Action Plan towards the SMART PORT concept in the Mediterranean Area

SMART-PORT

D.3 Description of the competitive advantages and disadvantages of the Mediterranean container ports

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**MED Programme**

Priority-Objective 3.1.

Axe 3: Improvement of mobility and of territorial accessibility

Objective 3.1: Improvement of maritime accessibility and of transit capacities through multimodality and intermodality
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1 Introduction

The globalization of business and trade relationships and the communications revolution have transformed the world economy in a quite fundamental way, as international trade causing every party to operate in an increasingly competitive market. International transport operators are included in this struggle for market share. They are making efforts to satisfy customers’ needs by upgrading service quality, reducing costs. Some of the different actions they are developing are: creating huge containerships on mainline trade routes in order to capitalize on economies of scale, increasing service frequency through strategic alliances with other ship operators, providing feeder service networks on a regional basis meeting the geographically extensive needs of the shippers, among others (O’Kelly, 1998).

In this context, logistics in general and the maritime and port industry in particular, are evolving very rapidly. The maritime transport services have expanded enormously in a trend characterized by a worldwide redistribution of labor and capital and an integration or globalization of markets. It should be noted that this changes continues to drive the maritime sector today (Meersman and Van de Voorde, 2001). Port authorities and enterprises are often confronted with new technologies. From a business economics perspective, strategies must be adapted with a view to increasing profits. All of this translates into a modified market structure.

The customers of transport operators, the shippers, are also concerned about the logistics functions of cargo collection, consolidation, warehousing and inventory management at several hub ports. These trends for these agents, ship operators and shippers, also stimulate fierce competition of ports to become hub centers. With this scenery, most of the European ports are included in strong competition group, not only for the tons of cargo but also for the ship lines that have promote the investments into infrastructure, industry and the future flow of goods.

In recent times, the shipping companies are manifesting themselves as strategic customers of ports. On the one hand, they attract traffic and industrial activity to the port, while on the other hand, they are attracted by such industrial activity. In this company, a substantial scale increase has been observed. This has been achieved due to the horizontal cooperation and takeovers. In addition, shipping companies have set their sights on terminal operators and hinterland transport services, as operations are considered as complex logistics chains where each link must contribute to the optimization of the
According to Meersman et al. (2008), it is important to the maritime logistics chain that the economic benefits shipping companies seek through far-reaching scale increases and the corresponding cost reduction should not be wasted through time and cost bottlenecks on the quay, in the terminal or during hinterland transport.

This scenery has changed the competitive balance in the market, since shipping companies have acquired greater overall strength through their control of logistics chains. An important structural evolution, within the ports themselves, may be observed: traditional stevedoring firms are been developing into more complex terminal operating companies to solve the lack of working capital.

In this context, the market can be presented as an extremely dynamic environment where all parts involved in it must be assumed to proceed proactively and to anticipate on moves by other agents. In 2001, Heaver et al. (2001) examined the various forms of cooperation and concentration in the maritime sector. Table 1 collects an overview of the different forms of cooperation characterizing the port and maritime sector.

<table>
<thead>
<tr>
<th>Market players</th>
<th>Shipping companies</th>
<th>Terminal operators</th>
<th>Port authorities</th>
</tr>
</thead>
</table>
| Shipping companies | - Vessel sharing agreements  
| | - Joint ventures  
| | - Consortia  
| | - Alliances  
| | - Mergers and take-overs  
| | - Conferences  |
| Terminal operators | - Joint-ventures  
| | - Dedicated terminals  
| | - Capital Share  
| | - Consortia  |
| Port authorities | - Concessions for dedicated terminals  
| | - Concessions  
| | - Joint-ventures  |
| | - Alliances  |

Source: The relation between port competition and hinterland connections (Meersman et al. 2008)
One of the major problems in any operational decision of the ports is the demand for the turnover capacity. Thus, it is necessary to analyze the variables that determine the position port ranking. In order to determine the nature of the port competitiveness, Jolic et al. (2007) proposed to answer the following three questions:

- Which factors determine the port selection?
- Why a certain port is selected by users?
- What are the legal aspects with influence on the competitiveness of a port?

These authors described a seaport as a logistic and industrial center which has an active role in the global transport system that is characterized by slow and functional agglomeration of activities that are directly or indirectly included in the logistic chain. According to this definition, several levels of port competition can be defined:

- Competitiveness at one port
- Competitiveness between projects for different ports
- Competitiveness between port authorizations

### 1.1 Competition and port competitiveness

As it was mentioned before, globalization and increased competition are two of the main forces influencing the development of the port sector currently. In this competitive port environment, ports can be considered more than a complex of berths, docks and adjacent land where ships and cargoes are served. The novelty in this global economy is the degree of interdependence between actors and the opportunity to select worldwide the inputs, intermediate or finished services and products. This leads to increased competition in every stage of the logistics chain.

There are many definitions attributed to the term port aiming to include all the activities taking place in and through it. A port has been defined as a transit area or a gateway where people and goods move from and to the sea. As such, it is considered the place of contact between land and maritime space, an intermodal place of convergence. (Weigend 1958; Hayuth 1985). Ports act as interfaces between different elements, such as rail, road, inland waterway, maritime transport and logistics operators. In the present competitive port environment, it is important to determine the key factors that guide the users in choosing a specific port. According to the Notteboom (1998) “a sea port is a logistic and
industrial node in the global transport system with a strong maritime character and in which a functional and spatial clustering of activities takes place, activities that are directly or indirectly linked to seamless transportation and transformation process within logistic chain”.

The presented idea of considering ports as integral logistic chain is becoming more popular. This implies that the success of a port depends on many factors, not only on its performance on the market. These new concept requires proactive management and port policy.

