mau	3	2,95

a) Via Medina-Valladolid-Burgos-Miranda: full electrification
b) Via Aranda-Burgos (without electrification between Madrid-Colmenar-Burgos)
c) Via Ermidas-Poceirão-Setil-Entroncamento-Abrantes-Torre das Vagens-Elvas-Badajoz-Ciudad Real-Manzanares
d) Via Ermidas-Poceirão-Setil-Entroncamento-Abrantes-Torre das Vargens-Valencia de Alcantara-Caceres
e) Via Ermidas-Poceirão-Casa Branca-Évora and new line to be built towards Badajoz-Ciudad Real-Manzanares, with no use of the line Lisboa-Porto, and with full electrification
(Approximated distances and not counting the acesses to terminal (Madrid-Abroñigal, Coslada-Vicalvaro, Barcelona-Morrot, etc.)
* It refers to 2009. The year 2010 was not used as indicator once it presents an exceptional operacional revenue of 41,7M€ due to financial accounts out from the normal activity.

The final score Sines collects is bleak. From factors liable to be incremented highlights the upgrading on rail links, the extension of the area of the strategic competitive hinterland influence and financial performance criteria as targets of continuous improvement. Certainly the choice of other factors could influence the final result (the parameter choice for business or residential environment could assign a higher score to Sines, for example), or even changes in the weights exert changes in classifications.

Similarly, knowing that liners give greater importance to reliability and quality of service than to location, maybe we have been too generous in assigning such a weight to this factor. Above all, this analysis is intended to carry out a narrowing of the criteria that influence the choice for cargo concentration ports; others could also rightly be used. The identification and selection of a particular port are at the end, decision from major international ship-owners, which determine whether a given port operations are feasible and profitable, but the decision to invest in infrastructure to provide adequate service of rail connections to the hinterland, for example, no longer depends on them, and it is a paradox, since it is an extremely important factor which weighs in the decision of choice. However, the presence of infrastructure does not **necessarily guarantee** traffic since the service lines can select ports were they provide services as changes arose in business opportunities (Rodrigue, Comtois and Slack, 2009).

Financial efficiency as a net revenue per tonne in Sines, has the worst record among the major Iberian ports, which is proof that the movement of bulk presents lower results per tonne than the unitized cargo, with higher value, although these financial indicator do not demonstrate the performance of the port but that of the PA (De Langen, Nijdam and Van der Horst, 2007: 24). The indicators on which underpin the competitiveness criteria are subjective in nature, because the international comparison is difficult to accomplish, due to lack of standardization and the different collection methods. This analysis was used essentially as a **proxy** for the port choice by shipping companies. The main function of the indicators should not be to serve exclusively as institutional information, or as a method of comparison between ports, but rather to assume that the potential benefits of the port passes for both users and consumers (De Langen, Nijdam and Van der Horst, 2007: 32).

Intra-port competition; different agents

The growing pressure of competition happens also at intra-port level. Sines like other ports faces economic uncertainty and financial volatility in the coming years, at a time the economic growth of Western countries deteriorates. In fact, due to the great uncertainty, each of the participating players will try to pre-empt others through strategic moves which will have a crucial impact on the **decision-making variables**, such as costs, prices, supply and demand. Several forces act within this circle and are not free of conflict of interests.

Shippers (cargo owners or/and freight forwarders), intend to get the best shipping prices. Fewer services do incur in more expensive freights due to defect of competition. The **logistics operators** wish to obtain the maximum benefit between costs and revenues and capture market share from competitors. Their instruments of power are rates, capacity, flexibility and speed of delivery. As instruments of that power they have the pricing, the technology used and the value added service. From the **terminal operator's** side, we saw the introduction of fixed capacity of unloading at terminals and even a policy of prices reducing. The **ports** also intend the maximization of profit. Additionally may want to minimize costs through the supply chain, or to maximize the

volume of cargo handled. Their negotiating tools are the price charged, maritime access to the port and concessions policy.

In conclusion, each actor within the activities inside and outside the port perimeters has its own agenda and tools in order to accomplish strategic objectives. However, most ports ultimately depend on the behavior of its largest and most influential customers: **ship-owners**. The main objectives of those are minimizing the overall costs. For this feature they have instruments such as the bargaining power, which ultimately depend on their size. The danger of dependency to a shipping company lies in the potential for relocation, which in the case of Sines would be disastrous. As the penalties for relocation are relatively mild, service lines tend to change their ports of call with relative ease.

Efficiency, productivity and reliability

The efficiency of a port system is a critical factor for the efficiency of the countries by they own (Tongzon and Heng, 2005) and is mentioned by several authors as being the main factor for choosing a port (Aronietis, et al, 2010), the reason which there was the concern for attribute the second place in the criteria constraints of port competitiveness. The concept of **efficiency**, while distinct, is closely related to the concept of productivity, largely because of the idea that port performance (as any company), improves as more efficient and productive is (Serrano and Trujillo, 2006). As a factor of competitiveness, efficiency can be measured in terms of financial performance. According to Goss (1990: 211): *"any improvement in the economic efficiency of a seaport will enhance economic welfare by increasing the producers' surplus for the originators of the goods being exported and consumers' surplus for the final consumers of the goods being imported"*. For many ports increased cargo handled, and thus the productivity of the terminals, has become a challenge to face, especially for ports that receive large container ships, which, due of slow steaming, put great pressure on port operations in terms of response times to fulfill (ship turnaround times). The longer a ship remains moored more expensive will be the final price to be paid, which lead us to the issue of productivity.

Productivity, or operational efficiency, is measured by the maximization of the equipment and, *ceteris paribus*, the inability of a port may give rise to congestion and delays and this can be mitigated by the introduction of better equipment such as semi-automated cranes. Other operational efficiency measures dealing with capital and labor, are absent from this study because it is considered that, even imperfect, productivity analysis of a port based on the total cargo volume continues to be the simplest to perform and the one ports mostly rely. In productivity analysis was used a production function average, in which the movement (in TEU), of a port is function of the number of terminals, the length of the pier and the number of gantry cranes in use. It was found the differences between the potential annual movements in TEU with real movement (Appendix 1). In this aspect, Sines shows weak competitiveness with its four container cranes (the fifth and the sixth were not at the time this study was conducted), especially

if compared to Valencia, which exceeds, by far, the average of other ports, even though when a port exceeds its planned capacity it can cause inefficiencies. This assessment cannot however be remiss that terminal productivity is not the productivity of the port, nor that port performance can be confused with the performance of terminals.

The **reliability** of service is the result of several global parameters, or good or bad operational indicators (speed and flexibility of operations, delays in operation, strikes and other social disturbances) and represents the perception that customers have of the general performance of a given port. An important element related to the efficiency and reliability of the ports is the labor factor. Labor costs account for about 60% to 70% of operating costs, even in capital-intensive container terminals. As the demand for labor varies greatly from one day to the other, the working arrangements should be flexible enough to meet the supply of labor, without imposing excessive costs, reducing the turnaround time of ships in port and proportional risk of rupture (Merk et al , 2011: 26). Finally, reliability translates into a conclusive reading that results from efficiency and productivity, and provides the metric for the reputation of a port.

The measurement of port performance: efficiency or effectiveness?

Brooks and Pallis (2008) define strategy as related to factors associated with the services provided (product-market scope) and also the strategic plan itself. According to the authors, the strategic performance can be evaluated through internal performance indicators (efficiency) or external, from stakeholders (effectiveness). According to those authors, efficiency and effectiveness are related but distinct concepts. If the terminal operator decides to increase the efficiency of the terminal and to obtain it he maintains more ships moored, the use of the terminal increases but the delay time also increases, which does not fit the expectations of the customers. This option will result in a tradeoff; efficiency is achieved at the expense of efficiency. The effectiveness is therefore related to the **expectations of the various stakeholders**, which do not always coincide. Customer-focused PA's tend to have an attitude of efficacy. The difference between port administrations that follow a line of efficiency and pursuing other based management effectiveness lies therefore in the attention given to indicators that measure the port activity in the abstract, or which focus is centered on customers' expectations. The measurement of service quality, rather than its quantification, happens to be extremely important because it represents the line of measurement by customers; efficiency is important to improve the levels of port operations, but is of secondary importance, customer satisfaction is the critical indicator that should be measured in an organization focused on efficacy (Brooks and Pallis, 2008: 10).

2. Sines as a logistics gateway

The ZILS (Industrial & Logistics Platform)

It is no coincidence that the ZILS was considered Sines´ life insurance by the president of APS (AICEP´s Portugal Global interview, Sept. 2008). In fact it is assumed that the integrated development of the entire region depends on the concentration of diversified

industries that, by processing specific local comparative advantages, promote employment, entrepreneurship and vocational skills. This focus initially on the outskirts of the port, should promote, through spillover effects (ripple effect), the launch of activities of great value added based on new technologies and I & D, whose synergies allow the stimulation of regional economic potential.

Logistics platforms of merchandises fit into the overall scheme of supply chains of goods and cannot dissociate itself from the policies of general transport planning. The main use of this market is to provide various types of logistics supply chain by covering the entire production process: since the transportation of raw materials to final waste reprocessing. According to the plan presented in 2006 and to which was attributed the name "Portugal Logistics", one of the goals would be networking the main Atlantic ports with logistics platforms by UIC gauge. A national network of Logistics Platforms presented in 2008 (Decree 152/2008 of 5th August), based on the "Portugal Logistics", intended to give to those platforms a strategic location in spatial terms. For what concerns us directly for this work stands out the location of Logistics Platform of **Poceirão** (Project LOGZ), with a total of 220ha and designed to encompass the flow of goods to and from Autoeuropa, and scheduled to have a direct link to Sines.

