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Analysis of possibilities the North Aegean Candarli Port of being a regional hub port in the Mediterranean Sea region

Hasan Tarcan
World Maritime University

WORLD MARITIME UNIVERSITY

Malmö, Sweden

ANALYSIS OF POSSIBILITIES THE NORTH AEGEAN CANDARLI PORT OF BEING A REGIONAL HUB PORT IN THE MEDITERRANEAN SEA REGION

By

HASAN TARCAN

Turkey

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(PORT MANAGEMENT)

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Declaration

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

Signature: …….

Date: ……..…

Supervised by: **Daniel MOON**
Professor
World Maritime University

Assessor: ……
……..

Co-Assessor: ……
……..

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Abstract

Title of dissertation: T**he analysis of possibilities the North Aegean Candarli Port of being a regional hub port in the Mediterranean Sea Region.**

Degree: **MSc**

Mediterranean Sea is the main transportation corridor between Far- East Asia and Europe Port Said, the port of Piraeus, Malta are the main ports in the region. In this environment, the Turkey Government is urged to develop its port infrastructure because of the determinant the hub port for the region and shippers that is called North Aegean Candarli Port. However, ports have become a member of highly competitive environment in the Black Sea and Mediterranean Region. Therefore, global carrier`s expectations should be considered.

The author looked for the answer whether there is any possibility to be a region hub port or not for the North Aegean Candarli Port. As a result of the question, author carried out analytic network process. In ANP, the defining port competition criteria, identifying the competitors in the region and analyzing the hub port selection points in the region was key elements. In addition to ANP, the demand forecast analysis made by author is aimed to find the demand in the region for the following years, so that hinterland, transshipment cargo and global trade are emphasized because of the directly effect on the container freight flow. To analyze the demand forecast, multi linear regression analysis, linear regression analysis and correlation coefficient analysis were carried out.

The conclusion shows that Candarli Port has potential as selected port by the carriers among the competitors and selected by the shippers according to this research. ANP application results support the statement that Candarli Port can be a hub port in the future.

KEY WORDS: ANP, hub port, demand forecast, port selection criteria.

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LIST OF ABBREVIATIONS

AHP	Analytic hierarchy process
ANP	Analytic network process
BOCR	Benefits, opportunities, costs and risks
EU	European Union
GDP	Gross domestic product
NACP	North Aegean Candarlı Port
TEU	Twenty-foot equivalent unit
T/S	Transshipment cargo
TEN-T	Trans-European transport network
TURK-SAT	Turkish Statistical Institute

CHAPTER ONE

INTRODUCTION

1.1.Background

The Turkish Government is urged to develop its port infrastructure. The new seaport, whose name is the North Aegean Candarli Port, will become the government's priority infrastructure project and is in bidding process in 2011. However, ports have become a member of the highly competitive environment in the Black Sea and Mediterranean Region. This port is important because of different causes. Firstly, Candarli Port will support and provide a service to the same hinterlands like Izmir Alsancak Port. Because, the Izmir Alsancak Port does not have enough container yard area and draft for bigger vessels than 12,0 meters. In addition, the city of Izmir has heavy traffic, noise and light pollution such as in the Malmo Copenhagen Port case. Secondly, the draft limitation in the Izmir Alsancak Port cannot allow bigger vessels to arrive at port berth. Therefore, the cargo which is addressed to Turkey unloads in the Port of Piraeus. All these reasons show that the Candarli Port should be active as quickly as possible because the Candarli Port will be used as a gateway for the cargo, replacing Izmir Alsancak Port with Candarli Port, providing services to mother vessels and transshipment cargoes.

The Candarli Port is an important project for the European Union (EU) because it will be part of an extension of the trans-European transport network, or Trans-European transport network (TEN-T), as Turkey plays an important role in the interconnection between the EU, the Middle East, the Caucasus and the Mediterranean, Aegean and Black Seas.

All these factors are important for the Candarli Port. However, the starting point was "this port will fulfill expectations". Then, another question was "Are there any possibilities among the competitors?". Later, it should be important to look for the answers of these questions. The author will try to answer these questions in this dissertation.

1.2.Thesis Objective and Research

The Mediterranean Sea is the main transportation corridor between Far- East Asia and Europe. Port Said, the port of Piraeus and Malta are the main ports in the region. However, the Black Sea region and the Eastern Mediterranean Sea region do not have a leader port. Therefore, this dissertation will look for the answer whether there is any possibility to be a region hub port or not.

The objective of this research is to analyze the possibilities of the North Aegean Candarli Port being a regional hub port in the Mediterranean Sea region. In addition, the research has also emphasized the competition between ports which are located in the same proximity namely Port Said, Malta and the port of Piraeus.

1.3. Research Methodology

The research methodology chosen is a significant part of the research. In order to carry out this study, there are mainly two fundamental analyses, namely demand forecast analysis and analytic network process.

Firstly, demand forecast analysis is aimed to find the demand in the region for the next few years, so that hinterland, transshipment cargo and global trade are emphasized because of the direct effect on the container freight flow. To analyze the demand forecast, multi linear regression analysis, linear regression analysis and correlation coefficient analysis were carried out.

Some data namely gross domestic product (GDP) analyses for next 20 years, population forecast for the next 20 year and trade analysis that are provided about national and regional institutions were collected and put in the analyze as a component.

Secondly, defining port competition criteria, identifying the competitors in the region and analyzing the hub port selection points in the region were carried out for the analytic network process. It could be said that port competition capabilities of the ports that are located in proximity are measured. In analytical network analysis (ANP), modern decision support methods analytical hierarchy analysis (AHP) and ANP which have been improved by Professor Thomas L. Saaty have been very popular in the past few decades. The ANP is based on the relative comparison between the criteria and alternatives. As a result of the analysis, ports are ranked with qualitative data. This study does not aim to know the future or competition criteria among the ports. It will just light to some points that were analyzed.

1.4. Scope of the Study

The aim of this research is to analyze the possibilities of the North Aegean Candarli Port being a regional hub port in the Mediterranean Sea region. Thus, investigating hub port possibilities was the main aim of this dissertation. Further, the competition between ports which are located in the same proximity, namely Port Said, Malta Port, the port of Piraeus is also focused on different features in this research. In order to carry out this study, two fundamental analyses and their results are generated mainly. The demand forecast analysis is aimed to find the demand in the region. Secondly, port competitiveness and analysis of the port selection in the region are aimed at assessing the possibilities of being a hub port. According to this analysis, some conclusions will be made about the Candarli Port.

The model of what driven elements are affected in the decision of carriers as a hub port and forecast analysis for the Candarli Port is processed in Figure 1.

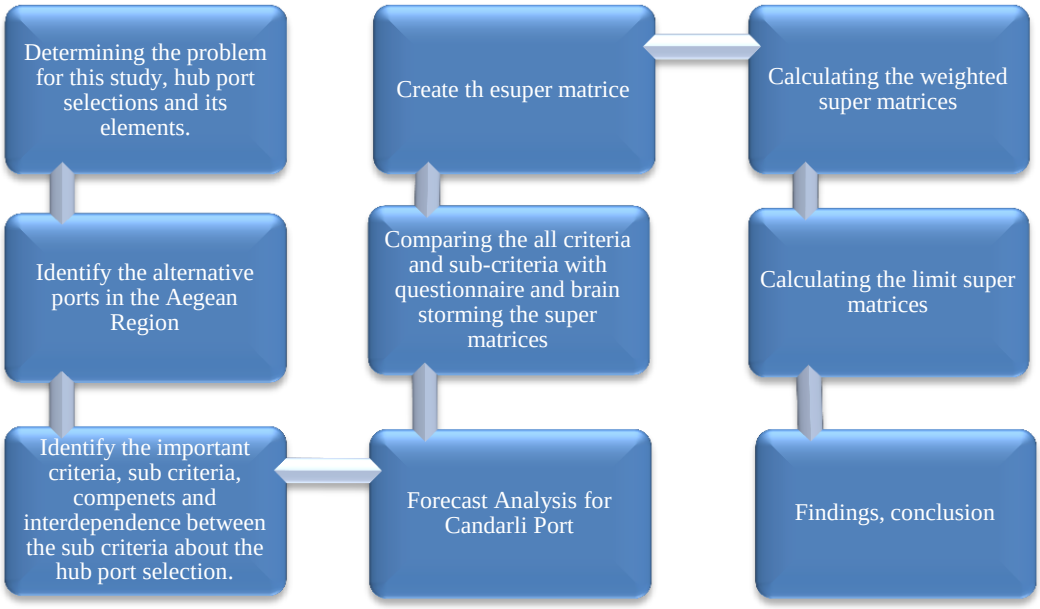

Figure 1: Flow chart for ANP

Source: Author

The first step includes identifying which are the hub port selection criteria for the carriers. In this step, thirteen nodes and four cluster criteria are defined for the possibility of Candarli Port being a hub port in the region. This is a problem for the ANP model. Moreover, the alternatives for being a hub port in the region are the port of Piraeus, Malta and Port Said.

In the second chapter, port features such as geographical locations, port infrastructures, hinterland connectivity and regional situations are introduced. These are extremely important because of the comparative advantages of the Candarli Port.

The third chapter provides the demand forecast analysis. As a result of the analysis, not only qualitative information but also quantitative information is provided to analysis the possibilities of being a regional hub port. To carry out this analysis,

focus is on the independent variables that are directly related with the Candarli Port. There are multi linear regression analysis, linear regression analysis and correlation coefficient analysis in this chapter to achieve the result.