As in other fields, competition requires competitiveness. Musso (2006) showed the relation between competition and competitiveness of ports. According to Figure 1, these terms are linked by the requirements for improvement, strengthening and stimulation of strengthening and improvement of quality of the port service and the position of the market.

![Figure 1](image_url)

Figure 1, Relation of competition and competitiveness of ports. Source: Ports: competition and competitiveness, Course in Advanced Port Economics, Antwerp, 2005. (Musso 2006).

Several factors have to be taken into consideration for the decision-making process in the selection of a certain port since the selection criteria is not only based on the integration of the production or transportation chain. When these factors are analyzed, it is relevant to be considered that the selection of the economic actors are based on several and different elements. Such elements are related not only to the technical characteristics of the port, but also and increasingly more to hinterland and logistic services offered. One of the most important segments of port competitiveness is the level of intervention of the state in the chain of port activities. In this way, Jolić et al. (2007) exposed that the shipping agencies, forwarders and port operators have to keep close connections in order to optimize
the goods flows and the port capacity. This position may vary depending on the position of the company within the port activities and the government investments, among other factors. These authors indicated that the competition and the competitiveness understand the research of different fields collected in the following table:

Table 2: Types of strategic partnerships in the maritime sector.

<table>
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<tr>
<th>Port economies</th>
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<td>Changes in economy</td>
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<td>Changes in transport industry</td>
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<td>Demand of port services and demand consequences</td>
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<td>Structure of port industry market</td>
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<th>Port selection criteria</th>
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<td>Position with respect to hinterland</td>
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<tr>
<td>Characteristics of geotraffic position</td>
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<td>Frequency of bottlenecks in the port</td>
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<table>
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<th>Characteristics of competitiveness</th>
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<td>Is there an optimal size of ports and terminals?</td>
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<td>Vertical integration: specialised port terminals</td>
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<td>Horizontal integration: linking</td>
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<td>Level of computerisation/robotisation of the port</td>
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<th>Micro and macro economic influence of changes on the market</th>
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<tr>
<td>Roles of ports and port politics</td>
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Source: Strategic positioning – instrument of port system competitiveness analysis (Jolić et al., 2007).

1.2 Port competitiveness evaluation

In the recent years, large number of publications related to maritime and seaport management has tried to analyze the fierce competition for market share among ports, including port operators and port authorities, located in the same port range and therefore, serving almost the same hinterland. The policy makers state serious concerns about competitiveness. This concern has increased its intensity as a response to globalization, rapid technical change and sweeping liberalization (Boltho, 1996).

Since the role of ports in social economy more and more important, the competition between the ports is becoming more intense. The way to evaluate port competitiveness is an important research field. Different methods used to evaluate port competitiveness are presented in the literature review:

Slack (1985) explored the criteria shippers employ in the port selection process. He examined the factors considered by exporters and freight forwarders, focusing on the containerized traffic between the North American Mid-West and Western Europe. His results suggest that the most principal factors
influencing the decision-makers are price and service considerations of land and ocean carriers. In this study, port infrastructures do not appear to play an important role in the routing decisions made by an important group of independent businesses involved in the North Atlantic container trade.

Branch (1986) tried to provide a practical, overall understanding of the elements of port operation and management of a competitive, profitable port authority. This book, based on the author’s experience reflected the most important criteria for port selection: cost, nature of traffic, adequacy of port facilities, overall efficiency and industrial relation records.

Bird and Bland (1988) reported on the Perception of Route Competition via Seaports in the European Communities Research Project by interviews to forwarders in different European countries. According to the results, the frequency of shipping service resulted to be a main reason for choice of seaport in cargo movement. In addition, time on the route and labor problems at ports are major worries of freight forwarders. Two of the most relevant conclusions are a preference for ‘delivered price’ consignments and the belief in the importance of port charges in route determination. In a second part of this study, the authors determined that the most important factors of concern in a freight forwarder’s life are costs and time.

Frankel (1992), concerned about the influence of shipping policy and decision-making on the choice between different ports, presented a hierarchical network approach for the determination of the most effective choice or strategy to represent the effect of policy alternatives on desired and undesired outcomes and the impact of these outcomes on the objectives. The suggested model was based on the analytic hierarchy or expert choice process and permitted the consideration of both qualitative and quantitative performance measures and their impact on policy or decision objectives.

D’Este and Meyrick (1992), in their study of the Australia–Tasmania RoRo market, observed differences between freight forwarders and producers (i.e. consignors) in selection criteria and they cited several other studies which found that differences exist between shipper and carrier perceptions of the selection variables.

Whyte (1992) also pointed to the prominence of source loyalty (i.e. buying a product or service from the same source from which it was obtained previously) in freight markets. This author presented this tendency as a key feature of the transport choice process.
Matear and Gray (1993) examined the factors that were important in the choice of freight services for both shippers and freight suppliers and explored whether the service choice decision was based on different sets of criteria for the two groups and further, whether freight suppliers used different criteria in selecting sea and air transport services. Principal components analysis was used to elicit the factors important in freight service choice. They demonstrated that shippers and freight forwarders employ different criteria in selecting transport services: carrier timing and price characteristics are more important for freight shippers while performance and schedule are more important for freight suppliers purchasing sea services and a combination of schedule and space is more important for freight suppliers purchasing air services.

Murphy et al. (1992, 1994) developed two analyses in order to analyze the port selection: univariate and multivariate ones. Both analyses indicated that the choice of port selection factors depended on the participants in international commerce. They showed that port selection factors are evaluated differently by freight forwarders, large shippers, small shippers, ferry operators and port managers.

Murphy et al. (1997) noted that while there may be differences between shippers and carriers in terms of mean importance ratings for different factors, the relative importance of the different factors within both groups (which could be illustrated by correlation) may be similar.