Again, the PET assumes the strategic importance of logistics platforms location as multimodal corridors and redistribution links of goods and merchandises. In which concerns for Sines in terms of logistics, some measures arise from the reading of this Plan: one will be regarding the implementation of the Single Window Logistics (Janela Única Portuária - already foreseen since 2006 occur with the implementation of Logistics Portugal) based on Port Single Window, which is just a tiny drop of water in the aridness which the Plan contemplates the whole sector.

Transport corridors and distribution networks

The development of intermodal transport modes provided new opportunities which in turn had a major impact on the associated logistics. This produced a certain paradox: according to Rodrigue, Comtois and Slack (2006), for the customer, the geographical space became irrelevant as to the supplier of this type of service, routes or modes of transport have assumed even greater importance. The global production and consumption have substantially changed the distribution with the emergence of regional production systems as well as major consumer markets. No single location can efficiently meet the distribution requirements of such a complex web of activities.

The definition of urban area considered it as the hierarchy of certain services and functions as a corridor is a structure that organizes interactions within this hierarchy (Rodrigue, Comtois and Slack, 2006). The transportation corridor provides the capability to physical movement and promotes accessibility and movement of flows of production, distribution and consumption. In this **conceptual model** Sines regulates freight traffic inbound and outbound serving as an interface between regional, national and global systems. Corridors have been becoming the main structure for the accessibility to the interior and which through the ports gain access to the distribution

system. Strategies are therefore increasingly going through the control of distribution channels so as to ensure unimpeded movement of containerized cargo.

Delimitation of the frontier (spatial structure)

The existence of a obvious *"missing link"* presupposes the need for a direct link from Sines to the Logistics Platform of Badajoz, gateway to the competitive hinterland which without it, there will be no growth potential due to the exiguity of the natural hinterland (Figure 3).

Figure 3: Sines rail network: the "*missing link*".

Source: Adapted from REFER (2013).

At the origin of the current network lies the fact that, at the beginning, this railroad has been designed for Sines as both a liquid and dry bulk port, including unloading of coal to feed the thermo electric plants of Sines and Pego (near Abrantes, up north). This tortuous path (red color), exemplifies the concept of friction in a visible way and brings out the existence of a missing link, which could be a new rail line between Ermidas-Évora-Badajoz or Ermidas-Poceirão-Badajoz.

Spanish markets localized at Provinces of Extremadura and Madrid are the obvious to **gain market share** in the competitive hinterland, which should be the main immediate concern to policy makers once transporting goods to the "heart of Europe" does not pass the scrutiny of a more detailed analysis: not only is there no continuity in high speed (Madrid-Irun-France), as there is yet no interoperability (e.g., France-Germany), i.e., for some many years this assumption will be pure illusion.

3. Quantitative analysis: Gini´s and Location coefficients

To obtain an overview of the national and Iberian port market as a way to identify the individual from the collective, we used some basic statistical models whose use in the social sciences is well documented. Thus, in empirical terms, we proceeded to an analysis made by two different approaches: i) study of the degree of dependence of loads on the most important continental Iberian ports, through the Gini coefficient, and ii) application of the Location coefficient between Sines and an Iberian port range, to assess the convergence or divergence of growth recorded in the last decade.

The cargo dependancy: the Gini coefficient

The Gini coefficient is a measure of inequality commonly used to calculate the inequality in income distribution, but can be applied to the degree of concentration that directly highlights the extent to which each port depends on certain traffic of freights. It is assumed that a high Gini coefficient shows a high specialization / dependence in a given cargo. Values near zero indicate perfect equality while values close to one reveal a high inequality. The representation of the Gini index is given by the following expression, known as Brown´s formula:

$$G = \left| 1 - \sum_{k=1}^{k=n-1} (X_{k+1} - X_k)(Y_{k+1} + Y_k) \right| \tag{3.1}$$

G = Gini coefficient of port i
X = Cumulated proportion of cargoes when they have equal percentages.
Y = Cumulated proportion of cargoes percentage.
k = 1, 2…, 10 = cargoes (%).

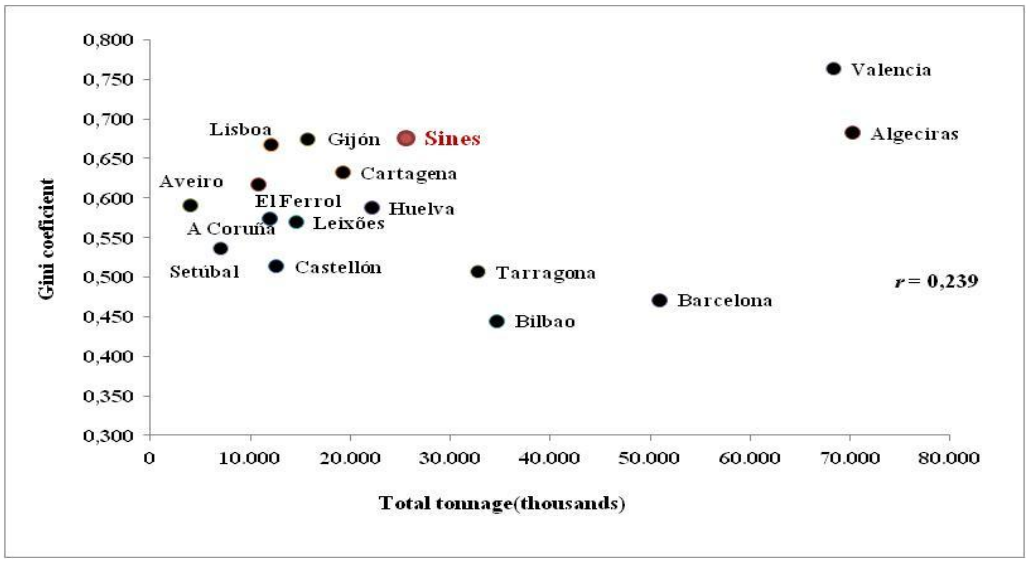
Accordingly, and to assess the degree of diversity / specialization of national ports together with the Iberian ports, goods were disrupted into ten major categories. National ports chosen for this analysis are responsible for 97% of total throughput handled in the country by sea and the eleven major Spanish ports account for about 90% of the total cargo handled in Spain. Table 2 presents the sample selection of the main Iberian ports. The data used were taken from the series published on the website of IPTM, IP, in the case of Portuguese ports and from Puertos del Estado, in the case of Spanish ports, broken down into 10 types of categories that correspond to equipment using and specific infrastructure. They refer to 2010.

Table 2: Main *16* Ports and cargo throughput broken down into *10* categories.

Ports	Cargoes (thous. Ton.)
A Coruña; Algeciras; Aveiro; Barcelona; Bilbao; Cartagena; Castellón; El Ferrol; Gijón; Huelva; Leixões; Lisboa; Setúbal; Sines; Tarragona; Valencia	Dry bulk agricultural ore coal others GS Liquid bulk crude oil refined liquified gases Breakbulk Containers Ro-ro

From the analysis performed using the Gini coefficient (Appendix 2), it appears that, from the 5 ports in port range B-B, **Bilbao** is the port that displays a lower reliance on a certain type of cargo. So, we can state that is the highly diversified port of the range, with a Gini of 0.445. **Barcelona** appears in second with 0.472, followed by **Sines** (0.677), **Algeciras** (0.683) and, finally, **Valencia** that with an index of 0.764 is the more dependent port in a given cargo, the containerized goods, the one with the higher relative share (71.8%), a real container port indeed (Appendix 3). In the case of Sines, although the increased growth of containerized cargo in recent years, it can be said that it is still a port specialized in liquid bulk, a condition that can be adjusted in the coming years if the trend on containerization follows. Figure 4 gives us a more accurate idea of the differences recorded for each port.

Figure 4: Scatterplot.



Source: Own elaboration.

The Location coefficient (LC)

The LC was used by Lopes (2001: 58-65) for the calculation of regional imbalances, and have been applied to the breakdown of the workforce by three main industries. This study applies the LC analysis on the behavior of cargo volume of the 5 main Iberian ports, comparing two periods: 2002 and 2011. It is intended to place each port on the deviations from the average of the port range, it means, how much each of them should have grown to follow the movement, on average, of all five ports. The purpose is to verify that the port that interests us most - Sines - followed or diverged in the trend demonstrated by its main competitors. In essence, in this study we have two variables that stand in confrontation: the growth of a certain type of cargo (x) and the total cargoes (y), in which, for each port we´ll have as the proportions of each type of cargo and the set of cargoes that will fit in the set.