In the fourth chapter, the analytical network process is identified to analyze the data. All subjects of ANP and its calculation are explained including determining the selection criteria, creation of the unweight super matrix, calculation of the weighted super matrix and the limiting super matrix as well.

In the fifth chapter, the ANP analysis is applied to the Candarli Port case with criteria such as calculation of super matrixes and resulting of implications.

The last chapter provides a comprehensive summary of the Candarli Port case. In addition, the analysis about the Candarli Port is assessed some interpretations, as made challenges presented about this research.

CHAPTER TWO

CANDARLI PORT

2.1. Introduction

The Republic of Turkey with a total area of 814,578 km2 and 8,333 km of coastal line lies in the main passage corridor between Asia and Europe. Turkey is surrounded by the Black Sea in the North and the Mediterranean Sea on the South; it connects the Balkans to the Middle East, Central Asia to the Caucasus and the Black Sea countries with the Mediterranean countries. Turkey's location promotes its transport policies and investments to a key rank compared with other policies of the Turkish Republic.

Turkey has the precedence about its geopolitical position in the region. Therefore, the advantages of the geopolitical position have created Turkish ports. The potential of becoming hub ports, the forms of continuous Europe-Asia railway links, by the completion of Marmaray Project and the existence of traditional free trade zones bring Turkey an advantage. Besides, because of the European Union expansionary policy, Turkey has also accessed and integrated with EU such as Trans European Transport Networks (TEN-T), Mediterranean Motorways of the Sea (MEDA-MOS). At the same time, these projects have been supported by the EU for integration and connection between EU transportation networks and Asian links via the Turkish transportation ways (Transportation Forum Report, 2009).

The transport sector plays a crucial role in the development of the entire economy through all aspects of production, employment and regional development and life value of all people. Thus, upgrading of the transport infrastructure is one of the key

factors for a country motivated to enhance its competitiveness to the international standards.

The ports are known as a core point that conjecture the situation via the economic activities such as industrial, commercial, some added services, logistics and distribution, multimodality. In another words, it creates the developments of global and national economies. Therefore, ports have always been valued for achieving efficient trading (Cariou, 2006). On the other hand, the poor quality of transport services, value added and logistics services stand for major technical and operational barriers to economic developments and international connections. Therefore, the development of transport infrastructures like the multimodal transportation concept, port superstructures and infrastructures or road, railway connections is a key element to increase the transport competitiveness among other countries. In addition, because of globalization, huge demand and in balance of the trade, there has been an increased competition not only world trade globalization but also regional and national transportation caused improving the importance of the distance and speed in the transportation sector.

In this respect, policies that will ensure shifting freight transportation to railways and transforming major ports to logistic centers, which will emphasize safety in transportation modes are followed. In this context, the level of development of the country can increase by enhancing the transportation system efficiency, safety and integration with the European one.

The fundamental elements of Turkey's national transportation policy to make balanced, coherent and well-organized shipping in ports, roads and rail network where transportation forms make the most of the mode integration. In this respect, the cargo uses a logistic center and logistic park, so transportation modes will change the rail mode in general. Further, ports provide not only cargo operations but also value added services, the place that cargo changes the transportation modes

effectively and safely. The conclusion is that increasing the transport system efficiency, safety, integrated level between each other indicates the development level of states (Transportation Forum Report, 2009).

2.2. Geographical Location of Candarli Port

The proposed location for the new port is in the east end of the Çandarlı Gulf, which is 20 km long and 25 km wide. It is within the limits of the town of Zeytindağ, district of Bergama, only 55 miles to İzmir and 245 miles to Istanbul by seaway. It is located 80 km to İzmir by highway, 7 km to İzmir-Bergama road intersection and 20 km to Dikili. This is a location that combines the availability of ground and navigation channel without any problem and natural sheltering from almost all directions.

Figure 2: Place of Candarli Port

Source: www. Cografiharita.com.tr

2.3. Transportation Modes Network

2.3.1. Road Network

According to the OECD International Transit Forum, Turkey has a chance to become the most significant logistics center and transshipment country due to the dynamic logistic market and wide international road network. Turkey has a high quality East-West road network. TEM Network, TRACECA Corridors and Pan European Corridor are important international networks and corridors through Turkey. In addition, the majority of cargoes and passengers are carried by road. Therefore, the road infrastructure has developed enormously in the past decade.

In the Candarli case, Candarli Port does not have good highway connections. However, Izmir has five main highways connecting to regional or other important hubs. Izmir is the closest city to Candarli Port. According to the General Directorate of Highways, Izmir has 1292 kilometers of state roads.

Candarli-Izmir: 86 km.

Izmir-Manisa: 36 km

Izmir-Istanbul: 561km

According to the futuristic plan of the General Directorate of Highways, the highway volume of Candarli Port has been investigated because of the volume of the Candarli Port traffic.

2.3.2. Rail Network

Rail network has become more important every year because multimodal transportation saves total cost and is safer. The railway network in the Candarli Port region covers all the cities. According to the Turkish Railways Organization, the railways networks can be extended or investigated for future volumes. Furthermore, there are special logistics village studies in Denizli that is close to Candarli Port. These villages will specialize in container handling and storage. Second logistic village is located in Balikesir, which is connected to the “Tekirdag-Bandirma train

Ferry Project" and "Baku-Kars-Tiblisi Railway Project". Consequently, there are several railway projects developed.

2.4. Port Infrastructures

According to the port plans, the Candarli Port will be built in two phases in terms of time and location at Candarli. Infrastructures in the port will be designed to serve 18 m draft vessels. The total breakwater length will be 1145 m. Design of quays includes 2000 linear meters of steel pipe pile quay walls for a total of 2000 m berth line with extension possibility to 75 m wide.

The main stocking yard area of 100 Ha and apron area of about 20 Ha will be built. 15 control gates will serve Candarli Port accesses and logistics services and value added service; technical areas will cover about 800,000 square meters. In the first phase that is the most complex, the breakwaters, 1000 m quay line with terminal areas and all superstructures to active the port in the operation. Approximate capacity will be 2 million TEU (See Figure 3).

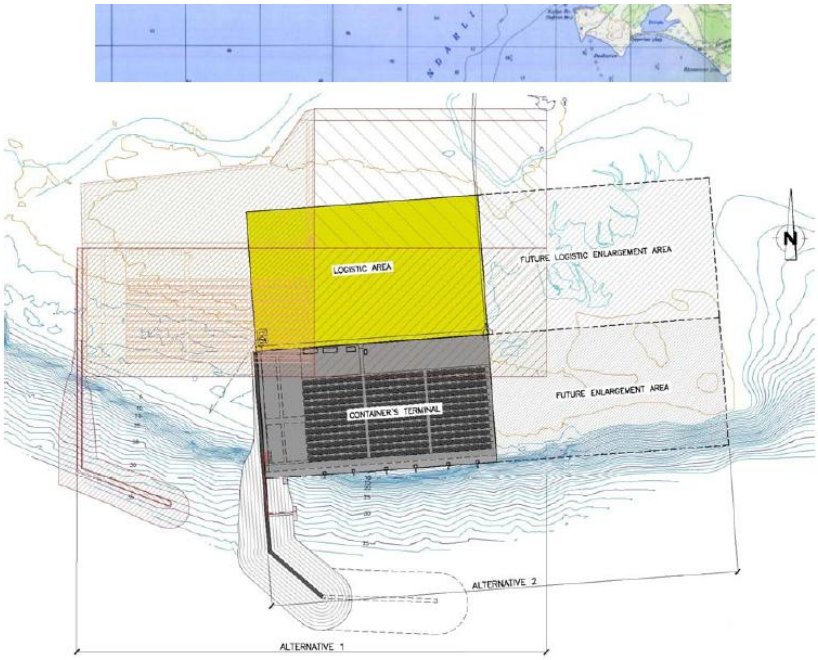

Figure 3: Port Layout

Source: Port Plans

CHAPTER THREE

DEMAND FORECAST OF THE NORTH AEGEAN CANDARLI PORT ANALYSIS UP TO 2030

3.1. Introduction

This chapter tries to find the potential for the North Aegean Candarli Port (NACP) to become a future regional hub port in the Aegean and Black Sea regions.

The usefulness of demand forecast is a non-contestable point for the port and shipping sector. However, it does not mean to know the future. The forecast analysis is interpreting and analyzing the current situation of port traffic, and it helps to predict port traffic throughput (Stanford, 2009). Therefore, it is important that the forecaster tries to produce correct information for the manager. If the real cargo throughput growth is under the forecast level, it is a lack in the amount needed; it can be seen in the return of investment for the port infrastructure that is generally considered by port operators. On the other hand, if there is cargo throughput growth over the forecast level, there may be port congestion, long transit periods, as seen in the period from 2004 to 2008, because the port did not have enough infrastructures and superstructures to handle the huge quantity of cargoes. As a result the port could not provide services as clients expected in a short time.

The benefit of analysis of different points of view is provided by preparing the demand forecast analysis with different variables for the NACP. However, some unpredictable factors such as regional government promotions, political and economic developments and investment priorities directly affect the cargo volume

capacity of the region, whereas legal and administrative developments that affect less should also be taken into consideration about the cargo volume (Transportation Forum Report, 2009). According to the Japan International Cooperation Agency (JICA,1998), there are several influential demand forecast factors such as population of the hinterland, gross domestic product of the region and individual spending expenses, and export, import volumes of region, fundamental product consumptions. However, in this dissertation three main elements that could be gathered are used for the NACP forecast analysis study, namely hinterland cargo with gross domestic products, population of the region and trade growth with current situations, transshipment cargo and cabotage cargo.