Cullinane and Toy (2000) undertook a content analysis, a technique which can measure the frequency of different words in a series of documents, considering the articles contained in a database of literature relevant to the subject of freight route/mode choice decisions obtaining the following hierarchy: cost/price/rate, speed, transit time reliability, characteristics of the goods and service. These authors stressed the importance of accurately identifying relevant factors in transport choice studies.

Kumar and Vijay (2002) analyzed the route and carrier determinant criteria in one supply chain from the Pacific-Rim region to the North Eastern region of the U.S., also known as the New England region. The objective of this paper was to provide a decision-making framework for the intermodal choices of shippers once their Pacific-Rim cargoes reach the U.S./Canadian West. Among the most critical factor to be considered in the transportation chain, the authors cited on time performance, value, information technology, equipment-operations and finally, customer service.

Mangan et al. (2002) used an in-depth, triangulated research methodology incorporating both quantitative and qualitative to investigate port selection in the Ireland/UK and Ireland/Continental
Europe markets. The qualitative methodology had never previously been employed in this context. In addition, determinants of choice and the role of other selection variables were elucidated and two techniques (input-oriented modelling based on the Aaker and Day model and process-oriented modelling) were employed to model the decision making process. The research provided a valuable insight into the operating dynamics of the Irish RoRo freight market that would be of particular use to all stakeholders in the sector.

Nirt et al. (2003) exposed that in the past, the method of research on port choice behavior can be divided into four types, namely descriptive statistics analysis, multi-objective decision analysis, multivariate analysis and multiple choice analysis. Each method has its characteristics and restrictions to make the analysis research differently. The authors focused their attention on the factors that may affect the user's port choice behavior, or even influence the cost of the whole fleet or shipper in the west coast of Taiwan. They used the revealed preference multinomial logical model for proceeding to the analysis of shippers' choice behavior concluding that the most important factors are highway travel time, travel cost, number of available routes and frequency.

Ha (2003) presented a comparative evaluation of service quality factors at 15 major container ports in the world. From previous studies and from personal interviews and questionnaires directed to containership operators and logistics managers, the important service quality factors were identified and comparisons among container ports were made. Duncan test analyses suggested that service quality at Northeast Asian ports lags behind that of well-developed major ports elsewhere.

Tiwari et al. (2003) modelled the port choice behavior of shippers, in China, using a shipper level database obtained from a survey of shippers of containerized cargo in China during 1998. The authors applied a discrete choice model where each shipper faced a choice of 14 alternatives, based on shipping line and port combinations, and made their decision on the basis of various shipper and port characteristics. The results indicated that the distance of the shipper from port, distance to destination (in case of exports), distance from origin (in case of imports), port congestion, and shipping line's fleet size play an important role in the transportation decisions of shippers. In addition, the authors estimated the changes in these variables and their impact on the market share of shipping line–port combinations.

Lirn et al. (2004) applied the Analytic Hierarchy Process (AHP) to analyze transshipment port selection by global carriers. An AHP designed questionnaire survey was distributed to port users, covering the
total population of global ocean container operators, and to transshipment service providers (port operators/authorities). The results of the AHP analysis revealed that both global container carriers and port service providers have a similar perception of the most important service attributes for transshipment port selection.

Malchow and Kanafani (2001 and 2004) used an alternative form of the discrete choice model to analyze the distribution of maritime shipments among US ports. They tried to model the distribution as a function of the characteristics that describe each shipment and each port. They assumed that vessel schedules were fixed in the short-term and examined the assignment to ports for exports of various commodity-types as a function of geographic location, port characteristics, and characteristics of vessel schedules. They concluded that the most significant characteristic of a port is its location. They showed also how the market share predicted for a port could be expected to vary with each commodity-type and each carrier.

Song and Yeo (2004) identified the competitiveness of container ports in China including Hong Kong from the outsiders' perspective, using the framework of the Analytic Hierarchy Process. In addition they tried to provide managerial and strategic implications.

Cullinane et al. (2005) analyzed the relative competitiveness of the neighboring container ports of Shanghai and Ningbo in China. Their objective was to develop a view of the likely future outcome of the competition between them. The relative competitiveness of the two ports was evaluated on the basis of price and quality of service, as embodied within the concept of generalized cost as incurred by customers. A critical political dimension was presented as a necessary element of this analysis.

Tongzon and Heng (2005), motivated by the phenomenon of privatization of the port industry, measured the port efficiency identifying the relationship between the owner-ship structure and port efficiency. In this way, they tried to help port authorities improve their operation efficiency. They presented a method based on Principal Component Analysis to establish a port competitiveness index. This index was used to justify the total throughput as a proxy for port competitiveness and then, they ran a regression model of total through-put on the determinants of port competitiveness. By this model, the casual relationship between the determinants and the total throughput was examined. In this study, the determinants considered to analyze port competitiveness were: port terminal operation efficiency level, port cargo handling charges, reliability, port selection preferences of carriers and
shippers, the depth of the navigation channel, adaptability to the changing market environment, landside accessibility and product differentiation.

Guy and Urli (2006) tried to assess whether the accepted rationale of port selection by shipping lines – based on the combined importance of quality of infrastructures, cost, service and geographical location – was useful to account for the selection behavior observed in the Northeast of North America. They used a multicriteria approach in combination with scenarios where the relative importance given to selection criteria and the performance of ports are both varied across a wide range. This allowed them to assess how port preference was affected by changes in criteria weight (expressing selection rationale) and by changes in evaluation (expressing relative port performance). They concluded by discussing the implications for the hub-and-spoke paradigm of network evolution.