The LC can then be obtained from:

$$CL = \frac{\Sigma_i \left| \frac{x_i}{x} - \frac{y_i}{y} \right|}{2} \tag{3.2}$$

In the case of growth asymmetries, evolution can only be considered against a pattern, in which case this is the default of the behavior of all 5 ports and the evolution of imbalances is analyzed by comparing the actual trend with what should have been found for if the differences were not registered.

$$\delta_i = \delta + (\delta_i - \delta) \tag{3.3}$$

δ is the growing rate registered in that period for the 5 ports set

δ_i is the effective growth rate of a specific cargo at port i

Through LC we intend to verify the deviation (δ_i - δ) between the behavior of a given port and the group behavior in general. If the variable x is dissociated into goods of different nature j (j = 1,2, 3 ... m), the corresponding identity (3.3) can take the following form:

$$\delta_{ij} = \delta + (\delta_j - \delta) + (\delta_{ii} - \delta_j) \tag{3.4}$$

From the previous expressions built on relative components we turn into the absolute value of the components by multiplying the two terms of identities by the absolute value

of the variable registered at the beginning of the period. From (3.4) we go to $x_{ij}\delta_{ij}$ whose sum over *j* originates:

$$\sum x_{ij}\,\delta_{ij} = \sum x_{ij}\left[\delta + (\delta_j - \delta) + (\delta_{ii} - \delta_j)\right] \qquad (3.5)$$

$\delta_j - \delta$ = cargo component: highlights the behavior of a certain type of cargo among the set (ex: containers vs. total cargo)

$\delta_{ij} - \delta_j$ = port component (or global): emphatizes the behavior of one type of cargo in one specific port *n* in face to the behavior of the same cargo in the 5 ports set containers in port i vs. containers in the 5 ports altogether)

As $\sum x_{ij}\,\delta_{ij} = x_i\delta$, we obtain

$$x_i\,(\delta_i - \delta) = x_i\,(\delta_i' - \delta) + x_i\,(\delta_i - \delta_i') \qquad (3.6)$$

x_i = represents the total volume handled at port i (tonnes)

δ_i' = is the growth rate port should have verified if any type of cargo had evolved as in the case of the 5 ports together

The component associated with (δ_i'-δ) reflects the expected effects of global features on a group of ports and so is called global component or "port component" while the associated with (δ_i - δ_i '), that puts in confront the effective evolution of the port and the one that should have been in it from the different types of cargo if they had behaved alike, in average, occurred in the group of ports, is referred as "cargo component". The two will explain the deviation (δ_i - δ) between the behavior of the port and that of all the 5 ports.

Table 3 summarizes cargo movements at the port range, grouped into three main categories: Dry bulk, liquid bulk and general cargo (including break bulk and containerized cargoes), having excluded Ro-ro traffic since as Sines doesn´t show any movement of this type this would cause overestimation of the data.

Table 3: Cargo partition in port range B-B: 2002 to 2011 (thousands tonnes).

2002

Cargo	Algeciras	Barcelona	Bilbao	Sines	Valencia	∑
Solid bulk	2.839	3.383	4.625	5.796	5.797	22.440
Liquid bulk	17.913	9.930	13.125	14.318	1.624	56.910
General cargo	32.889	18.688	12.051	26	25.393	89.047
Total	53.641	32.001	29.801	20.140	32.814	168.397

2011

Cargo	Algeciras	Barcelona	Bilbao	Sines	Valencia	∑
Solid bulk	1.567	3.544	4.451	4.041	2.374	15.977
Liquid bulk	23.036	10.761	19.763	16.151	4.530	74.241
General cargo	53.847	28.759	9.445	5.600	58.571	156.222
Total	78.450	43.064	33.659	25.792	65.475	246.440

δ (growth rate in the period) = **0,463**
δi (i = Al;Ba;Bi;Si;Va)
δAl= 0,463; **δBa=** 0,346; **δBi=** 0,129; **δSi=** 0,281; **δVa=** 0,995
δj (j = GS; GL; Fr; Co; Ro)
δGS = -0,288; δGL = 0,305; δGe = 0,754

If we multiply the R02 matrix (year 2002), by the vector δ_j we find the necessary addictions to calculate the vectors δ'_j

[-0,288 0,305 0,754] * [R02] = [29444 16145 11758 2717 17972]

as such,

δ´Al = (78450 + 29444 - 53641 / 53641 - 0,463 = **0,548**

δ´Ba = (43064 + 16145 - 32001 / 32001 - 0,346 = **0,504**

δ´Bi = (33659 + 11758 - 29801 / 29801 - 0,129 = **0,395**

δ´Si = (25792 + 2717 - 20140 / 20140 - 0,281 = **0,135**

δ´Va = (65475 + 17972 - 32814 / 32814 - 0,995 = **0,548**

In the possession of all elements for the determination of the components, the results are summarized in the next table. With them we can elaborate Figure 5 (Shift-share Analysis).

	Algeciras	Barcelona	Bilbao	Sines	Valencia
Di = δi - δ	0,463-0,463= 0,00	0,346-0,463 = -0,117	0,129-0,463= -0,334	0,281-0,463= -0,182	0,995-0,463= +0,532
Port component = δ'i - δ	0,548-0,463= +0,085	0,504-0,463 = +0,041	0,395-0,463= -0,068	0,135-0,463= -0,328	0,548-0,463= +0,085
Cargo component = δi - δ'i	0,463-0,548= -0,085	0,346-0,504 = - 0,158	0,129-0,395= -0,266	0,281-0,135= **+0,146**	0,995-0,548= +0,447

Figure 5: Shift-share Analysis.

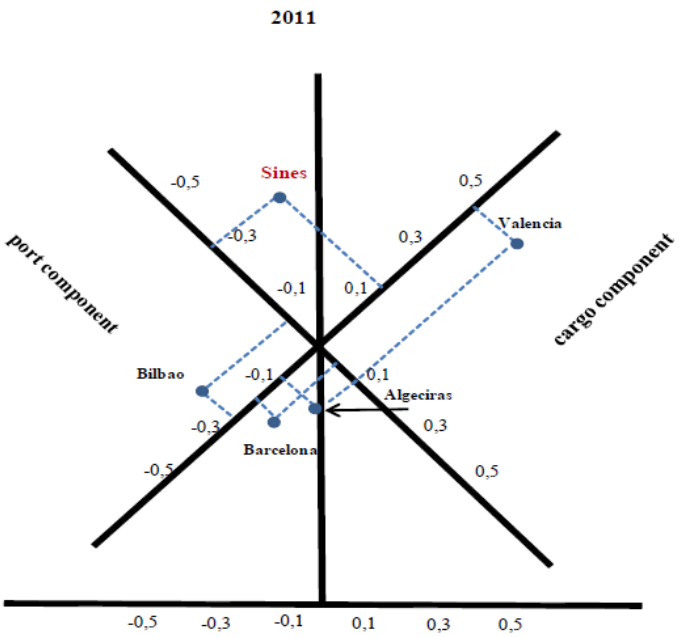


Figure 5 shows that Sines displays a remarkable growth on cargo component, which, as we have seen earlier, marks the effective evolution of the port and the one it should have been, if the different types of cargo had behaved as, on average, occurred in the group of ports. The cargo type highlighted is general cargo, including containerized cargo segment. Sines has the second higher rate which it is not surprising (in 2002 this type of cargo was nonexistent). It also shows that growth has been sustainable. The Port of Valencia is the fastest growing port - and the one that stands out among the Spanish ports. On the other hand, Bilbao is the port that loses more ground in the global approach with the others over this ten year period. As that, the port component (or global), which represents the evolution of the total loads handled on all ports, shows that Sines scores the highest negative value of the 5, namely, the growth observed in the bulk liquid has not been sufficiently able to correct the loss of global growth, which was not more penalized due to the increase in containerized cargo.

4. Sines as a regional cluster

Economy and regional development

In the current context - marked by globalization and international economic integration - with the increasing mobility of goods, capital and human resources towards emerging economies, several regions of the country are facing serious problems, in particular those whose production process is very much based on the routine and massed industrial phases of production, or marked by stagnation in the primary sector, such as the Central Alentejo and much of the southern territory. This context is also marked by increasing competition between territories, as well as the growing importance of environmental issues gaining a new dimension with climate change and the need for the replacement of energy sources, something that creates some restrictions, but also opportunities for the development of regions. The delocalization also imposes to the national economy the need to evolve into knowledge intensive activities and creativity, hence the emergency in the formation of clusters supported in dynamic businesses that appeals to innovation and diversification, certainly, but also call on traditional export goods, incorporating comparative advantage through differentiation and upgrading of products. The view that an increase in the income of the poorest regions and more equitable access to public goods oriented to the satisfaction of basic needs would lead to their development (redistributive point of view), changed in order to meet the new realities: the need to combine the aspects of economic and social cohesion with the competitiveness and environmental sustainability.