When the hinterland cargo calculation is done some regional and national variables have to be considered, which is approachable in terms of gathering information. However, to calculate transshipment cargo, world seaborne trade, world port container throughput and international economic indicators have to be taken into account (http://www.lojistikdefteri.com/1123/turkiye-transit-yukte-kan-kaybediyor).

All in all, this chapter consists of methodology of forecast analysis, hinterland, transshipment and cabotage cargoes, demand forecast and traffic analysis for 2030 which refers the most probable three elements: pessimistic situation, normal situation and optimistic situation.

3.2. Methodology

The main aim of this chapter is to assess the future demand for the NACP with various variables that affect the dissertation. It has three influential factors namely hinterland connection and its impact on the port demand, cabotage cargoes, transshipment cargoes, which is also aimed the NACP for the future projection.

Forecast is made by carrying out the following items;

- Population growth, gross domestic products and trade growth of primary and gateway hinterland,
- Transshipment container throughput

- Cabotage container throughput

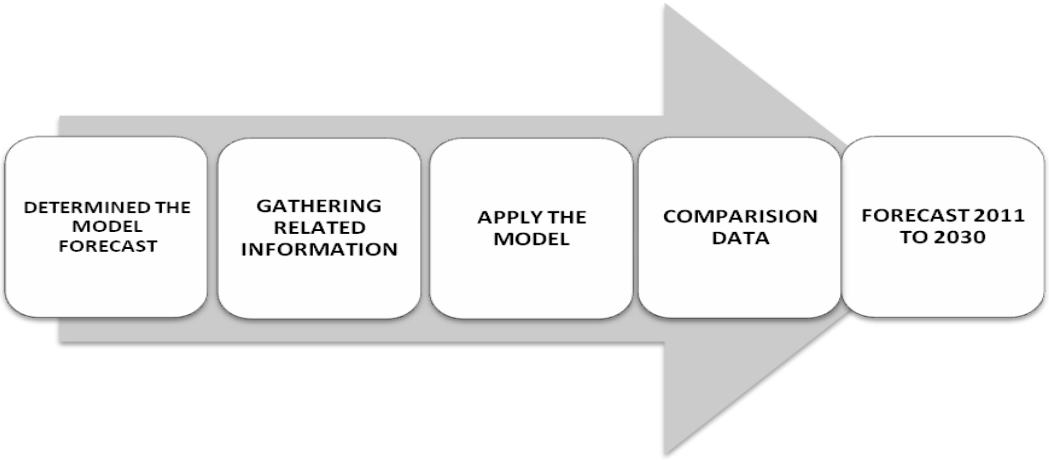

Figure 4: Study Diagram

Source: Author

Demand forecast calculation is divided into three parts, namely hinterland cargoes, transshipment cargoes and cabotage cargoes. Hinterland cargo forecast is calculated hinterland connections effects for the cargo demand by using multiple regression analysis. Transshipment cargo forecast is calculated by two methods. The first one was applied by JICA in 1998. In this analysis, the deviation distance compares to total throughput for the ports. Then, Mediterranean Sea future container projection can be predicted. The second one is the relation between the total throughput of the region and transshipment cargo with linear regression analysis. It is assumed that the cabotage cargoes will be increased in parallel with the increase of the GDP. The average regional cabotage cargo ratio is around 8,2 percentage for the last 3 years. However, the GDP growth forecast is used for the future.

For the hinterland cargoes, the Multiple Regression Analysis results provided the cargo traffic forecast for primary and gateway hinterland. The multiple regression analysis indicates outcomes with estimated population, estimated Gross Domestic Product and predicted growth for trade data of relevant cities are as calculated. It is

carried out in a way that the container throughput of selected ports is complied. The projection demand of container is up to 2030.

What is the multiple regression analysis?

A regression analysis is a useful statistical technique for modeling the relationship variables in the shipping market. In addition, the analysis is concerned with modeling the relationship among variables. It measures how a response variable is related to a set of explanatory variables (Bovas, 1983). In other words, the estimated equation with more than one independent variable is used to predict target variable.

Formula of multiple regression analysis;

$$Y_i = \beta_0 + \beta_1 x_{1i} + \ldots + \beta_k x_{ki} + \varepsilon_i \quad ,\text{i} = 1,2,\ldots,\text{n}$$

In the North Aegean Candarlı Port case, six independent variables are defined.

y is defined as a total throughput of the region,

x_1 *is variable as a population of the primary hinterland,*

x_2 *is variable as a GDP of primary hinterland,*

x_3 *is variable as a trade of primary hinterland,*

x_4 *is variable as a population of the gateway hinterland,*

x_5 *is variable as a GDP of the gateway hinterland,*

x_6 *is variable as a trade of the gateway hinterland.*

The transshipment cargo forecast is calculated with two methods. First of all, it is identified that the relation between transshipment cargo and total cargo handling is calculated by using regression analysis which is carried out for transshipment forecast.

$$Y_i = \beta_0 + \beta_1 x_{1i} + \varepsilon_i$$

y is defined as a transshipmentcargo of the region,

x_1 *is variable as a total throughput of the,*

The second method is that the relation between the port deviation distance from the main routes and transshipment ratio of ports are calculated; then the transshipment cargo is predicted using the graph. This method was used for the JICA study for another region in 1997 as well.

The data used in this dissertation is gathered from the following national institutions; the Ministry of Development provides GDP forecast used for the regression analysis for the hinterland. The Turkish Statistical Institute provides the population forecasts projection. The population forecasts for cities are used for the regression analysis.

The Undersecretariat for Maritime Affairs provides container throughput statistics for the national ports and cabotage statistics as well. Moreover, transshipment container movement records are also used from the UMA.

Ports Department of Turkish State Railways provides ports that are not privatizing container throughput statistics and revenues are obtained from the department. Further, the organizations mentioned above, the following documents and reports are referred to;

- TINA report for the future transportation infrastructure,
- ISL reports for world container development,
- UNCTAD Secretariat for global containerization conditions,
- WTO (World Trade Organization) International Trade Statistics,
- Review of Maritime Transport, United Nations, 2010

3.3. Hinterland connections and demand forecast for the North Aegean Candarli Port (NACP)

Sargent (1938) defined that "cargo tends to seek the shortest route to access the sea." In other words, goods need the good hinterland connections to approach the gate. According to Notteboom, the hinterland is where the port has business capability in a certain area (Notteboom, 2008).Thus, the seaport hinterland plays a vital role in the supply chain solution, logistics service providers and importers for loading unloading their cargoes. In particular, the efficient hinterland connection is important for three users, namely the port authorities because to capture a target cargo they have to present their ability about diversification and efficiency of hinterland connections; some ports have identified a wide link as a strategic improvement factor. Another beneficial side is the logistics and shipping companies whose effective and efficient hinterland connection contributes to their competitive price for the customers and economic performance for the firms. A third beneficial part is the shipper side, such as improved hinterland access and provided lower transport costs and cheaper price for trading (Horst, Lugt 2011).

However, there are some studies about whether the port hinterland has kept its value in terms of port selection criteria and better performance in port operations. Some scholars like Bergantino (2002), De and Park (2003) or Malchow and Kafani (2004) bounce an idea off that the development of multi-modal transport has a negative impact on the importance of port hinterland on port operations. On other hand, Bichou and Gray (2005) claimed that port performance indicators like total port throughput and port efficiency are still linked to traditional and industrial, political and social atmosphere of ports and port hinterlands. At the same time, the hinterland has caused to improve the port operations, multi-modal transportation and inter-port competition (Alonso & Soriano 2009). In other words, the development of a port hinterland connection for the ports is a key element for the competitiveness among the other ports. Therefore, the hinterland connection of the NACP will be a vital factor not only in the power of competition among the other competitor ports but also in the reduction of trading costs for traders. According to the Master Plan Study for

Coastal Structures, the hinterland is divided into a primary hinterland that "area where port and city assume a controlling role and determine life of area" (Tan, 2007) and gateway area for goods and customers. The North Aegean Candarli Port is identified as the primary hinterland gateway area using two models, namely the Graph Model and the Gravity Model. Consequently, the primary hinterland area consists of Aegean region cities, west part of Turkey, namely Izmir, Manisa, Denizli, Aydın, Uşak, Afyon and Kutahya. In addition, the gateway hinterland area includes Istanbul, Ankara, Canakkale, Balıkesir, Eskisehir and Bursa. A multiple regression model will apply for primary and gateway hinterland for 2030. Figure 5 indicates the hinterland connections of the Candarli Port by highways and railways.