Ugboma et al. (2006) presented the findings of a survey to determine the service characteristics that shippers consider important when selecting a port and the way these characteristics are prioritized according to their importance. Seven criteria for the port selection decision and four ports were identified, and the decision problem was structured into a three-level hierarchy using the Analytic Hierarchy Process. The findings suggested that shippers place high emphasis on efficiency, frequency of ship visits and adequate infrastructure, while quick response to port users' needs was insignificant to them.

Acosta et al. (2007) analyzed the factors affecting port competitiveness from the perspective of the agents and companies that operate in one of the Mediterranean ports most active in container traffic: the Port of Algeciras Bay. Authors considered that it was essential to understand the perspective of the suppliers of port services, in order to apply the necessary judgment when formulating policies to strengthen the competitive position of a port. The model selected by them to meet the objective outlined was based on the ‘extended diamond’ of Porter. Within this methodology, two procedures were used: quantitative and qualitative perspective. From the data obtained in the survey, a model was estimated by using L1 regression. This model enabled the competitive advantages and disadvantages of the port, from the point of view of port operators. The analysis demonstrated that the variables representing greater competitive advantages are associated with trans-shipment, and with the maritime accessibility of the Port to vessels, whereas those generating greater disadvantages are associated with rail transport.
Shintani et al. (2007) analyzed the design of container liner shipping service networks by explicitly taking into account empty container repositioning. Two key and interrelated issues, those of deploying ships and containers are usually treated separately by most existing studies on shipping network design. In this paper, both issues were considered simultaneously. The problem was formulated as a two-stage problem. A genetic algorithm-based heuristic was developed for the problem. Through a number of numerical experiments that were conducted it was shown that the problem with the consideration of empty container repositioning provided a more insightful solution than the one without.

Grosso et al (2008) tried to identify the main factors criteria influencing the decision of freight forwarders in choosing a port. These authors developed a methodology based on qualitative analysis using a 5-point Likert scale questionnaire that was submitted to a sample of freight forwarding companies operating in the port of Genoa. The findings of their research showed that the main elements affecting the decision of port choice could be grouped in four broad factors: connectivity of the port, cost and port productivity, electronic information and logistics of the container. In addition, they discussed how these factors were evaluated from the freight forwarders perspective.

Leachman (2008) presented an economic optimization model of waterborne containerized imports from Asia to the USA. Imports are allocated to alternative ports and logistics channels so as to minimize total transportation and inventory costs for each importer. The model was exercised with 2004 transportation costs, import volumes and declared values, plus a range of hypothetical container fees assessed on imports routed via the San Pedro Bay Ports. The results demonstrated that, without reductions in container movement lead times, container fees would result in significant diversion of cargoes to other ports.

Chang et al. (2008) identified the factors affecting shipping companies’ port choice based on a survey to a sample of shipping companies. Six factors were considered relatively important: local cargo volume; terminal handling charge; berth availability; port location; transhipment volume and feeder network. Exploratory factor and confirmatory factor analyses identified five port choice categories: advancement/convenience of port, physical/operational ability of port, operational condition of shipping lines, marketability and port charge. A comparison between the main trunk and feeder service providers indicated that the former face more intense competition than the latter. Moreover, authors exposed that the main haul shipping lines are more sensitive to port cost factors.
Meersman et al. (2008) discussed the relationship between port competition and hinterland connections. They presented an analysis based on expected trends in maritime transport and the likely consequences for seaports. This research showed capacity to be the key to success, both in maritime throughput and in hinterland transportation services.

Wiegmans et al. (2008) concerned about the importance of port choice and container terminal selection for deep-sea container carriers, tried to analyze three dimensions: the buying decision characteristics; port choice strategy; and terminal selection. The results showed that strategic considerations at company level are important. For port choice the most important criteria from a carrier’s perspective resulted to be the following ones: availability of hinterland connections, reasonable tariffs and immediacy of consumers (large hinterland). In addition to these criteria, shipping lines attach great value to often neglected factors, such as feeder connectivity, environmental issues and the total portfolio of the port. The study revealed that port selection and terminal selection are not the same with terminal selection criteria mainly depending on: handling speed, handling costs, reliability and hinterland connections.

Tongzon (2009) tried to evaluate the major factors influencing port choice from the Southeast Asian freight forwarders’ perspective, their decision-making style and port selection process and draw out some policy implications for port operators and authorities. Efficiency was found to be the most important factor followed by shipping frequency, adequate infrastructure and location.

Liang et al. (2010) expose that all external and internal factors had to be considered for the measurement of a port’s overall competitiveness. Thus, a large number of indicators has to be used to evaluate a port. These authors used the statistical technique based on Factor analysis for port’s comprehensive competitiveness evaluation, providing a valuable suggestion for the managers port to make the strategy of development. Using this technique, the observable variables may be represented by lower number of common factors. In this technique, the weight factors are determined by variance. Few works about the application of FA applied to port’s comprehensive competitiveness evaluation have been presented in the literature (Wang et al. 2007).

Acosta et al. (2011) provided an exploratory analysis from the perspective of the port operators of the factors determining the competitiveness of fuel supply at the ports of the Gibraltar Strait. The study was based on interviews and questionnaires focused on public and private institutions involved in the port services. The results revealed that fuel prices and geographical advantage are the two main factors
seen by Gibraltar Strait port operators as influencing shipping company choice of bunkering port. In order of importance, other identified factors related to the cost and quality of services, including port tariffs, supply waiting time, service rates, simplicity of crew changing, presence of restrictive environmental regulations and customs strictness.

Liu et al. (2013) presented a port competitiveness evaluation model according to the characteristics of Chernoff Faces. They used the model to evaluate port competitiveness of ten coastal ports in China, mapping out all the ports in image. Through those images, authors could see the relative strength of port competitiveness clearly, providing the final rank of the ten ports.