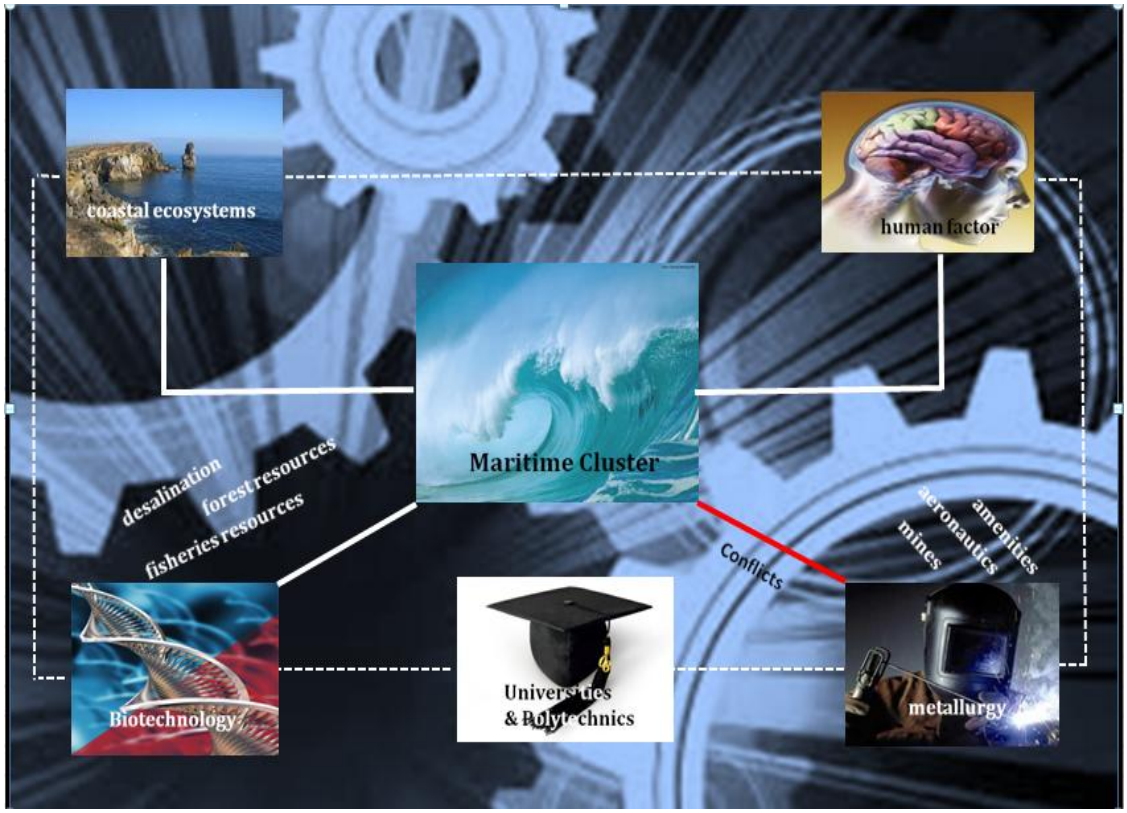
As a national objective, it is not enough to appeal for the internationalization of firms and the discovery of new export markets. It is also necessary to identify which companies have that potential, because the export markets tend to select the most efficient companies. Hence the importance of investing in high added value and capital-intensive sectors, to the foreign market, and the labor-intensive and lower value for the internal market, particularly as import substitutes. But the ability to put goods and services in foreign markets does not exhaust the process of internationalization of production: the presence of foreign capital is also a factor of competitiveness given the natural selectivity of the same. This issue takes on greater significance and relevance if we consider the low level of capitalization shown by a relevant part of national enterprises.

The process of "clustering"

Clusters are defined as a population of interdependent organizations operating in the same value chain and geographically concentrated (Rodrigue, Comtois and Slack, 2006). However, in this specific case, Sines can be described as a multidimensional cluster, displaying some **territorial discontinuity**. Ports and cities interact across multiple dimensions: economic, social, environmental and cultural, but in the case of Sines and by virtue of its remoteness relative to large cities (which happens to be a benefit in the set of priceless environmental assets), the chalked clustering model passes necessarily to be singular.

From the starting embryonic point constituted by the ZILS emerges a trend of diversity in the installed activities which most visible example in the impact on the region's economy and jobs are the factories ARTLANT, PTA and Ibercoal. It is units of this size, sector of activity of medium-high-tech, high-value added, targeted for exports and to new markets, which should guide the effort to create attractive conditions to turn Sines into a technological excellence center and a national reference for subsidiary activities. The extension of this trend to contiguous areas will be the next step to plan and execute. Within this prism it conveys certainly proceed to an exhaustive survey of all the capabilities of attraction and establishment of competitive industries that can benefit from the whole existing infrastructure and to be developing in the near future, something worthy to figure in the annals of large implemented projects at national level (Figure 6).

Figure 6. A regional "mega-cluster".



The map of development planning of the region should obey to a **triangulation** in which the vertices should consisting in Sines as "bridgehead", Beja and Évora, natural poles for logistics, concentration of industrial activity and population settling. In fact, it will actually be a parallelogram if the angles are extended to include the Estremoz deposits of marbles, at north, and the Pyrite Belt, at south. We start from a limited idea of growth pole for a stronger perception of development region.

Sines prospective scenario for the horizon 2030

From the Integrated Scenario prepared by iTREN-2030 for transport and energy demand, based on economic growth forecasts for the various regions of the world and the repercussion that such occurrences will have on freight traffic carried through the Panama Canal, the following three prospective scenarios were elaborated: i) Strong Growth Scenario ii) Moderate Growth Scenario, and, iii) Stagnation Scenario (Table 4).

Table 4: Prospective Scenarios for 2030.

	Scenario 1: Strong growth Scenario	**Scenario 2: Moderate growth Scenario**	Scenario 3: Stagnation Scenario
	Post-crisis strong recovery both in economy and trade	***eastbound* traffic far superior than westbound traffic**	Stagnation (or contraction) of the global commercial flows
World trade	> Strong global development (global) > Panama exponencial increase of traffic	**> Moderate growth driven by emerging countries (regional)** **> Traffic via Panama grows enough to compete with Suez**	> Weak growth of global trade (local to local) > Traffic via Panama does not record significant changes
Logistics	> Global distribution networks in Sines (and inland) to Europe	**> Emphasizes the importance of distribution centers in Sines to provide the Iberian Peninsula**	> Trend for the existence of Local Distribution Centers
Transportation Networks	> Rapid rail connection to Spain and increase of its geographical areas of influence > Shipping prices remain relatively constant > Big boost of the Short-sea shipping	**> A rail link to the competitive hinterland carried out in phases, balanced with the increased SSS** **> Prices of land transport increased considerably**	> Competitive hinterland remains very low > Prices of all transport modes worsen rapidly
Infrastructures	> New Container Terminal (Vasco da Gama II) to to cope with the increased freigths > Great development of ZILS	**> Terminal V. da Gama runs almost at full capacity** **> Sustained Development in ZILS**	> The growth of the containerized cargo segment is minimal > ZILS loss of competitiveness

With a resumption of maritime traffic flows to pre-crisis levels driven by strong economic growth in emerging and conditioned by a weak economic growth of Western economies, facing a forecast in which demand for shipping varies in line with the prices of fuel and in growing environmental pressures to reduce the traffic associated with the terrestrial mode, we have defined a **Moderate Growth Scenario** which arises as the more likely to occur.

From the Moderate Growth Scenario was undertaken a further sensitivity analysis (Table 5). Sines arises as a gateway port of entry and exit of goods and commodities in the Iberian Peninsula and transshipment to ports in Northern Europe and Western Mediterranean, made possible by the use of larger ships that can pass through the Panama Canal and to the north-south deviation that enlargement provides to ship-owners, also registering trade flows growth with Mercosur. The increased traffic flow

also results in a major growth opportunity to the distribution networks - primarily rail and sea - since price increasing on road transport requires a lower cost option.

Table 5. Sensitivity analysis

Sensitivity Tests	Definition	Positive aspects	Negative aspects
Larger ships	Larger ships carry more goods, economies of scale favor lower prices. (Take into account the flows originated through the Panama Canal in terms of deep-sea and between EU ports, in terms of short-sea shipping (SSS)	CO2 reduction by shifting to feeder. Larger scale leads to potential port cost reduction	The increase in road traffic in the hinterland may be one result; need to transfer to rail
North/South deviation	Ports of the Atlantic seaboard become more competitive. Ship-owners prefer transshipment than call ports further north. Sines, deepwater port, receives post-Panamax ships	Decrease in ton / km due to smaller journeys made	Overhead railway. Possible referral to the road to decongest
Rising prices in the hinterland (transportation and logistics)	The rising price of fuel and fees on road transport increment hinterland transportation costs (c. 10%)	Decline of land transport. Modal shift from road to rail and sea	Increasing the time required for the delivery of the goods

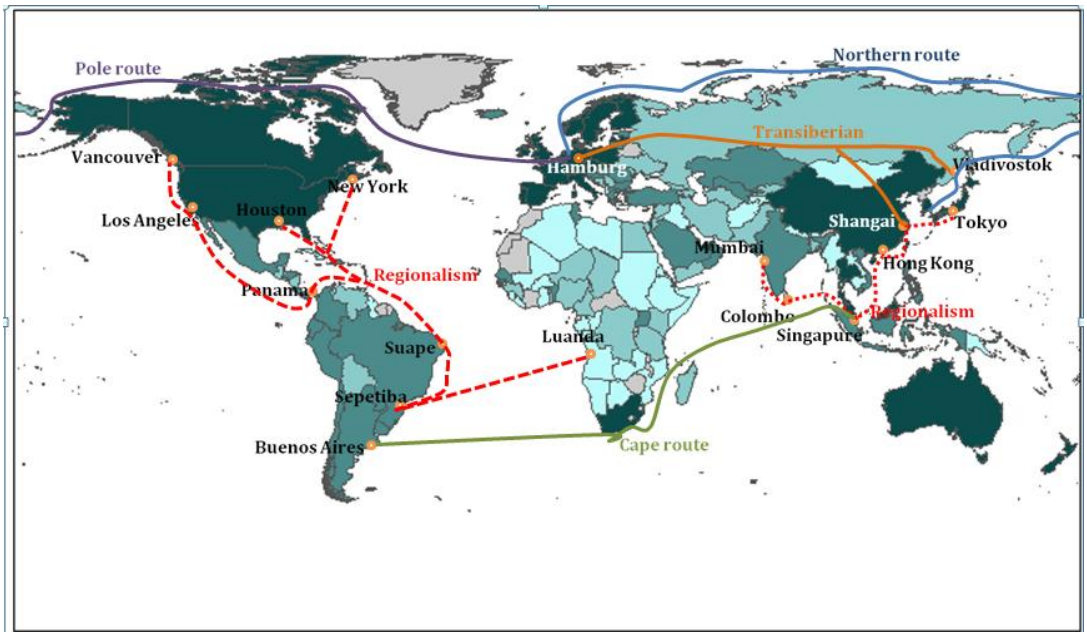
Despite a relative parity between Panama and Suez, the latter will continue to be the main strategic point of passage along the global beltway, namely due to the fact that represents a 2.000 km shorter path, the flows with Southern Asia will probably be maintained in opposition to those arising in both coasts of North America, declining. This analysis also reveals, from the standpoint of geopolitical and geostrategic, high exposure to political and social events, namely, the strong current vulnerability of global marine network due to the need of traffic flows by narrow channels.