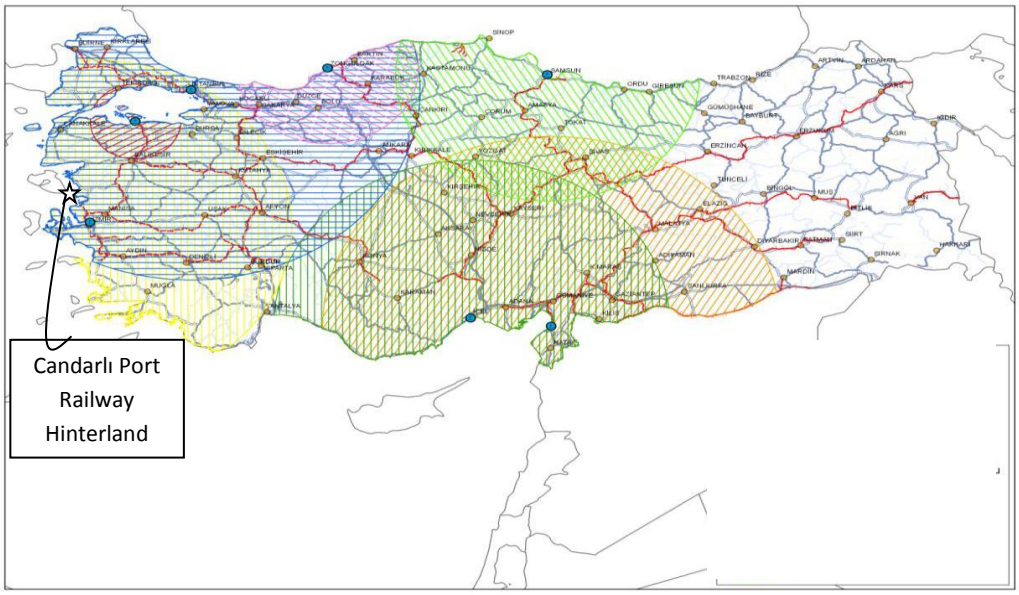

Figure 5: Hinterland connections railway and highway

Source: Master Plan study for Coastal Structures

Figure 6: Candarli Port Hinterland

Source: Master Plan Study for Coastal Structures

3.3.1. Gross Domestic Product

The gross domestic product has a direct impact on hinterland cargoes and is defined in many academic sources as "the market value of all final goods and services produced in a country in a given period including personal consumption, government purchases, private inventories, paid-in construction costs and the foreign trade balance" (www.wikpedia.com). Therefore, GDP gives an idea about the economic situation of a region or/and provides making predictions about the regional or national trading ability. According to the Ocean Shipping Consultant, there is an absolute link between the gross domestic product and trade and it contributes to the container port demand progress directly (World Container Port Markets,1999). It is obviously clear that GDP is an important factor for hinterland cargoes and its futuristic projections.

Table 1 indicates GDP growth of Turkey for the period from 2000 to 2010. It is accepted that if the GDP growth has increased over an average of the world GDP, the economic situation is better than the average.

Table 1: GDP Growth of Turkey 2000-2010.

Years	GDP mil usd	Growth in GDP %
2000	265 384	6,8
2001	196 736	-5,7
2002	230 494	6,2
2003	304 901	5,3
2004	390 387	9,4
2005	481 497	8,4
2006	526 429	6,9
2007	648 625	4,7
2008	742 094	0,7
2009	616 703	-4,8
2010	735 828	8,9

Source: Turkish Statistical Institution, 2011.

In Table 1, the average GDP growth rate is 4,08 % from the period 2000 to 2010 in Turkey. In addition, the economic crisis had a negative impact on the GDP in 2009 like most of the other countries as well. According to the Ministry of Development, GDP growth will be predicted as 5,9 % in 2011 and 4,8 % in 2012. In addition, after 2012 the GDP growth is forecasted in the study as a 4,5 % in a pessimistic scenario, 4,8 % in a normal scenario and 5,1 % in an optimistic scenario.

3.3.2. Population

The population of Turkey, which represents one of the primary drivers of demand for import cargo, is a big enough, with 73 million. Moreover, according to the Master Plan Study of Coastal Structures, the primary hinterland region is defined as Izmir, Manisa, Denizli, Aydın, Uşak, Afyon and Kutahya for the North Aegean Candarli Port. These places will be directly affected by the port demand. The primary hinterland current population and population projection are given Table 2.

Table 2: **Primary hinterland population and forecast**

Cities	2008	2009	2010	2015	2020	2025	2030
Izmir	3795978	3868308	3948848	4192359	4413630	4616203	4604421
Manisa	1316750	1331957	1379484	1464552	1541850	1612617	1608501
Denizli	917836	926362	931823	989285	1041499	1089301	1086521
Aydın	965500	979155	989862	1050903	1106369	1157149	1154195
Uşak	334111	335860	338019	358863	377804	395144	394136
Afyonkarahisar	697365	701326	697559	740575	779662	815446	813365
Kutahya	565884	571804	590496	626910	659998	690289	688528
Total	8593424	8714772	8876091	9423448	9920813	10349666	12177996

Source: Turkish Statistics Institution

Table 2 shows that the population of the primary hinterland is around 8,8 million; however, it will slightly increase up to 12.1 million in 2030. In other words, the demand of port usage will improve because of the upwards trend of population.

The calculation of the primary hinterland area is done in Table 3.

Table 3: Izmir port demand table for population

	2005	**2006**	**2007**	**2008**	**2009**	**2010**
Handled TEU	784.317	847.926	894.685	891702	814069	945755
population	8.443.505	8.488.217	8.533.166	8.593.424	8.714.772	8.876.091
TEU Import demand per person	0,092	0,099	0,104	0,103	0,093	0,106
GDP mil USD	74 039	81 177	100 327	101430	96662	105264

Source: Author calculation

In Table 3, the population generates a demand for import cargoes. The import demand per person in the region is between 0, 092 to 0,106, the average of 5 years around 0, 0995 TEU per generated person. So, if the population projection of the primary hinterland is forecasted 12,1 million for 2030, that means the population will generate;

(12,1 million people) X (0, 0995 TEU) = 1 203 950TEU

In addition to above statement, Istanbul, Ankara, Canakkale, Balıkesir, Eskisehir and Bursa are defined as a gateway for the North Aegean Candarli Port. Table 4 shows a population and forecast for the gateway area.

Table 4: **Gateway population and forecast period 2015, 2020, 2025 and 2030**

Cities	**2008**	**2009**	**2010**	**2015**	**2020**	**2025**	**2030**
Istanbul	12 697 164	12 915 158	13 255 685	14073116	14815889	15456344	18 186 800
Ankara	4 548 939	4 650 802	4 771 716	5065971	5333350	5563898	6 546 794
Canakkale	474 791	477 335	490 397	520638	548117	571811	672 824
Balıkesir	1 130 276	1 140 085	1 152 323	1223383	1287952	1343627	1 580 987
Eskisehir	741 739	755 427	764 584	811733	854576	891517	1 049 009
Bursa	2 507 963	2 550 645	2 605 495	2766167	2912164	3038049	3 574 739
total	22 100 872	22 489 852	23 040 200	24461008	25752048	26865247	31 611 154

Source: Turkish Statistical Institution

Table 4 indicates that the population of the gateway hinterland is around 23,04 million; however, it will dramatically increase up to 31,6 million in 2030 according to the Turkish Statistical Institution. In other words, the primary hinterland and gateway hinterland tables indicate that the population flow will be upwards and affect the port usage positively. Consequently in 2030, total population that generates a demand for the NACP will be around 43,8 million, 31,9 million in 2010, which is a huge increase in the population. Moreover, balance and heavy trade depended upon not only economic indicators, but also on containerized cargo flows in the NACP region.

3.3.3. Trade

World economic growth and International trade:

In general, the market developments in shipping are connected to global trade and countries production directly. The statistics about international trade are therefore of high potential interest to the shipping sector. This is because, it is important to understand how international trade is working (Wijndst & Wergeland, 1997).

Goods are moved from one place to another place all over the world because there is a need for daily requirements to the people or industrial raw materials for production all over the world. World trade creates a demand for maritime transport and its legs, namely carriers, ports and logistics centers and shore based operation firms.

The United Nations Conference on Trade and Development (UNCTAD) defines

> the world faced with global economic crisis at the end of the 2008,the year 2009 recorded the first and deepest drop in global output since the 1930s, with world gross domestic product (GDP) contracting by 1.9 per cent. Developed economies and countries with economies in transition recorded the largest contractions, of 3.4 per cent and 6.3 per cent respectively. Developing economies have been affected too, with growth in these economies

decelerating to 2.4 per cent – a much slower rate compared to 2007 and 2008" (UNCTAD, 2010).

In other words, all economic activities in 2009 decreased by 1,9 % including shipping.

The below table and graph show that Turkey, EU and World GDP growth from 2007 to 2010.

Table 5: **Selected countries and world GDP**

Years	World	EU	Turkey
2007	3,9	2,8	4,7
2008	1,7	0,7	0,7
2009	-1,9	-4,2	-4,8
2010	4,9	1,8	8,9

Source: World Bank

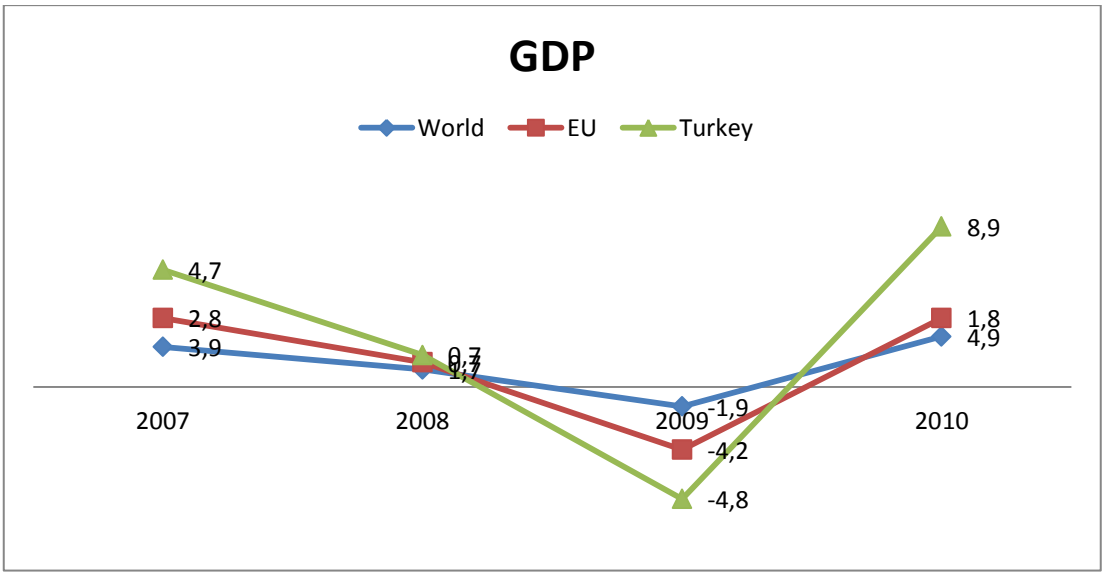

Figure 7: **GDP Comparison**

Source: World Bank

Seaborne trade lives directly through world trade. Hence, the increasing trade indicates that increasing on the seaborne trade statistics. On the other hand, because of the global economic crisis and corresponding reject in trade, a surplus of container

ships occurred during the crisis in some ports. Consequently, when the global financial crises deepened at the end of 2008, port throughput volumes and incomes decreased parallel to the financial crises.