Talley et al. (2013) deduced that the port choice literature is included in the maritime transport chain choice literature. Authors demonstrated that determinants of the port choice by shipping lines and shippers found in the literature and determinants of shipping line and shipper choice by ports are also determinants of maritime transport chain choice.

Sayareh et al. (2014) presented a paper where the main objective was to weigh the most dominant decision-making criteria by Technique for Order Preference to Similarity by Ideal Solution (TOPSIS) and selected an optimized container seaport in the Persian Gulf by Analytical Hierarchy Process (AHP) according to decisive port selection factors. The findings of this research suggested that the working time, stevedoring rate, safety, port entrance, sufficient draft, capacity of port facilities, operating cost, number of berths, ship chandelling, and international policies are critical factors for selecting container seaport in the Persian Gulf.

2 Methodology

The literature on the issue of competitiveness is extensive. Among them, an influential and classical approach is the diamond model developed by Porter (1990). In this model, all factors influencing the competitiveness were classified into interrelated components and exogenous parameters. These factors included factor conditions, demand conditions, related and supporting industries, firm strategy-structure and rivalry while the latter included government and chance. According to Porter’s study the definition of these factors are presented below.
• Factor conditions: The Nation’s position in factors of production, such as skilled labor or infrastructure, necessary to compete in a given industry, in the case presented in this study it would be the factors of production presented in the port.

According to standard economic theory, factor of production will determine the flow of trade. The most important factors in this group are those involving sustained and heavy investment and they are specialized. In order to be able to support competitive advantage, a factor has to be highly specialized to the particular needs presented in the port activities. These factors are scarcer and they are more difficult for foreign competitors to imitate.

• Demand conditions: The nature of home-market demand for the industry’s product or service. It might seem that the globalization of competition would diminish the importance of home demand. However, this is not the case since nations gain competitive advantage in ports where the home demand provides their companies clearer scenery of emerging buyer needs and where customers pressure ports to innovate faster and achieved more sophisticated competitive advantage than their foreign rivals. In general way, a port can anticipate global trends if the nation’s values are spreading.

• Related and supporting industries: The presence or the absence in the nation of supplier industries and other related industries that are internationally competitive. Internationally competitive home-based suppliers generate advantages since they deliver the most cost-effective inputs in an efficient, rapid and early way. According to Porter study, the nation’s companies benefit most when the suppliers are, themselves, global competitors.

• Firm Strategy, Structure and Rivalry: The condition in the nation governing how companies are created organized and managed as well as the nature of domestic rivalry. National scenery and context have influence on how companies are created, organized and managed. No one managerial system is appropriate universally. competitiveness in a port results from the convergence of the management practices and organizational modes favored in the country and the source of competitive advantage in the industry. In addition, countries can also differ markedly in the goals that company set. These goals reflect the characteristics of national capital markets and the compensation practices for manager in each company.

According to Porter, these determinants define the nation environment in which companies are born and learn how to compete. Each point of the diamonds, and the whole diamond, has influence on
essential ingredients for achieving international competitiveness success such as the information that
defines the opportunities that companies perceive and the direction in which they have to be working
on, the goals of the owners, managers and individual companies...

In the study presented by Porter, he concluded that when a national environment permit and supports
a fast accumulation of specialized assets and skills or when the national environment affords better
ongoing information and insight into products and process needs, companies gain a competitive
advantage. Furthermore, if the national environment encourages companies to be innovated,
companies both gain a competitive advantage and upgrade those advantage overtime.

Although some weaknesses existed in Porter’s diamond model, it was considered as a key tool for the
analysis of competitiveness and applied in many areas (Fahy, 2002; Berger, 2008). One of the most
important reason was that it provided many feasible guidance to identify factors influencing the
competitiveness of countries, industries and firms from a systematic and comprehensive perspective
(Zanakis and Becerra-Fernandez, 2005; Zhao et al., 2011; Ajitabh and Momaya, 2004).

Afterwards, the diamond model was expanded by other authors. For example, Dunning (1992)
proposed to treat multinational activity as a third exogenous parameter that should be added to
Porter’s model. Rugman and D’Cruz (1993) developed the double diamond model, as an extension of
Porter’s original diamond model. In this case, both domestic and foreign diamonds were considered.
This method has also been employed to identify influence factors of competitiveness of a country’s
shipping industry. In this context, port competitiveness is one of the most prominent issues drawing
considerable attention in the literature since many maritime countries have been motivated to carry
out large-scale port development in order to improve their infrastructure, expand facilities and improve
services. This scenery creates ever-increasing competition between ports.

2.1 Data analysis
According to the results obtained from the surveys, a matrix X(m), composed of R rows and C columns
was constructed for each m (company or institution interviewed). It has to be noted that some of those
surveyed may give responses biased towards the upper or lower extreme rating than others since the
personality or attitude of the person interviewed may have influence on the answer, rather than a real
difference related to the competitiveness of the Port. To avoid this effect, the responses to each
question may be typified according to the following equation:
where \( I = 1, 2, \ldots, R \) and \( j = 1, 2, \ldots, C \).

Subsequently, each ‘m’ matrices was reduced to a single matrix (Z) calculating the mean of each cross value from the typified data. Analysis of the key factors of competitiveness reveals which are the rows and columns corresponding to a positive or negative assessment, and if there is any interaction between different rows and columns. According to Hubert and Rousseeuw (1997), extreme factors can be detected by calculating the deviation of each cell of the response matrix, previously typified, from the mean behavior of all cells. In order to calculate the mean behavior of columns and rows, the values of the matrix will be related with two groups of regressors constituted by fictitious variables. The first group reflects the mean behavior of each column, in this case this group is related to the functional activities undertaken in the Port whereas the second group reflects the mean behavior of each row, the determinants of the competitiveness of the port. R fictitious variables for the rows and C variables for the columns are constructed. Logically, as an independent term is included in the model, R-1 regressors for the first group and C-1 for the second have to be introduced in the model. Finally, the structure of the model may be given by:

\[
Z_{ij} = \theta_0 + \sum_{k=1}^{R} \alpha_{ik} I_{jk(k)} + \sum_{l=1}^{C} \beta_{lj} J_{ij(l)} + e_{ij}
\]

(2)

Where \( I_{jk(k)} = 1 \), for \( I = k \), and \( I_{ij(k)} = 0 \) for the rest of the possibilities. Similarly, \( J_{ij(l)} = 1 \), for \( j = l \), and \( J_{ij(l)} = 0 \) for the other values. The independent term is \( \theta_0 \) and \( e_{ij} \) is the random perturbation.