The widening of the Panama Canal: what results to Sines?

With the growing size of container ships, which forces the existence of a smaller number of scales, the port chosen by the shipping companies shall, in addition to other factors, have **absorption capacity** of its hinterland and quality and efficiency of intermodal connections, aspects that are materialized in the way ship-owners choose the ports of call for their service lines.

The Panama Canal is currently far from being able to influence the flow of global maritime commerce due to the limiting scale of vessels it supports. However, with the enlargement of the passage, routes around the world (round-the-world liner services), will again be envisaged, which can revive the network service (Notteboom and Rodrigue, 2009). In principle, with the expansion of the Panama Canal, there may be a relative parity between the Suez in terms of capacity. But these expectations can be subjected to some contention in result of a lower aggregate demand, the trend for "regionalism" trade, the increase in fuel prices and the choice for alternative routes at the expense of current routes (Figure 7).

Figure 7. Alternative routes and regionalism.



Source: Own elaboration.

Another issue relates at the cost of the tariffs levied on containerized traffic in transit through the Panama Canal since the high financing investment may lead to an increase in the rates charged by the PCA, resulting in the loss of attractiveness for that passage[2]. To this is added the price increases with labor that is already happening in some of the emerging Asian economies and which might encourage more local trade at the expense of long-distance trade.

Final considerations on Sines in the horizon 2030

Based on a Moderate Growth Scenario, additional sensitivity analyzes outlined show that it is still possible to watch an increasing trade via the Panama Canal and, as an option for reducing transport costs associated with fuel prices, service lines are redefined so as to focus on distribution platforms through SSS (short-sea shipping). With the redesign of logistics distribution networks, road transport will be surpassed by rail within the competitive hinterland, and by maritime, over the long haul. Thus, Sines will emerge as a port located on the Atlantic seaboard with strong chances of being chosen as a new global maritime network node, as transshipment hub, or preferably as a gateway - which may be significantly positive if players involved can create transnational networks supporting land redistribution. The rail links, the overall port performance and the actions taken to increase the level of competitiveness, play a role that will surely make all the difference for Sines in getting a higher status or, the other way around, of less importance in the port hierarchy.

[2] Panama Canal Authority has substantially increased the rate of $ 40 per TEU in 2006 to $ 72 in 2009, an increase of 80%. In 2011, the rates increased slightly to $ 74 per TEU. This means that the increases already captured about 40% of the potential cost savings which decreases a substantial part of the expected gains (Rodrigue and Notteboom, in: PTI Journal, issue no. # 52, Nov. 2011).

5. Final Report - Global and Strategic Vision*; a possible synthesis*

The geographical location vis-à-vis the maritime chain

The globalization of logistics networks emphasizes the importance of the relationship between the development of a port within the global supply chains (Notteboom and Winkelmans, 2001) and the development of the local region (Notteboom and Rodrigue, 2005), because the ports do not compete alone as simple local cargo handling points but yes as crucial vertices of the global chains (Ducruet and Notteboom, 2010) and the port of Sines cannot be dissociated from the logistics distribution network to which it belongs. A port that is both a **gateway** ensures large field circulations cargo in the inland. The optimal management of these flows in the global space distribution will have to give particular attention to costs, time and reliability.

With the widening of the Panama Canal, the passage of larger vessels **may encourage** the option for Sine's strategic positioning since the economies of scale resulting will cause fewer ports of call and traffic concentration at specific hubs. It should however be borne in mind that, like most ports, Sines is dependent on its main clients: the ship-owners, which are the basis of the allocation process of more or less centrality and greater or lesser importance in terms of port hierarchy. The issue of "centrality" of a port from the point of view of the ship-owner choice has been subject of great debate among experts. This position is supported by the strategic perspective with one looks to centrality, the global preferences of ship-owners by minimizing costs and what is meant by this, as Rudel and Taylor (2000: 89) state: *"time advantages on the sea leg do not necessarily imply cost reductions "*. For those who rely solely on the reclassification of Sines within the hierarchy based on the apparent advantage of gains attained through **reduction of time** with distance in relation to Mediterranean or northern European ports, this is an argument that falls to the ground.

If the last word belongs to the ship-owners, the choice for ports of call for the large ULCS's (Ultra Large Container Ship), the absence of appealing conditions of a port (which reveals in the form of competitive factors) both in the existence of infrastructure, logistics nodes and **reliable connections** to the hinterland, will reproduce those repulsive effects.

The core of competitive strength offered - the geographical horizontality of Sines compared with Panama - is not sufficient to explain its choice. The attractiveness of this criterion only hypothetically justified as Sines is not an isolated piece of chess in international trade flows board, which, according to Rodrigue (2011: 7), *"(...) physical flows may not necessarily use the most direct path, but the path of least resistance."* Therefore one has to look at the strengths and weaknesses of the logistic chain and aspects related to different levels of friction once the distribution increasing prefers reliability of service. The reliability regards indirect costs caused by delays or damage occurred in the handling of cargo (Tongzon, 2008) and this trend has grown in such a way that, according to Maersk, (Antwerp Port Authority Newsletter Volume 14, No. 64, July 2011, p. 11), *"Reliability is the new price war. Customers do not look for the*

cheapest price; they look for reliability of services." The competitiveness of a port is above all the **product of efficiency** in the provision of services required by users (Brooks and Pallis, 2008:9) and attractiveness is only one prerequisite that enables a port to gain competitiveness (Ng, 2006).

Towards a potential increase in traffic and starting first to blur, *inter alia*, the main conditions set out in, to Sines, corseted by the smallness of its hinterland, there remain **two possibilities**: first, will be to constitute as an enhancer of the outbreak for a regional industrial cluster which creates conditions for increasing exports and attracting cargo flows to its competitive hinterland - ways to create absorption - constituting an Iberian gateway. The second will be to constitute in a simple node of transshipment of containerized goods, which does not convert the port, in the medium term, in a dynamic regional pivot.

The nature of Sines and the direct competition

Sines remain, as prior seen, a very specialized liquid bulk port, although the containerized cargo segment is being gradually rising in importance (Appendix 4). The growth of this type of cargo, however, was not enough to put Sines within the growth average observed in its counterparts. Thus, we can state that, in the overall assessment, has been losing ground against competitors in these last ten years. But it will take some restraint on the analysis of these numbers: not only compares a group of ports which contains two major hubs in Europe as the economic reality of the two countries is fairly distinct. It is still impressive however, and to serve as a collation, the growth that occurs especially in the port of **Valencia**.

To not subvert the outcome of this analysis should be recalled that a port is a cluster of economic activity where a large number of firms provide goods and services, and together create different port products. Assess the overall performance of a port from aggregate indicators can distort the assessment between ports. The main port performance indicator used by ports remains throughput volume, however there is several limitations to its use: i) adding up throughput volumes of different commodities to one aggregated throughput figure limits the value of a comparison between ports (one tonne of oil is different from one tonne of fruit juice), ii) the movement of cargoes does not tell us much about the economic impact of the port on the local region, and iii) the increase in cargo volume can be explained by international trade flows and not by the performance of a port (De Langen, Nijdam and Van der Horst, 2007: 24).

Assigning a dimension that many authors give to the necessity for the existence of a diverse portfolio of loads, to ensure greater operational flexibility and a lower risk in face of prices fluctuations of raw materials, Sines should pursue the path of growth in **containerized segment** without losing the vocation as “energy” port. The recent condition of the first national port for exports should continue to be promoted using all port marketing strategies in order to attract more customers who export by sea and thus by increasing demand, help creating conditions for the establishment of more regular lines.

The supply of transport

Economic development is increasingly linked to the development in transport. The reduction of time has become a key requirement since the dispatch of goods and commodities through the intermodal chain, to final delivery to the consumer. The modes of transportation join the productive factors in a complex network of relationships between producers and consumers and as a result we can obtain a more efficient division of production by exploiting comparative advantages as well as the means to develop economies of scale. The productivity of space, capital and labor are so enhanced with distribution efficiency.

In terms of spatial economics, the delimitation of the border where Sines competes for traffic on competitive hinterland forces to study the spatial location and the expansion of its distribution network. This expansion is mainly due to the process of rationalization and specialization of rail traffic, whose success depends however in the increased capacity, speed and unitization of general cargo via container. Thus the railroad that serves the port of Sines will be the **catalyst** for fixing various logistical and industrial clusters of heteroclite nature, along the corridor that links the port to inland urban areas or to industrial centers and concomitant rapid runoff flows originated in the hinterland. Production units as Embraer plant, located in the district of Évora, certainly contributes and requires, at a same time, that the railway network responds to these conditions. By virtue of our geographical condition we have to adapt our connections to the rest of Europe and in conjunction with Spain, whether through evolution to the European gauge, either by matching network electrification, strengthening resistance couplings or adapting the control system and signaling of rail traffic. What is at stake is the question of interoperability allowing Portuguese trains enter Spain without difficulty, as has been claimed by various economic agents.