In the Izmir region, the relation between Izmir region container throughput and trade quantity is calculated in Figure 8.

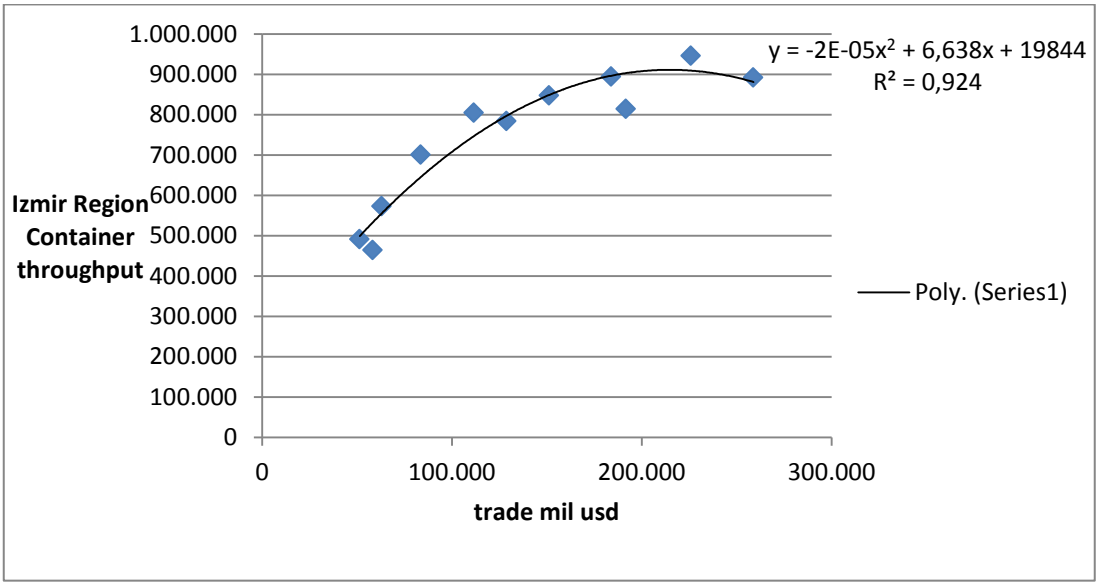

Figure 8: **Container throughput total trade relations**

Source: Author calculation

As can be seen in Figure 8, the R square between trade in the region and container throughput is 0,924, which means between two variables there is a powerful relationship. Therefore, trade in the Izmir region, which is located near the Candarli Port, has directly affected the container throughput.

Table 6 indicates the existing Port of Izmir regions data and hinterland factors**.**

Table 6: Existing situation of Izmir region

Years	TEU	Primary Hinterland Pop. (X1)	Primary Hinterland GDP (X2) (mil usd)	Primary Hinterland Trade (X3)	Gateway Pop. (X4)	Gateway GDP (X5)(mil usd)	Gateway Trade (X6)
2000	464.455	8.223.453	27 286	13.096	18.399.06	74 684	45.178
2001	491.277	8.267.000	20 593	11.706	18.850.29	52 969	39.659
2002	573.231	8.310.777	35 639	14.547	19.312.58	86 187	48.417
2003	700.795	8.354.786	46 533	19.519	19.786.20	11 .531	64.083
2004	804.564	8.399.029	60 128	25.423	20.271.45	145 406	86.185
2005	784.317	8.443.505	74 039	30.369	20.768.59	179 049	98.334
2006	847.926	8.488.217	81 177	36.777	21.277.93	196 309	114.357
2007	894.685	8.533.166	100 327	42.655	21.799.75	242 622	141.330
2008	891702	8.593.424	101029	23304	22.100.872	244 320	235 538
2009	814069	8.714.772	96179	17797	22.489.852	232 592	173 853
2010	945755	8.876.091	104 739	26932	23.040.200	253 293	198939

Source: Turk Sat, Ministry of Economy, 2011

3.4. Hinterland Forecast for Scenarios

Hinterland drivers, population, GDP and trade are described in three different scenarios. The Ministry of Development and the Central Bank of Turkey provide the GDP growth for future projection, Turkish Statistical Institute (TurkStat) provides the population growth for future projections and the Ministry of Customs and Trade provides the trade growth for the future projections as well. According to the figures, the port traffic capacity will be estimated for each scenario considering pessimistic, normal and optimistic cases for 2030.

3.4.1. Pessimistic Scenario for Hinterland

For the pessimistic scenario, the foreseen increased ratio of the GDP, the Ministry of Development and The Central Bank of Turkey report forecast is 5,9% for 2011, 4,8% for 2012 and 4,5% for the following years until 2030. With the data for trade development since 2000 released by The Ministry of Customs and Trade, 8% annual trade growth rate is obtained. With the carried out survey, parameters are expected up to 2030 which are used for container throughput forecast for primary and gateway hinterland.

Table 7: **Pessimistic scenario for the hinterland factors**

Years	Increase of GDP	Increase of Trade	Primary Hinterland GDP (mil usd)	Primary Hinterland Trade mil usd	Gateway GDP (mil usd)	Gateway Trade Mil usd
2009			96 179	17797	232 592	173 853
2010			104 739	26932	253 293	198 939
2011	5,9 %	8 %	110 919	29 087	268 237	214 854
2012	4,8 %	8 %	116 243	31 413	281 113	232 042
2015	4,5 %	8%	131 935	38 953	319 063	287 733
2020	4,5 %	8 %	161 621	54 534	390 852	402 826
2025	4,5 %	8 %	197 986	76 347	478 794	563 956
2030	4,5 %	8 %	242 532	106 886	586 522	789 538

Source: Author

In Table 7, primary and gateway hinterland areas GDP and trade with growth forecast values are calculated and presented. These figures led to the forecast of total handled cargo which is presented in Table 8.

Table 8: **Pessimistic hinterland of the Candarli Port forecast.**

Years	TEU (Y)	Primary Hinterland Pop. (X1)	Primary Hinterland GDP (X2) (mil usd)	Primary Hinterland Trade (X3)	Gateway Pop. (X4)	Gateway GDP (X5)(mil usd)	Gateway Trade (X6)
2011	860747,3	8989705	110.919	29.087	23335115	268.237	214.854
2012	855994,3	9102076	116.243	31.413	23626803	281.113	232.042
2015	849032,3	9423448	131.935	38.953	24461008	319.063	287.733
2020	861440,6	9920813	161.621	54.534	25752048	390.852	402.826
2025	931687,5	10349666	197.986	76.347	26865247	478.794	563.956
2030	835332,2	12177996	242.532	106.886	31611154	586.522	789.538

Source: Author

Table 8 presents the pessimistic scenarios for hinterland influential factors.

3.4.2. Normal Scenario for Hinterland

For the normal scenario, the foreseen increased ratio of the GDP, the Central Bank report forecast is 5,9 % for 2011, 4,8 % for 2012 and 4,8% for the following years until 2030. With the data for trade development since 2000 released by the Ministry of Customs and Trade, 10% annual trade growth rate is obtained. With the carried out survey, parameters are projected up to 2030 which are used for container throughput forecast for primary and gateway hinterland.

Table 9: **Normal scenario for the hinterland factors**

Years	Increase of GDP	Increase of Trade	Primary Hinterland GDP (mil usd)	Primary Hinterland Trade mil usd	Gateway GDP (mil usd)	Gateway Trade Mil usd
2009	----	---	96 179	17797	232 592	173 853
2010	---	---	104 739	26932	253 293	198 939
2011	5,9 %	10 %	110.919	29.625	268.237	218.833
2012	4,8 %	10 %	116.243	32.588	281.113	240.716
2015	4,8 %	10 %	132.982	42.364	321.593	312.931
2020	4,8 %	10 %	164.897	63.546	398.775	469.397
2025	4,8 %	10 %	204.473	95.319	494.481	704.095
2030	4,8 %	10 %	253.546	142.979	613.157	1.056.142

Source: Author

In Table 9, primary and gateway hinterland areas GDP and trade with growth forecast values are calculated and presented. These data led to forecast of a total handled cargo, which is presented in Table 10.