In order to estimate the model, ordinary least squares may be applied. However, this method is very sensitive to the existence of extreme patterns. To avoid it, the model was estimated minimizing the sum of the residuals in absolute value. The finally equation defining the model corresponds to the formula (L1 regression):

\[
\hat{Z}_{ij} = \hat{\theta}_0 + \sum_{k=1}^{R} \hat{\alpha}_{ik} I_{jk(k)} + \sum_{l=1}^{C} \hat{\beta}_{lj} J_{ij(l)} = \hat{\theta}_0 + \hat{\alpha} + \hat{\beta}^l
\]

(3)

At this point, the residuals are generated from the differences between the real values of the matrix of standardized scores and from the values estimated using the model given by the following expression:

\[
e_{ij} = Z_{ij} - \hat{Z}_{ij}
\]

(4)
The estimation of the model provides as many residuals as the number of boxes in the matrix of competitiveness ($R \times C$). According to the analysis of the residuals, in terms of whether they are considered atypical or extreme and of their positions in the matrix, the competitive advantages and disadvantages can be determined.

If any of the residuals $e_{ij}$ obtained are unusually large, this can be considered that the real value of the dependent variable is not completely explained by the mean effect of the rows and columns. Therefore, considering the statements proposed by Haezendonck (2002) and Winkelmans (2002), it can be concluded that there is an interaction between row $i$ and column $j$, that is, between functional activities undertaken in the Port and resources needed for the port operation.

Therefore, the detection of high residuals, positive and negative, may lead to the detection of advantages and disadvantages, respectively, in terms of competitiveness. The best way to detect in which observations are the interactions is by representing the standardized residuals graphically, $\hat{e}_i = e_i / \hat{\sigma}$ against the estimated values $\hat{e}_i$. When the residuals are distributed similar to a normal distribution, 85% of them will be located between $-1.5$ and $+1.5$. Values out of that range can be taken as extreme observations. This indicates positive or negative interaction, respectively.

In the following section, the results of the application of this procedure are presented for each port. In this case, all the questionnaires were treated by similar way; that is, attaching equal value to all the responses and obtaining from them the perceived competitive advantages and disadvantages.

3 Results

The objective of this research is to analyze the factors that affect port competitiveness from the perspective of the agents and companies that operate in each one. The model selected to achieve the objective is based on the "extended diamond" of Porter. The survey has the aim of assessing the competitiveness of the Port of Tripoli from the perception of companies and institutions in the sector, regarding dry bulks that enters by sea and leaves by truck.

The survey is divided into two parts (Annex 1). The first one contains questions about the identification or situation of the company. The second part of the survey is the most important one and consists of a questionnaire of competitiveness. The answers to the questions asked in this questionnaire are based
on a scale of estimated intensity/importance, in function of the perception of the person who is interviewed. They must score according to a range of variables depending on whether they constitute a disadvantage or an advantage for the competitiveness of the Port:

- -2: Very unfavourable.
- -1: Unfavourable.
- 0: Neutral (variables that constitute neither an advantage nor a disadvantage for the competitiveness of the port)
- +1: Favourable.
- +2: Very favourable

The survey matrix presents the perceptions obtained from the second part of the questionnaire. It combines the functional activities performed in the Port, from a perspective of logistic chain, with the determinants of port competitiveness. The functional activities performed in a port (the horizontal axis of the matrix) are subdivided into:

- Activities related to the foreland:
  - Maritime accessibility (ACC)
  - Maritime transport (MAR)
- Activities concerning the port sector itself:
  - Transshipment (T/S)
  - Storage (STR)
  - Logistics that provide value added and manufacturing industry (AV)
  - Activities of the maritime transport agents (AG)
- Activities linked to the hinterland:
  - Road transport (ROAD)
  - Rail transport (RAIL)

The determinants of port competitiveness are represented on the vertical axis. These determinants are structured in accordance with the components of Porter’s extended diamond, as follows:

- Factor conditions:
  - Infrastructure (INF)
- Superstructure (SUP)
- Human capital (HC)
- Technology and communications systems (T&C)

- Competition in the Port:
  - State of the internal competition in the port community (IC)
  - Cooperation or collaboration of the institutions or companies involved in the port activity (CC)

- Government or public sector:
  - Intervention or position of the Port Authority (PA)
  - Intervention or position of the Central Government (CG)

- Environment:
  - Air Emissions (AE)
  - Solid and Liquid Wastes (WST)

- Total Energy (Electricity consumption and Fossil fuel consumption)
  - Total Energy Consumed (EC)

The results of the surveys conducted to all ports has been summarized with the aim of maintain some aspects of confidentiality of the ports analyzed.