The existence of a missing link presupposes the need for a direct link from Sines to the Logistic Platform of Badajoz, gateway to the competitive hinterland without which there will be no potential growth due to a shortage of natural hinterland. The connection of southern ports to the logistics platform of Poceirão and from that to Madrid was until recently a priority. Notwithstanding and recently, the EC / TEN-T proceeded to rewrite what is understood as "core networks", predicting that the communication axis from Sines to Spain presents a path that passes through Lisbon (via Poceirão?) and Aveiro. The link to the "**Central Corridor**" (Priority Project 16 via Badajoz) that would allow to get to Madrid in the shortest time was postponed until 2030. The Logistics Platform of Badajoz is an essential node to connect Sines to flows of goods with origin / destination in Extremadura and the Autonomous Community of Madrid, optimizing competition in relation to Algeciras and the Iberian hinterland. If this connection not occurs, will contribute to the loss of competitiveness and is contrary to economies of scale to be obtained with the formation of a regional cluster supported in port activities. If it is right that national government policy lacks *praxis* for the restructuring of maritime-port sector, among political and technocratic hesitations, each government

unilaterally devotes time and resources drawing rail lines that do not represent common decisions, further fueling the confusion that persists in this matter.

Sines as a regional cluster: potential and challenges

The philosophy of what is proposed to Sines is something that brings us the reality of new maritime clusters as Turku, in Finland, more than Antwerp, Rotterdam or Hamburg, and this for a need to adapt to scale, resources and population. Taking the example of the Finnish clusters, it is no coincidence that today these regions have a GDP per capita among the highest in the world, with poorly unemployment rates and where nested professionals of various specialties and great qualifications collect results from the investment increase allocated to economic sectors **rescued from inactivity**. These clusters constitute the daring model way to Sines, something that poses a real challenge to the investment policy, which, by their size, exceeds the financial capacity and legal framework of the APS, which suggests its design under the strictest integrated national policy and subject to a fierce supervision.

If the dematerialization of the economy led to the discontinuation or extinction of various production sectors once illustrative of both professionalization and qualification of hand labor and the quality of national production (sectors of metallurgy and metalworking; construction and ship repair), taking advantage of technological progress seen in manufacturing methods, in terms of equipment, machinery and computerized support tools, as well as new methods of management and optimization of productivity, should back **to invest in these industries of the secondary**. Several European countries have done it and have returned to have very competitive maritime industries (which drive a whole range of others of high-value and highly tradable, such as electronics and mechatronics). We have the representative case of Finnish shipyards who build the largest cruise ships and the German yards of Jade Weser, where gigantic oil platforms are built; countries where labor costs are the highest in the world!

As a complementary way to attract people and facilitating mobility between regions not only the conditions attached to the business environment must be developed but also the **residential environment**. It seems clear that business and technical staff must live in or near cities in an attempt to minimize traffic movements. In this aspect, the region's potential, the beauty of the landscapes, the quality of the fishery resources and its beaches coupled with the fact of being an uncluttered area with plenty of space, can create special conditions for setting an educated population with high professional qualifications.

The shift in world´s economic paradigm - and to which the nations have to respond -, represents the displacement of the *locus* of world trade, as different countries occupy the top positions on the international scene; is facing this new environment that policies have to be implemented and adequate. However, it is essential that the economic model to adopt should become more concerned about **environmental issues and the long-term sustainability**.

Increase Sines competitiveness will be focalized in the creation of a "brand" but also through the marketing of "location", to recognize the region as a sensitive area of integrated actions. The wager is also in notoriety and visibility of the port and the ZIL´s but should especially be cultivated and secured the image of trust in the supply chain.

The **marketing plan** of Sines should be a natural extension of the strategic plan and shall promote the APS strategy in attracting new customers and for resident industries promote their business, seeking to satisfy the needs of customers, whether current and potential, in all inherent and complementary relationships. The marketing plan allows to detect opportunities, threats, strengths and weaknesses, enables promote management by objectives, basing the decision making, goal setting, quantifies deviations and their correction with the process, the quantification of results, a lower possibility of failure, control mechanisms and optimization of resources and results. From the analysis of the context (opportunities and threats) and from the analysis of the port (strengths and weaknesses), was formulated the following SWOT analysis (Table 6).

Table 6: SWOT analysis.

Strenghts		Weaknesses	
1	One of the European ports that provides better accessibility by sea	1	Poor uptake of hinterland traffic and incipient rail link to Spain
2	Privileged geostrategic position against the main sea routes	2	Remoteness from the main centers of production and consumption at national / Iberian
3	Port capacity (deepwater port) and adjacent space ready for setting industrial and logistics companies	3	Great dependence of MSC and risk of relocation of activity of this ship-owner
4	Deepening specialization and "clustering" logical actions		Very sparsely economic (especially industrial) and population of the region where it is located, as well as low intensity in work activities installed
Opportunities		**Threats**	
1	Attraction of large and medium-sized enterprises (economic value)	1	Northern european hubs
2	New industries with high added value	2	Western mediterranean hubs
3	Attracting FDI	3	Eastern mediterranean hubs
4	Increased exports by sea	4	Suspension of Priority Project # 16
5	Attract cargo after the widening of the Panama Canal	5	Danger of serious accident at sea, in port or pipelines
6	Regionalization of port hinterland	6	Contraction of GDP(s)
7	Establishment of a hub & spoke port	7	Contraction of world trade flows

Source: Own elaboration.

Finally, we must point out that, in the formation process of a cluster of excellence, the potential tourist and residential environment should be promoted alongside the *branding* associated to Sines, so that does not become a reducer synonymous of industrial area, *ergo*, creator of repulsion forces.

Sines to become (Sines as mega region, not confined to port intervention area), a real pole of development, one welcoming regional cluster for businesses and I & D, undergoes a more interventionist action of APS in conjunction with other political and social forces, private and public, (with new multidimensional and multi-regional assignments?). For this to be feasible **investments** are needed, this at a time adverse to

its realization but maybe that where such an occurrence becomes more pressing and pledge of major impact on regional socio-economic structure.

Now that much talk of sea-based resources of economy, it might be interesting to talk about investments in the exploitation of mineral resources and fisheries, fish farming, aquaculture and algae culture, agro and wine tourism, capture and storage CO^2 industries, "green " industries for the reuses and recycling of materials, desalination plants and pump stations and respective extensions of water transport (when the effects of severe drought that threatens the entire country tend to be perennial), and, why not, endogenous-based tourism in fields such as agro and wine industries. Such macro structuring investments - to name but a few - certainly alter the industrial and qualification of the regional workforce contributing to the implementation of some hinge industries and are examples of investments **consistent and innovative**. Consistent because they appeal to the usage of natural resources, innovative because they represent industrial development, promoting new business models, increase the technological capacity and stimulating competitiveness and the creation of skilled jobs.

The "new" players: Brazil, Mercosur and China

With regard to maritime trade with the emerging countries and in face of the potential of these markets in all inter / national trade, should be given due attention in an **anticipation** setting as opposed to a retroactive response. Sines in this challenge cannot play a secondary role (which may even constrain all future capacity growth) and staying summarized to its natural hinterland, but to establish a plurality of forms of businesses regionally and even supranational, which comes, according to what Notteboom (2012) recently stated: *"the future of ports depends not only on expected trade flows but where and under what conditions these flows will move globally, seen from the perspective of the distribution network."*

According to APS, freight traffic between the Port of Sines and Brazil has been growing in recent years in the area of petroleum products, and this country reached **forth position** in 2010 in the supply of crude oil and in 2011 was the country with the highest rate of growth in container traffic. In 2011 there was an annual increase of 8% on exports, consisting Brazil as one of the leading destinations for new goods. Also in 2011 was established a regular weekly MSC service linking Sines to South America. With this new service is registered an increase in the growth of trade with Brazil, both in export and import markets. In January 2012 the MSC opened a new regular service linking the ports of Sines, Brazil, Uruguay and Argentina which does provide a new impetus to trade not only to Brazil but with Mercosur. Also in the first quarter of 2012 the CMA-CGM, the third major global player, now connects Sines to Africa through a regular line, serving ports on the west coast but could be extended to other destinations.

The existence of **regular lines** implies the predetermination of schedules, ports of origin and destination, pre-established freight and integration with land and sea transportation chains. The scale of a port by a larger number of regular lines enhances the attraction for more throughput volume, increasing performance and efficiency levels of the port,

which can plan the scales, minimizing waiting times and costs by offering a wider range of destinations to lower costs and low transit times (Caldeirinha, 2010:36). On the other hand, when shipping companies establish regular lines, they value a range of marine services such as ship repair, which can be an incentive for the establishment of such services (Notteboom, 2012). The regular lines calling Sines are still small in number when compared to those serving Spanish ports, as depicted in Table 1 above.

As for China, our exports have grown but we are still very far from speaking about parity. China has a growing share in the international movement of trade (both in absolute and relative terms), but trade flows trans-Pacific are growing faster than transoceanic, which could indicate possible changes becoming traffic more "located". Chinese investment in Portugal became the subject of great debate with the recent purchase of privileged actions held by the State in EDP and REN. Thus, it will be at last time to start working on attracting **direct investment of that country** to the port itself or/and in the hinterland?