Table 10: **Normal hinterland scenario for Candarli Port**

Years	**TEU (Y)**	**Primary Hinterland Population**	**Primary Hint.GDP (mil USD)**	**Primary Hint.Trade (mil USD)**	**Gateway Population.**	**Gateway GDP (milUSD)**	**Gateway Trade**
2011	865022,3	8989705	110.919	29.625	23335115	268.237	218.833
2012	865309,5	9102076	116.243	32.588	23626803	281.113	240.716
2015	875239,7	9423448	132.982	42.364	24461008	321.593	312.931
2020	930250,5	9920813	164.897	63.546	25752048	398.775	469.397
2025	1076869	10349666	204.473	95.319	26865247	494.481	704.095
2030	1112618	12177996	253.546	142.979	31611154	613.157	1.056.142

Source: Author

3.4.3. Optimistic Scenario for Hinterland

For the optimistic scenario, the foreseen increase ratio of the GDP is 5,9% for 2011, 4,8% for 2012 and 5.1% for the following years until 2030. With the data for trade development since 1996 released by Ministry of Customs and Trade, 12% annual trade growth rate is obtained. With the carried out survey, parameters are projected up to 2030, which are used for container throughput forecast for primary and gateway hinterland.

Table 11: **Optimistic scenario for the NACP**

Years	Increase of GDP	Increase of Trade	Primary Hint. GDP (mil USD)	Primary Hint. Trade (mil USD)	Gateway GDP (Mil.USD)	Gateway Trade (Mil. USD)
2009	---	---	96 179	17797	232 592	173 853
2010	---	---	104 739	26932	253 293	198 939
2011	5,9 %	12 %	110 919	30 164	268 237	222 812
2012	4,8 %	12 %	116 243	33 784	281 113	249 549
2015	5,1 %	12 %	134 028	45 946	324 123	339 387
2020	5,1 %	12 %	168 205	73 513	406 774	543 019
2025	5,1 %	12 %	211 097	117 621	510 502	868 830
2030	5,1 %	12 %	264 927	188 193	640 680	1 390 128

Source: Author

In Table 11, primary and gateway hinterland areas GDP and trade with growth forecast values are calculated and presented. These data led to forecast of a total handled cargo, which is presented in Table 12.

Table 12: Optimistic hinterland scenario for Candarli Port

Years	TEU (Y)	Primary Hinterland Pop.	Primary Hinterland GDP (mil usd)	Primary Hinter. Trade	Gateway Population	Gateway GDP (mil usd)	Gateway Trade
2011	869298,8	8989705	110 919	30 164	23335115	268 237	222 812
2012	874802,8	9102076	116 243	33 784	23626803	281 113	249 549
2015	902796,5	9423448	134 028	45 946	24461008	324 123	339 387
2020	1006605	9920813	168 205	73 513	25752048	406 774	543 019
2025	1248357	10349666	211 097	117 621	26865247	510 502	868 830
2030	1461979	12177996	264 927	188 193	31611154	640 680	1390 128

Source: Author

3.5. Transshipment Cargo Forecast for the NACP

Transshipment cargo is defined in Wikipedia as a "transshipment is the shipment of goods to an intermediate destination, and then from there to yet another destination", intermodal transportation where goods are transferred between sea to land modes intermodal transportation is between ships at port. However, Genco and Pitto (2000) classified three different types. If the transfer interchange between mother and feeder vessels is done at a hub port is called Hub and Spoke transshipment. If the containers are traded between mother vessels at long distance routes, ports are called relay transshipment, interlining transshipment with the containers transferring operation between linking deep-sea vessels deployed in parallel series but different port rotation (Genco & Pitto, 2000). Transshipment of containers had a three times faster growing speed than port-to-port services in the container market from 1980 to 2005 (Mc Calla, 2008).

What factors do affect the transshipment cargo?

According to Ashraf (2009), transshipment has benefits in terms of operation of the port, minimized costs, a wide network and link, and service reliability, and appropriate vessel for spoke ports (Ashraf, 2009). Generally, not directly, the increase of the world trade leads to more transshipment cargo. Not only increased trade but also operations of the port, minimized cost, a wide network and link, and service reliability, and applicable vessels for spoke ports have a positive impact on the transshipment cargo.

First of all, mother vessels should go on longer routes because of profitability. Due to fact that mother vessels can call few ports from one continent to another. Otherwise, if they spent a lot of time, that means spent a lot of port fees, which is non-acceptable for the companies. In addition, mother vessels apply cost trade-off, more economic ship the port cost per container is less if the feeder vessel use the port. In other words, the demand of containerization is caused by the large container vessel that provides economy of scale and also increases transshipment cargo. Therefore, this reason also increases the importance of transshipment cargo and its cost effects.

The second point is that the transport network can be wider than the port-to-port service directly. Because of the lack of equipment, draft or port area, small ports cannot host the mother vessels. Using the feeders can be accessible to all small ports that do not have enough capacity for handling the huge container vessels. Because of this, transshipment cargo becomes indispensable. Another reason is that to be a reliable service, transshipment provides a reliable service indirectly. There may be a reason for delay in port and long transit time. Moreover, according to McCalla (2008), value added logistics services can be provided to the customers during the transshipment time at the port (Mc Calla, 2008).

In the end, the transshipment cargo has increased in last three decades for the reason that there is a persuasive competition among the ports to capture the cargo in the region.

3.5.1. Mediterranean Region Transshipment Container Traffic

The Mediterranean Sea is an important access for the world seaborne trade and there has been considerable growth in transshipment as compared to direct services. Gioia Tauro, Malta, Damietta, Alexandria, Haifa, Mersin, Port of Piraeus, Port Said and Izmir are the major ports in the region. Table 13 has been chosen for the future plan for the Mediterranean Region.

Table 13: **Forecast for main ports in Mediterranean Sea**

Years	GioiaTauro	Marsaxlokk	Damietta	Alexandria	Haifa	Mersin	Piraeus	Port said
2030	6441647	3457116	3150505	-56515	2058081	2190133	3324811	7801765
2025	5787072	3065480	2723388	45675	1860778	1869316	2960616	6537244
2020	5132497	2673844	2296271	147866	1663475	1548500	2596421	5272722
2015	4477922	2282207	1869154	250056	1466172	1277683	2232225	4008201
2010	3823346	1890571	1442037	352247	1268869	906866	1868030	2743680
2007	3445337	1900000	913379	385000	1171000	782028	1373138	2768900
2006	2938000	1485000	1006534	404096	1053000	643749	1403408	2127243
2005	3160981	1321000	1129595	432894	1123000	596000	1394512	1521855
2004	3261034	1461174	1262946	580247	1033056	532507	1541563	869258
2003	3080710	1305000	955045	495186	1069000	466262	1605135	658736
2002	3008698	1244232	748031	510997	904428	365790	1398346	563126
2001	2488332	1165070	639325	500229	901000	305860	1165797	569436
2000	2652701	1033052	616759	601987	870432	293890	1161099	503793

Source: The Master Study of Coastal Structures 2010

The transshipment ratios of these ports are given in Table 14;

Table 14: **Transshipment Ratio of Mediterranean Ports.**

Ports	Transshipment ratios
GioiaTauro	80 %
Marsaxlokk	30 %
Damietta	87 %
Alexandria	70 %
Haifa	30 %
Mersin	25 %
Port of Piraeus	57 %
Port Said	77 %
Izmir	2 %

Source: JICA 1997

The situation of the transshipment cargo last 5 years in Turkey ports:

Table15: **The ratio of transshipments**

	2006	2007	2008	2009	2010
Total container handled	3858052	4,582268	5091621	4404442	5743455
Transshipment cargo	184921	145739	115606	12 542	874239
Ratio %	4,79	3,18	2,27	0,028	15,22

Source: Undersecretariat for Maritime Affairs (UMA), 2010

From Table 15, it is clear that in the past five years the transshipment cargo in the Turkish ports boomed to 15.22 % of the total containers handled.

For the future forecast for transshipment cargoes in the Mediterranean Sea, a regional forecast was conducted as can be seen in Table 16.

Table 16: **Forecasting for the transshipment cargo Mediterranean Sea**

Years	Mediterranean Sea
2015	9 020 829
2020	13 485 627
2025	19 161 076
2030	26 120 403

Source: The Master Study of Coastal Structures 2010

3.5.2. Forecast for the transshipment cargo

The calculation was done in two ways. First, one is the relation between the port deviation distance and the transshipment cargo handling ratio. It is assumed that the deviation distance for the ports is one of the key elements for being a hub port.

Therefore, there should be a relation between the deviation distance and transshipment cargo handling. The Candarli Port deviation distance is about 351 nm.

Table 17: **Deviation and distance table**

Ports	Deviation distance	Transshipment ratio for 2008
Damietta	17	87
Port of Piraeus	209	50
Haifa	170	30
Malta	1	30
Alexandria	57	70
Port Said	1	77
Izmir	368	2
Gioia Tauro	73	80

Source: Author

With these variables, it could be the numeric value of relation between two variables that can be calculated.

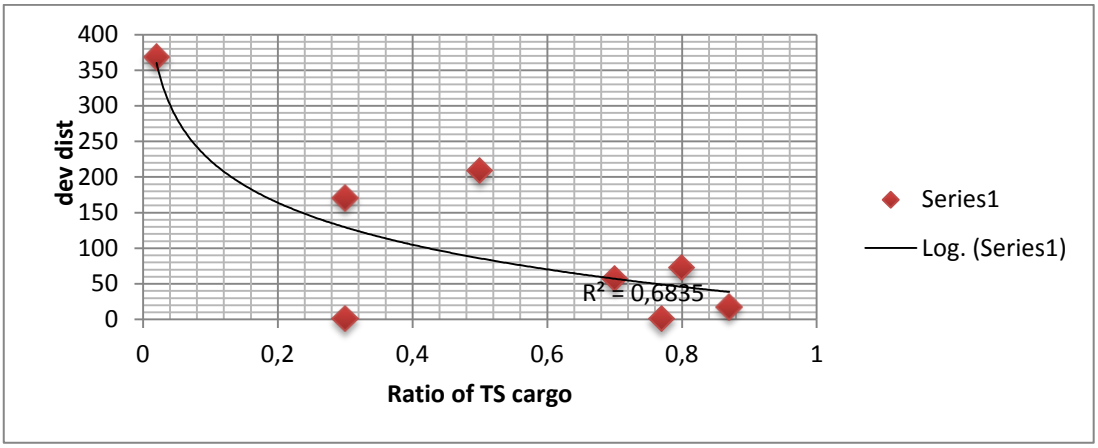

Figure 8: The relation between the deviation distance and ratio of transshipment cargo

Source: Author

The relation between variables is indicated with the R square that is calculated 0,683 which means there is a relation between variables. Therefore, the graph can be used to find the ratio of transshipment cargo for the NACP. Consequently, the transshipment ratio is found to be around 3,5 % for the Candarli Port. The ratio indicates that 3,5 % of the cargo will be transshipment. Finally, Table 18 presents the transshipment forecasts for the Candarli Port from the period from 2015 to 2030.