Table 3. Identification of advantages and disadvantages

<table>
<thead>
<tr>
<th>INF</th>
<th>ACC</th>
<th>MAR</th>
<th>T/S</th>
<th>STR</th>
<th>AV</th>
<th>AG</th>
<th>ROAD</th>
<th>RAIL</th>
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</thead>
<tbody>
<tr>
<td>SUP</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

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In the matrix above the amount of ports that consider that elements as advantages (marked in green) or disadvantages (in red) can be observed. If the cell has been filled, it means that this parameter has been pointed out certainly as a great advantage or disadvantage for any of the ports. The different advantages and disadvantages that have been identified by the respondents are described below one by one.

a) Resources or factor conditions

- **Infrastructure**
  
  Due to the set of variables that contributes to the port competitiveness of the analyzed ports, the infrastructure related to the maritime accessibility it can be highlighted the accessibility of the vessels entering to the port, the transshipment of containers and the storage. The reasons argued by the respondents to make this assessment has been, among others, the large investments carried out by the national, regional or local governments or by the port authorities themselves. The main objective of these investments is to avoid the bottlenecks in the container traffic growth.

  Nonetheless, in this infrastructure section, it can be also found the variables that make the set of analyzed ports less competitive: the facilities that enable the transport of goods by rail and road transport, especially those related with road transport. And to a lesser extent, those related to the logistic and manufacturing activities and those related to the maritime transport.

- **Superstructure**

  In this section two variables that improve the port competitiveness of the analyzed ports can be highlighted: the superstructure that allows containers transshipment (the cranes,
the warehouses, the offices, the controlled atmosphere spaces, etc.) and the superstructure related to the maritime transport agents activities. Nevertheless, the superstructure needed for the logistic activities that provides added value for the goods and that one related to the manufacture good that could be contenerized, as well as those related to the storage, have been considered as competitive disadvantages for these ports. The respondents have highlighted the lack of warehouses, offices, cranes that facilitate the intermodality, etc. and the limited activity of the Logistic Activities Zone related, among other aspects, the manufacturing processes that provides added value.

Another variable that reduces the port competitiveness of the analyzed ports is the superstructure regarding to the rail transport. Regarding to the respondents, it is due to they barely exist facilities to enable the rail transport.

- Human Capital
  In this section there are two variables that influence the port competitiveness of the analyzed ports. The first one it is the human capital related to the activities carried out by the ship agents. It is assumed as a competitive advantage due to the proper training of the staff. The second one is the human capital regarding to the transshipment, that it is considered as an important competitive disadvantage owing to the high cost of the stowage in the majority of ports.

- Technology and communications
  The technologies and communications related to the maritime accessibility are considered as key factors of the port competitiveness, among them, Ais software has been stood out.

b) Competitiveness of the port

- State of internal competition in the port community
  The respondents have emphasized two variables within the internal competition as a competitive advantage, those related to the ship agents and road transport, in which a fierce competition has been pointed out between the two activities.
Nevertheless, two competitive disadvantages have been identified in this section, those related to the rail transport and with the maritime accessibility of vessels. The reason is that there are monopolies in both services due to there are no private companies that provide these services or they are not relevant.

c) Government or public sector

- Intervention or position of the Port Authority
  The intervention of the Port Authorities related to the road and rail transport of the containerized goods is considered as a competitive advantage. Regarding to the respondents, there is a pressure ejected over the central government to improve the modes of transport and improve the intermodality.

- Intervention or position of the Central Government
  Some respondents have pointed the role of the central government regarding to the railroad transport as a competitive disadvantage.

d) Environment

- Air emissions
  This factor has been identified as an important one, which has defined some of the greater advantages and disadvantages according to the respondents, especially in the aspects related with the rail and road transport. Regarding to this factor, the respondents have highlighted a variable as a competitive advantage: the air emissions related to the railroad transport, it is due to the railway line is electrified in some stretches and their emissions are reduced to that areas in which a diesel locomotive is employed.
  Furthermore, air emissions related to the maritime and road transport has been identified as a competitive disadvantage due to the high emissions emitted from the engines of that kind of transport.

- Solid and liquid wastes
Two variables have been pointed out as a competitive advantage for the analyzed ports. Firstly, and as a great advantage for three ports, the solid and liquid wastes related to the railroad transport, and secondly, those related to the logistic and manufacturing activities that provide an added value, where the respondents have highlighted the good performance of the collection of waste systems and the public intervention to reduce them. Nevertheless the respondents have remarked the solid and liquid wastes regarding to the road transport as a competitive disadvantage.

e) 5. Energy

Energy Consumption

The variable that relates the energy consumption with the railroad transport is one of the variables that, regarding to the respondents is considered by four ports as a competitive advantage. As in the prior section, it is due to the electrification of the railway line. On the contrary, the energy consumption related to the road transport is considered as a competitive disadvantage.
4 References


Annex: Survey

SURVEY ABOUT COMPETITIVENESS OF THE PORTS

PART I: QUESTIONS OF STATUS OF THE COMPANY

1. Subsector which the company belongs to:
2. Staff numbers:
3. Age of the company at the port:
4. Geographical scope of the company:
5. Function within the organization:

PART II: QUESTIONNAIRE TO ASSESS THE PERCEPTION (-2, -1, 0, +1, +2)

A. ISSUES RELATED TO MEANS USED TO PROVIDE PORT SERVICES:

<table>
<thead>
<tr>
<th>Service</th>
<th>Assessment</th>
<th>Perceived</th>
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<tbody>
<tr>
<td>Maritime accessibility</td>
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<td>Storage</td>
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<td>Logistics that provide value added and</td>
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<tr>
<td>manufacturing industry</td>
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<tr>
<td>Activities of the maritime transport agents</td>
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<tr>
<td>Road transport</td>
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<tr>
<td>Rail transport</td>
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</table>

A.2. Assess available superstructure (i.e. berth and yard cranes, storage and office buildings, plugs of reefer containers …) to provide the following services:

For example (A.2.1.) Assess the available superstructure to facilitate maritime access of vessels to the port.
A.2.1. Maritime accessibility  &  2 & 1 & 0 & -1 & -2  
A.2.2. Maritime transport  &  2 & 1 & 0 & -1 & -2  
A.2.3. Trans-shipment  &  2 & 1 & 0 & -1 & -2  
A.2.4. Storage  &  2 & 1 & 0 & -1 & -2  
A.2.5. Logistics that provide value added and manufacturing industry  &  2 & 1 & 0 & -1 & -2  
A.2.6. Activities of the maritime transport agents  &  2 & 1 & 0 & -1 & -2  
A.2.7. Road transport  &  2 & 1 & 0 & -1 & -2  
A.2.8. Rail transport  &  2 & 1 & 0 & -1 & -2  

| A.3. Assess human capital (i.e. number and quality of employees) to provide the following services: |
|__________________________________________________________________________________________|
| For example (A.3.1.) Assess the human capital to facilitate maritime access of vessels to the port. |
|__________________________________________________________________________________________|
| A.3.1. Maritime accessibility  &  2 & 1 & 0 & -1 & -2  
A.3.2. Maritime transport  &  2 & 1 & 0 & -1 & -2  
A.3.3. Trans-shipment  &  2 & 1 & 0 & -1 & -2  
A.3.4. Storage  &  2 & 1 & 0 & -1 & -2  
A.3.5. Logistics that provide value added and manufacturing industry  &  2 & 1 & 0 & -1 & -2  
A.3.6. Activities of the maritime transport agents  &  2 & 1 & 0 & -1 & -2  
A.3.7. Road transport  &  2 & 1 & 0 & -1 & -2  
A.3.8. Rail transport  &  2 & 1 & 0 & -1 & -2  

| A.4. Assess technology and communications to provide the following services: |
|__________________________________________________________________________________________|
| For example (A.4.1.) Assess the technology and communications to facilitate maritime access of vessels to the port. |
|__________________________________________________________________________________________|
| A.4.1. Maritime accessibility  &  2 & 1 & 0 & -1 & -2  
A.4.2. Maritime transport  &  2 & 1 & 0 & -1 & -2  
A.4.3. Trans-shipment  &  2 & 1 & 0 & -1 & -2  
A.4.4. Storage  &  2 & 1 & 0 & -1 & -2  

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### A.4.5. Logistics that provide value added and manufacturing industry

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### A.4.6. Activities of the maritime transport agents

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### A.4.7. Road transport

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### A.4.8. Rail transport

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### B. ISSUES RELATED TO THE COMPETITION INSIDE THE PORT:

#### B.1. Assess the state of the internal competition (i.e. number of companies that provides the same service) in the port community to provide the following services:

For example (B.1.1.) Assess the state of the internal competition in the port community to facilitate maritime access of vessels to the port.

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<tr>
<th>Service</th>
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<tbody>
<tr>
<td>B.1.1. Maritime accessibility</td>
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<td>B.1.5. Logistics that provide value added and manufacturing industry</td>
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<td>B.1.6. Activities of the maritime transport agents</td>
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#### B.2. Assess the cooperation or collaboration of the institutions or companies involved (i.e. level of integration of the different organizations involved) in the port activity to provide the following services:

For example (B.2.1.) Assess the cooperation o collaboration of the institutions or companies involved in the port activity to facilitate maritime access of vessels to the port.

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### B.2.6. Activities of the maritime transport agents

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### B.2.7. Road transport

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### B.2.8. Rail transport

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### C. ISSUES RELATED TO GOVERNMENT OR PUBLIC SECTOR:

#### C.1. Assess the role of the Port Authority to provide the following services:

**For example (C.1.1.) Assess the role of the Port Authority to facilitate maritime access of vessels to the port.**

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<th>Service</th>
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<td>C.1.2. Maritime transport</td>
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<tr>
<td>C.1.6. Activities of the maritime transport agents</td>
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<td>C.1.7. Road transport</td>
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<td>C.1.8. Rail transport</td>
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#### C.2. Assess the role of the Central Goverment to provide the following services:

**For example (C.2.1.) Assess the role of the Central Goverment to facilitate maritime access of vessels to the port.**

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<th>Service</th>
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<td>C.2.7. Road transport</td>
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</table>
D. ISSUES RELATED ENVIRONMENT:

D.1. Assess the air emissions to the environment (i.e. total emissions) to provide the following services:

For example (D.1.1.) Assess the air emissions to the environment to facilitate maritime access of vessels to the port.

<table>
<thead>
<tr>
<th>Service</th>
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<tr>
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<tr>
<td>D.1.6. Activities of the maritime transport agents</td>
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<tr>
<td>D.1.7. Road transport</td>
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<td>D.1.8. Rail transport</td>
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</table>

D.2. Assess the solid and liquid wastes to provide the following services:

For example (D.2.1.) Assess the solid and liquid wastes to the environment to facilitate maritime access of vessels to the port.

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</table>
E. ISSUES RELATED ENERGY CONSUMPTION:

E.1. Assess the total energy consumption to provide the following services:

For example (E.1.1.) Assess total energy consumption to facilitate maritime access of vessels to the port.

| E.1.1. Maritime accessibility | 2 | 1 | 0 | -1 | -2 |
| E.1.2. Maritime transport      | 2 | 1 | 0 | -1 | -2 |
| E.1.3. Trans-shipment         | 2 | 1 | 0 | -1 | -2 |
| E.1.4. Storage                | 2 | 1 | 0 | -1 | -2 |
| E.1.5. Logistics that provide value added and manufacturing industry | 2 | 1 | 0 | -1 | -2 |
| E.1.6. Activities of the maritime transport agents | 2 | 1 | 0 | -1 | -2 |
| E.1.7. Road transport         | 2 | 1 | 0 | -1 | -2 |
| E.1.8. Rail transport         | 2 | 1 | 0 | -1 | -2 |