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APPENDIX 1. Productivity function of container terminals.

Variables	Algeciras	Barcelona	Bilbao	Sines	Valência	Total	Average	SD
Y (total TEU)	3.602.631	2.034.000	572.784	447.495	4.202.152	10.859.062	2.171.812	1.711.628
$\mathbf{X_1}$ (n.º terminais)	2	2	2	1	1	8	2	0,55
$\mathbf{X_2}$ (metros cais)	4.170	3.000	4.200	940	4.000	16.310	3.262	1.388
$\mathbf{X_3}$ (n.º pórticos)	19	17	10	4	13	63	13	5,94

	X_1	X_2	X_3	Média	Δ real/potencial	Pontuação
Algeciras	2.171.812	2.776.350	3.174.187	2.707.450	33%	4
Barcelona	2.171.812	1.997.374	2.840.081	2.336.422	-13%	3
Bilbao	2.171.812	2.796.324	1.670.624	2.212.920	-74%	1
Sines	1.085.906	625.884	668.249	793.346	-44%	2
Valência	1.085.906	2.663.166	3.174.186	2.307.753	82%	5

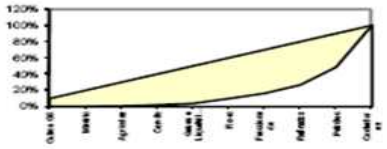
APPENDIX 2. Gini coefficients, port range B-B (2010).

ALGECIRAS

Distribuição	000 Ton. (Y)	Quota % (Y)	Cargas Totais (X)	Cargas Acum. (Y)	Quota Acum. % (X)	|X-Y|	$X_{k+1} - X_k$ (A)	$Y_{k+1} + Y_k$ (B)	A*B
Solid bulk (others)	4	0%	10%	0%	10%	10%	10%	0%	0%
Ore	13	0%	10%	0%	20%	10%	30%	0%	0%
Agricultural	472	1%	10%	1%	30%	9%	50%	1%	0%
Coal	986	1%	10%	2%	40%	9%	70%	1%	1%
Liquified gases	1.265	2%	10%	4%	50%	8%	90%	2%	2%
Ro-ro	4.196	6%	10%	10%	60%	4%	110%	6%	7%
Crude oil	4.567	7%	10%	16%	70%	3%	130%	7%	8%
Refined	7.246	10%	10%	27%	80%	0%	150%	10%	15%
Breakbulk	15.383	22%	10%	49%	90%	12%	170%	22%	37%
Containers	36.063	51%	10%	100%	100%	41%	190%	51%	98%
	70.195	100%	100%			107%			168%

Gini Coefficient 0,683

$$G = \left| 1 - \sum_{k=1}^{k=n-1} (X_{k+1} - X_k)(Y_{k+1} + Y_k) \right|$$

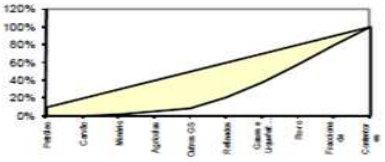


BARCELONA

Distribuição	000´Ton. (Y)	Quota % (Y)	Cargas Totais (X)	Cargas Acum. (Y)	Quota Acum. % (X)	|X-Y|	Xk-1 – Xk (A)	Yk-1 + Yk (B)	A*B
Crude oil	1	0%	10%	0%	10%	10%	10%	0%	0%
Coal	186	0%	10%	0%	20%	10%	30%	0%	0%
Ore	657	2%	10%	2%	30%	8%	50%	2%	1%
Agricultural	1.327	3%	10%	5%	40%	7%	70%	3%	2%
Solid bulk (others)	1.372	3%	10%	9%	50%	7%	90%	3%	3%
Refined	4.900	12%	10%	21%	60%	2%	110%	12%	14%
Liquified gases	6.657	17%	10%	38%	70%	7%	130%	17%	22%
Ro-ro	8.050	20%	10%	58%	80%	10%	150%	20%	30%
Breakbulk	8.589	22%	10%	80%	90%	12%	170%	22%	37%
Containers	8.050	20%	10%	100%	100%	10%	190%	20%	38%
	39.789	100%	100%			82%			147%

Gini Coefficient 0,472

$$G = \left| 1 - \sum_{k=1}^{k=n-1} (X_{k+1} - X_k)(Y_{k+1} + Y_k) \right|$$

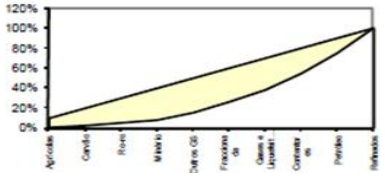


BILBAO

Distribuição	000´Ton. (Y)	Quota % (Y)	Cargas Totais (X)	Cargas Acum. (Y)	Quota Acum. % (X)	|X-Y|	Xk-1 – Xk (A)	Yk-1 + Yk (B)	A*B
Agricultural	262	1%	10%	1%	10%	9%	10%	1%	0%
Coal	681	2%	10%	3%	20%	8%	30%	2%	1%
Ro-ro	930	3%	10%	5%	30%	7%	50%	3%	1%
Ore	964	3%	10%	8%	40%	7%	70%	3%	2%
Solid bulk (others)	2.544	7%	10%	16%	50%	3%	90%	7%	7%
Breakbulk	3.750	11%	10%	26%	60%	1%	110%	11%	12%
Liquified gases	4.112	12%	10%	38%	70%	2%	130%	12%	15%
Containers	5.695	16%	10%	55%	80%	6%	150%	16%	25%
Crude oil	7.075	20%	10%	75%	90%	10%	170%	20%	35%
Refined	8.575	25%	10%	100%	100%	15%	190%	25%	47%
	34.588	100%	100%			69%			145%

Gini Coefficient 0,445

$$G = \left| 1 - \sum_{k=1}^{k=n-1} (X_{k+1} - X_k)(Y_{k+1} + Y_k) \right|$$

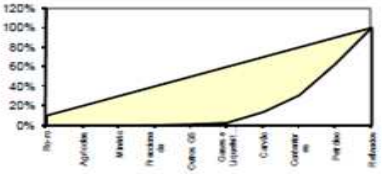


SINES

Distribuição	000´Ton. (Y)	Quota % (Y)	Cargas Totais (X)	Cargas Acum. (Y)	Quota Acum. % (X)	|X-Y|	Xk-1 – Xk (A)	Yk-1 + Yk (B)	A*B
Ro-ro	0	0%	10%	0%	10%	10%	10%	0%	0%
Agricultural	3	0%	10%	0%	20%	10%	30%	0%	0%
Ore	4	0%	10%	0%	30%	10%	50%	0%	0%
Breakbulk	77	0%	10%	0%	40%	10%	70%	0%	0%
Solid bulk (others)	200	1%	10%	1%	50%	9%	90%	1%	1%
Liquified gases	389	2%	10%	3%	60%	8%	110%	2%	2%
Coal	2.789	11%	10%	14%	70%	1%	130%	11%	14%
Containers	4.410	17%	10%	31%	80%	7%	150%	17%	26%
Crude oil	8.194	32%	10%	63%	90%	22%	170%	32%	55%
Refined	9.446	37%	10%	100%	100%	27%	190%	37%	70%
	25.512	100%	100%			115%			168%

Gini Coefficient 0,677

$$G = \left| 1 - \sum_{k=1}^{k=n-1} (X_{k+1} - X_k)(Y_{k+1} + Y_k) \right|$$

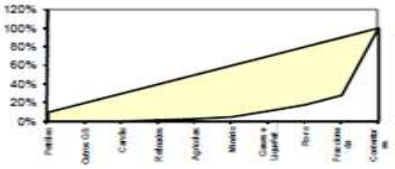


VALENCIA

Distribuição	000´Ton. (Y)	Quota % (Y)	Cargas Totais (X)	Cargas Acum. (Y)	Quota Acum. % (X)	|X-Y|	$X_{k-1} - X_k$ (A)	$Y_{k-1} + Y_k$ (B)	A*B
Crude oil	1	0%	10%	0%	10%	10%	10%	0%	0%
Solid bulk (others)	148	0%	10%	0%	20%	10%	30%	0%	0%
Coal	194	0%	10%	1%	30%	10%	50%	0%	0%
Refined	844	1%	10%	2%	40%	9%	70%	1%	1%
Agricultural	882	1%	10%	3%	50%	9%	90%	1%	1%
Ore	1.367	2%	10%	5%	60%	8%	110%	2%	2%
Liquified gases	4.325	6%	10%	11%	70%	4%	130%	6%	8%
Ro-ro	4.555	7%	10%	18%	80%	3%	150%	7%	10%
Breakbulk	6.949	10%	10%	28%	90%	0%	170%	10%	17%
Containers	49.029	72%	10%	100%	100%	62%	190%	72%	136%
	68.294	100%	100%			124%			176%

Gini Coefficient 0,764

$$G = \left| 1 - \sum_{k=1}^{k=n-1} (X_{k+1} - X_k)(Y_{k+1} + Y_k) \right|$$



APPENDIX 3. Iberian Ports: disaggregated Distribution per cargo types (2010).