Table 18: **Transshipment cargo forecast**

Years	Mediterranean Sea transshipment cargo forecasts	Transshipment ratio	Transshipment Forecast TEU
2015	9 020 829	3,5 %	315729
2020	13 485 627	3,5 %	471996
2025	19 161 076	3,5 %	670637
2030	26 120 403	3,5 %	914214

Source: Author

Another way of calculating transshipment cargo is the relation between about the transshipment cargo and total handled cargo. First of all, transshipment cargo quantities are indicated for the last 5 years (See Table 19).

Table 19: **Transshipment cargo by years**

Years	Total cargo handeled	Transshipment cargo
2007	894 685	1070
2008	891702	2241
2009	814069	121
2010	945755	5925

Source: UMA

Secondly, the R square is calculated for the portion of the relation, if it is close to 1 that means variables affect each other.

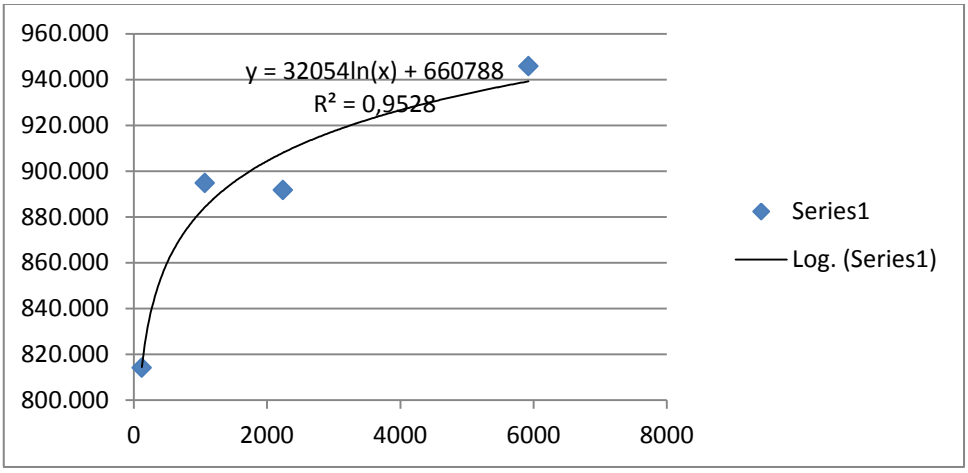

Figure 10: R square calculation for total cargo and t/s cargo

Source: Author

As a result of calculation, the formula about the transshipment cargo is as follows:

Y= $32054lnx + 66078$ and R square is 0,952.

Finally, the transshipment cargo is calculated in Table 20.

Table 20: **Transshipment cargo forecast by years**

Years	Mediterranean Sea transshipment cargo forecasts	Transshipment Forecast TEU
2015	9 020 829	579424
2020	13 485 627	592312
2025	19 161 076	603572
2030	26 120 403	613503

Source: Author

If comparing both methods, it is obvious that the first method was used by JICA in 1997. Therefore, the methods which relation between transshipment cargo and total cargo handled should be used for when forecasting.

3.6. Cabotage Cargo for the NACP

In International Law, cabotage is identified with coasting-trade, which means navigating and travelling along the coast between ports. Behind the cabotage policy, controlling the regional and sub-regional coastal trade and manpower of the region or state are main aims for states. Therefore, Turkey does not have any agreement with other states in the cabotage policy. It is clear that the cabotage cargo of the Izmir region will be affected by the Candarli Port container throughput in the future. Therefore, this should be taken into account for the futuristic plans.

The cabotage cargo has also become more and more important because some national firms have captured cabatoge goods in Turkey. Especially, the Minister of Transportation has tried to make a policy that transferred it as possible cargo as to sea transport which is cheaper and more environmentally friendly. Cabotage cargo will also directly affect Candarli Port.

Table 21: The ratio of cabotage cargo

	2006	2007	2008	2009	2010
Total container handled TEU	3858052	4582268	5091621	4404442	5743455
cabotage cargo TEU	23050	61417	162908	142025	208325
Aegean Region TEU	3745	15057	45876	29927	50618
Ratio of Candarlı Port region %	0,09	3,28	9,00	6,79	8,81

Source: UMA

As can be seen from Table 21, the average cabotage cargo ratio is around 8,2 percent for the last 3 years. It assumes that the cabotage will increase in parallel with the increase of the GDP. Therefore, the forecasts are calculated in Table 22.

Table 22: Cabotage Cargo in TEU

Years	Pessimistic scenario cabotage cargo (TEU)	Normal scenario cabotage cargo (TEU)	Optimistic scenario cabotage cargo (TEU)
2012	56177	56177	56177
2015	58705	58874	59043
2020	61347	61700	62054
2025	64108	64662	65218
2030	66993	67765	68545

Source: Author

Forecast for the NACP and Conclusion

The calculation was done by using different statistical techniques. Forecasting is analyzing and eliminating current situations. Consequently, Tables 23, 24 and 25 show the total forecast report for the period from 2015 to 2030, if the conditions and expectations will occur.

For the pessimistic scenario;

Table 23: **Pessimistic scenario for total throughput forecast in TEU**

Years	**Hinterland (TEU)**	**Transshipment (TEU)**	**Cabotage (TEU)**	**Total TEU**
2015	849032,3	579424	58705	1487161
2020	864860,7	592312	61347	1518520
2025	936126	603572	64108	1603806
2030	835332,2	613503	66993	1515828

Source: Author

For the normal scenario;

Table 24: **Normal scenario for total throughput forecast in TEU**

Years	Hinterland (TEU)	Transshipment (TEU)	Cabotage (TEU)	Total TEU
2015	865309,5	579424	58874	1503608
2020	933670,6	592312	61700	1587683
2025	1081307	603572	64662	1749541
2030	1112618	613503	67765	1793886

Source: Author

For the optimistic scenario;

Table 25: **Optimistic scenario for total throughput forecast in TEU**

Years	Hinterland (TEU)	Transshipment (TEU)	Cabotage (TEU)	Total TEU
2015	902796,5	579424	59043	1541264
2020	1010025	592312	62054	1664391
2025	1252795	603572	65218	1921585
2030	1461979	613503	68545	2144027

Source: Author

All in all, the North Aegean Candarli Port demand forecast was calculated. According to the calculation, the total container demand will be between 1,48 million TEU and 2,14 million TEU. It is assumed that the port of Izmir will provide services for cruise lines.

CHAPTER FOUR

ANALYTIC NETWORK PROCESS

4.1. Introduction to the ANP

Decision making is a process in which one of the alternative actions is chosen toward carrying out the aims and goals. Decision making makes up the core of all the managerial functions. For instance, planning includes deciding what to do, when to do, how to do, where to do, and by whom it will be done. Other managerial functions such as organizing, implementing, and controlling rely on decision making to a high degree. Modern society, which is changing so fast and becoming globalized, points out that a successful enterprise has a prosperous decision making process. This does not mean only collecting the information and implementing it, but also making the decision with the help of improved decision methods. Decision making is one of the keystones of an enterprise. So, making the right decision is necessary in order to get the competitive advantage and to maintain it. In many enterprises, the decision process needs a really heavy effort and time in order to collect information and analyze it. On the other hand, when assessing the alternative actions less time and effort is spent than spent on decision making. The results of the analysis are evaluated intuitively in order to render a verdict. The surveys show that even though it is enough just to make daily decisions intuitively, this way is not enough for complicated and vital decisions (Bulut & Soylu, 2009).

The enterprises which use modern decision support methods can have the competitive advantages in leading the business relations which are getting globalized every day, and managing that relations network. Modern decision support methods

AHP and ANP which have become very popular in the last few years are improved by Professor Thomas L. Saaty (Kuruüzüm A. veAtsan N, 2001).

The basic ANP structure consists of a single network. When it is in the most complicated case, benefits, costs, opportunities, and risks are analyzed. Every single choice will be created by four different methods. The values which the options have for every single method are converted to a single one by using various formulas. The point which needs attention is that benefits, costs, opportunities, and risks can have different significance levels according to the structure of the problem. This weighting is called benefits, opportunities, costs and risks (BOCR) analysis. While during the war it is very important to carry medicine or armament to the front lines or an area where a plague was about to spread, it is important to distribute medicine by deciding the best transportation mode because the lives that you will save are more important than the cost of distribution. On the other hand, in some cases the risk is very important. It is far from riskier than the benefits when people try human cloning (Ozdemir, 2004). ANP shows itself in a very wide area and every day its area of application is getting wider. It is used in many areas like marketing, health, politics, social fields and in many other areas where it is needed to make a decision and forecast.