A CORUÑA			
Category	mil. ton. (2010)	%	
Agriculture	1.517	12,8%	
Ore	659	5,5%	
Coal	499	4,2%	
Solid bulk (others)	516	4,3%	
Crude oil	4.506	37,9%	
Refined	2.866	24,1%	
Liquified gases	213	1,8%	
Breakbulk	1.005	8,5%	
Containers	93	0,8%	
Ro-ro	0	0,0%	
Total	11.874	100,0%	**0,574**

BILBAO			
Category	mil. ton. (2010)	%	
Agriculture	262	0,8%	
Ore	964	2,8%	
Coal	681	2,0%	
Solid bulk (others)	2.544	7,4%	
Crude oil	7.075	20,5%	
Refined	8.575	24,8%	
Liquified gases	4.112	11,9%	
Breakbulk	3.750	10,8%	
Containers	5.695	16,5%	
Ro-ro	930	2,7%	
Total	34.588	100,0%	**0,445**

GIJÓN			
Category	mil. ton. (2010)	%	
Agriculture	255	1,6%	
Ore	**6.298**	**40,2%**	
Coal	5.870	37,4%	
Solid bulk (others)	978	6,2%	
Crude oil	0	0,0%	
Refined	1.235	7,9%	
Liquified gases	2	0,0%	
Breakbulk	530	3,4%	
Containers	444	2,8%	
Ro-ro	69	0,4%	
Total	15.681	100,0%	**0,675**

SETÚBAL			
Category	mil. ton. (2010)	%	
Agriculture	226	3,2%	
Ore	334	4,8%	
Coal	570	8,1%	
Solid bulk (others)	2724	38,9%	
Crude oil	0	0,0%	
Refined	499	7,1%	
Liquified gases	201	2,9%	
Breakbulk	1696	24,2%	
Containers	498	7,1%	
Ro-ro	255	3,6%	
Total	7.003	100,0%	**0,537**

ALGECIRAS			
Category	mil. ton. (2010)	%	
Agriculture	472	0,7%	
Ore	13	0,0%	
Coal	986	1,4%	
Solid bulk (others)	4	0,0%	
Crude oil	15.383	21,9%	
Refined	7.246	10,3%	
Liquified gases	1.265	1,8%	
Breakbulk	4.567	6,5%	
Containers	**36.063**	**51,4%**	
Ro-ro	4.196	6,0%	
Total	70.195	100,0%	**0,683**

CARTAGENA			
Category	mil. ton. (2010)	%	
Agriculture	264	1,4%	
Ore	140	0,7%	
Coal	34	0,2%	
Solid bulk (others)	2.676	13,9%	
Crude oil	7.844	40,9%	
Refined	3.470	18,1%	
Liquified gases	3.808	19,8%	
Breakbulk	196	1,0%	
Containers	741	3,9%	
Ro-ro	11	0,1%	
Total	19.184	100,0%	**0,633**

HUELVA			
Category	mil. ton. (2010)	%	
Agriculture	928	4,2%	
Ore	1.618	7,3%	
Coal	535	2,4%	
Solid bulk (others)	2.313	10,5%	
Crude oil	5.650	25,6%	
Refined	2.805	12,7%	
Liquified gases	7.958	36,0%	
Breakbulk	283	1,3%	
Containers	0	0,0%	
Ro-ro	0	0,0%	
Total	22.090	100,0%	**0,588**

SINES			
Category	mil. ton. (2010)	%	
Agriculture	3	0,0%	
Ore	4	0,0%	
Coal	2789	10,9%	
Solid bulk (others)	200	0,8%	
Crude oil	8194	32,1%	
Refined	9446	37,0%	
Liquified gases	389	1,5%	
Breakbulk	77	0,3%	
Containers	4410	17,3%	
Ro-ro	0	0,0%	
Total	25.512	100,0%	**0,677**

AVEIRO			
Category	mil. ton. (2010)	%	
Agriculture	550	14,0%	
Ore	0	0,0%	
Coal	0	0,0%	
Solid bulk (others)	909	23,2%	
Crude oil	0	0,0%	
Refined	355	9,0%	
Liquified gases	596	15,2%	
Breakbulk	1.340	**34,1%**	
Containers	176	4,5%	
Ro-ro	0	0,0%	
Total	3.926	100,0%	**0,592**

CASTELLÓN			
Category	mil. ton. (2010)	%	
Agriculture	137	1,1%	
Ore	1.933	15,4%	
Coal	215	1,7%	
Solid bulk (others)	656	5,2%	
Crude oil	4.278	34,0%	
Refined	2.365	18,8%	
Liquified gases	1.024	8,1%	
Breakbulk	475	3,8%	
Containers	1.362	10,8%	
Ro-ro	120	1,0%	
Total	12.565	100,0%	**0,514**

LEIXÕES			
Category	mil. ton. (2010)	%	
Agriculture	741	5,1%	
Ore	327	2,2%	
Coal	0	0,0%	
Solid bulk (others)	1.158	8,0%	
Crude oil	2.995	20,6%	
Refined	3.246	22,3%	
Liquified gases	487	3,3%	
Breakbulk	596	4,1%	
Containers	4.992	34,3%	
Ro-ro	24	0,2%	
Total	14.566	100,0%	**0,570**

TARRAGONA			
Category	mil. ton. (2010)	%	
Agriculture	3.440	10,5%	
Ore	225	0,7%	
Coal	4.969	15,2%	
Solid bulk (others)	818	2,5%	
Crude oil	8.647	26,4%	
Refined	8.800	26,9%	
Liquified gases	2.046	6,2%	
Breakbulk	789	2,4%	
Containers	2.863	8,7%	
Ro-ro	169	0,5%	
Total	32.766	100,0%	**0,507**

BARCELONA			
Category	mil. ton. (2010)	%	
Agriculture	1.327	2,6%	
Ore	657	1,3%	
Coal	186	0,4%	
Solid bulk (others)	1.372	2,7%	
Crude oil	1	0,0%	
Refined	4.900	9,6%	
Liquified gases	6.657	13,1%	
Breakbulk	8.589	16,9%	
Containers	19.187	**37,7%**	
Ro-ro	8.050	15,8%	
Total	50.926	100,0%	**0,472**

EL FERROL			
Category	mil. ton. (2010)	%	
Agriculture	3	0,0%	
Ore	4.668	43,2%	
Coal	2.000	18,5%	
Solid bulk (others)	764	7,1%	
Crude oil	0	0,0%	
Refined	1.015	9,4%	
Liquified gases	1.601	14,8%	
Breakbulk	623	5,8%	
Containers	5	0,0%	
Ro-ro	131	1,2%	
Total	10.810	100,0%	**0,618**

LISBOA			
Category	mil. ton. (2010)	%	
Agriculture	3.384	28,2%	
Ore	42	0,4%	
Coal	10	0,1%	
Solid bulk (others)	1.220	10,2%	
Crude oil	0	0,0%	
Refined	1.270	10,6%	
Liquified gases	567	4,7%	
Breakbulk	287	2,4%	
Containers	5.170	43,1%	
Ro-ro	40	0,3%	
Total	11.990	100,0%	**0,668**

VALENCIA			
Category	mil. ton. (2010)	%	
Agriculture	882	1,3%	
Ore	1.367	2,0%	
Coal	194	0,3%	
Solid bulk (others)	148	0,2%	
Crude oil	1	0,0%	
Refined	844	1,2%	
Liquified gases	4.325	6,3%	
Breakbulk	6.949	10,2%	
Containers	49.029	71,8%	
Ro-ro	4.555	6,7%	
Total	68.294	100,0%	**0,764**

TOTALS		
Category	mil. ton. (2010)	%
Agriculture	14.391	3,5%
Ore	19.249	4,7%
Coal	19.538	4,7%
Solid bulk (others)	19.000	4,6%
Crude oil	64.574	15,7%
Refined	58.937	14,3%
Liquified gases	35.251	8,6%
Breakbulk	31.752	7,7%
Containers	130.728	31,7%
Ro-ro	18.550	4,5%
Total	**411.970**	100,0%

APPENDIX 4. Port of Sines: Disaggregated cargoes per type (2002-2011).

Sines	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	
		mil. ton.	mil. ton.	mil. ton.	mil. ton.	mil. ton.	mil. ton.	mil. ton.	mil. ton.	mil. ton.	
Solide bulk	**5.796**	**5.396**	**5.415**	**5.801**	**6.180**	**4.962**	**4.353**	**5.295**	**2.995**	**4.041**	**50.234**
agricultural	4,2	5	2,5	6	0	2,4	2	3,6	3	0	29
ore	66	6	4	12	4,3	8,7	0	4,2	3,5	4	113
coal	5.668	5.330	5.234	5.255	5.737	4.621	3.956	4.967	2.789	3.902	47.459
others GS	57	54	174	526	438	330	395	320	200	135	2.629
Liquid bulk	**14.318**	**15.442**	**16.764**	**18.551**	**19.506**	**19.321**	**17.780**	**15.977**	**18.030**	**16.150**	**171.839**
crude	8.736	9.457	9.883	10.046	9.913	9.009	8.651	7.159	8.194	7.029	88.077
refined	5.307	5.600	6.570	8.062	9.167	9.803	8.738	8.538	9.446	8.734	79.965
liquid gases	274	383	311	443	424	509	389	278	389	385	3.785
Breakbulk	**26**	**0**	**45**	**28**	**36**	**38**	**50**	**56**	**77**	**94**	**450**
Containers	**0**	**24**	**250**	**658**	**1.473**	**1.977**	**2.964**	**3.050**	**4.410**	**5.050**	**19.856**
Ro-ro	**0**	**0,55**	**0**	**0**	**0**	**0,02**	**0**	**0**	**0**	**0**	**0,57**
total	20.141	20.863	22.474	25.041	27.196	26.299	25.148	24.379	25.513	25.335	**242.389**