4.2.Comparing the Analytic Network Process (ANP) and Analytic Hierarchy Process (AHP)

AHP which was developed by Saaty in the 1970s is a decision making method which is used in solving complicated problems containing many criterions. AHP allows modeling in a hierarchal structure which shows the relations among complicated problems of decision makers, main goal of the problem, criterions, key criterions, and alternatives. In addition, the most important feature of AHP is that the decision maker can include both his/her objective and subjective thoughts in the decision process. AHP has a wide management area and it is used actively in many decision problems. Marketing, finance, education, public policy, economy, medicine, and

sports areas entreat many successful AHP practice to their studies. Moreover, AHP is used in many studies with the operational study techniques such as integer programming, goal programming, and dynamic programming (Kuruüzüm & Atsan, 2001; Saaty, 1994).

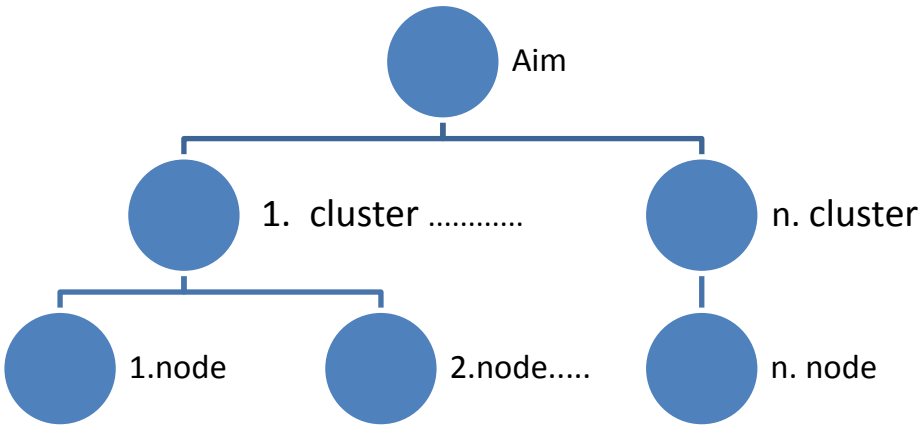

Figure 11: Analytic Hierarchy Process connections.
Source: K. Bulut, B. Soylu, 2009.

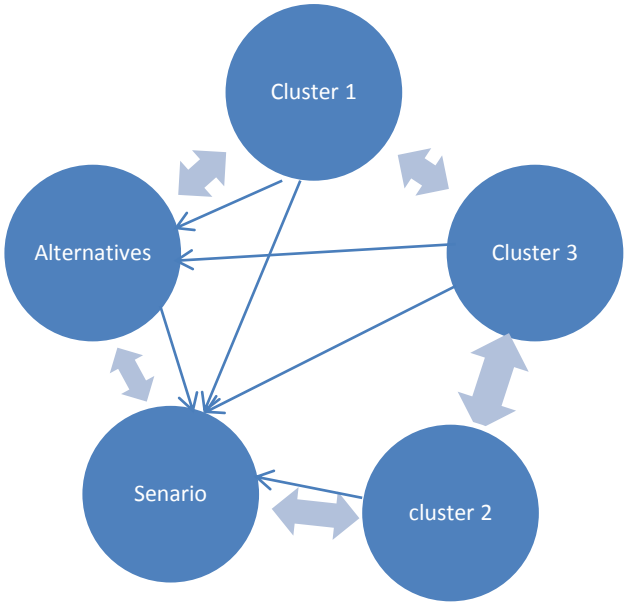

Figure 12: Analytic Network Process connections.

Source: K. Bulut, B. Soylu, 2009.

ANP is applied to the decision making problems in which the options are known clearly but the constraints effecting the decision making process cannot be expressed mathematically. Here, the aim is to be able to specify the best option according to the determined standards. In other words, the option which supplies the determined standards in the best way is tried to be specified. AHP is a method which provides relative prioritization of paired comparison and decision options in many-criterion problems. ANP is a more general form of AHP and states the relations among its components and directions in a layout way. On behalf of that structure, the indirect interactions come from indirect components and feedbacks are taken into account as well (Saaty, 2004; Köse & Yilmaz, 2003).

AHP models decision making problems in a hierarchical structure one-way and by assessing the factors, which are seen in the process, to make a decision systematically, determines the factorial priority orders. One of the most important hypotheses of AHP is its same level factors' being independent from each other and its ignoring the effect of the factors. However, in the real world, many factors which affect decision making problems are interactively functioning and it is needed to observe these interactions in order to make the best decision. Because AHP does not count on the interactions among many various factors (for example, cost and quality flexibility can be affected), the results are not significant. ANP is the method which pays attention to the relations among the factors in the process to make a decision and which clears away the necessity to model a problem by one side. It ranks the options which are up to the decision maker's personal justice and assessments from the most important to the least important. Moreover, it shows how close or far the options are to themselves and how much an option provides the goal by sorting out the options according to their importance level (Saaty, 1996 ; Sarkis& Talluri, 2002).

ANP tends to pay attention to many lower relations among the factors. The ANP method by this structure provides the problems being solved in a more effective and realistic way. While AHP shows the hierarchal relations with a one-way outline,

ANP provides taking into consideration more complicated relations among decision levels and features. ANP is a more usable method if considering in the models based on providence and the environmental factors which will affect the decisions. This way, ANP provides the complicated problems which cannot be modeled by hierarchical structures to be modeled (Dagdeviren, 2005).

AHP is the top level element for all the goals in the decision model. When compared to criteria it is from general to specific ongoing hierarchy. In ANP this structure is not included and the independency among the factors and factor levels are defined as feedback system approach. On the other hand, AHP does not include these feedback cycles but only concentrates on the factors by using the probability. As noted before, the independency among factor levels can be evaluated. The ANP approach finds this dependency relation among elements by a constant emphasis on the formation of super matrix. Relativist weights are adjusted by using the super matrix form and from there it is passed to the product matrix (Saaty, 1996).

As compared, ANP ranks the options from the most important one to the least important one up to the personal justice and assessments of the decision maker. Moreover, it shows how close or far the options are to themselves and how much an option provides the goal by sorting out the options according to their importance level.

4.3. ANP Model

The super matrix approach is an approach which is parallel to the Markov chains. Relativistic weights are arranged by the super matrix. To develop this form after the determinant problem, serial steps for the model calculations are needed. These steps should include the following details:

1. Making the bidirectional comparisons of the factors which are already controlled,
2. Forming down matrixes to the relativistic weights,

3. Arranging the super matrix whose columns are stochastic,
4. Taking up the forces until the weights get constant (Erarslan, 2001).

As noted above, ANP can be implemented in the cases when the options are known clearly and the existence of the criteria in order to evaluate these options. The first step of ANP is the options, and the criteria which will prioritize these options and finding the sub-criteria of the others. The basic ANP structure consists of a single network. When it is in the most complicated case, benefits, costs, opportunities, and risks can be analyzed all together. The values which the options have for every single method are converted to a single one by using various formulas. The point which needs attention is that benefits, costs, opportunities, and risks can have different significance level according to the structure of the problem. This weighting is called 'Benefit-Opportunity- Cost-Risk' (BOCR) analysis (Wijnmalen, 2005).

According to Saaty, some concepts of ANP (1996) and its features should be known such as feedback, outer dependence and inner dependence.

Feedback: Feedback is the biggest difference between ANP and AHP. While it looks at the one way effects of the criteria on alternatives, in ANP both the alternatives and the criteria (even the sub-criteria) and their interactions are included.

Outer dependence: The dependency which shows the interaction of a criterion with a criterion, which is in another group or with the group where alternatives exist.

Inner dependence: the dependency which shows the interactions of the criterions among themselves in a single group.

4.4. Making the bidirectional comparisons of the factors

In ANP, after the problem determination and identification of the sub criteria, in order to decide the importance of the standards and options paired comparisons are used and comparison of the options is done separately for every single standard. For

the ones which can be defined quantitatively there is not a problem while comparing the options. However, for the qualitative ones it is not that easy to define which option is more important than the other. Therefore, the bidirectional comparisons are carried out by different methods such as questionnaires, evaluations about the items and ports and brainstorming. In the comparison process, the components that are related with×, are compared with each other in terms of the value of the effects of ×, and these comparison values are created in the comparison matrix. After the normalization of the matrix column, the average value of rows is indicated in the weight of each component. Consequently, when making bidirectional comparisons of the factors, the Saaty Scale is used (Saaty,1990).

Table 26: Saaty Scales

Scale	Numerical Rating	Reciprocal
Extremely Preferred	**9**	**1/9**
Very strong to extremely	8	1/8
Very strongly preferred	**7**	**1/7**
Strongly to very strongly	6	1/6
Strongly preferred	**5**	**1/5**
Moderately to strongly	4	¼
Moderately preferred	**3**	**1/3**
Equally to moderately	2	½
Equally preferred	**1**	**1**

Source: How to make a decision: The Analytic Hierarchy Process, 1990.

In the Saaty Scale, the comparisons are made between 1 to 9 scales, where 1,3,5,7 and 9 design an equal importance. 2,4,6,8 indicate between values.

4.5. Forming down matrixes to the relativistic weights

ANP is for the relative cases for the irrelative; meaning certain cases relative weight vector is calculated. For the relative cases by making paired comparisons, one relative weight vector (Eigen vector) is calculated. However, in the cases which are not relativistic, this vector cannot be found by paired comparison.

Onut, Tuzkaya and Torun (2011) told that eigenvector is figured as an approximation of the relative importance by the elements for comparison by result of the equation:

$$Aw = \lambda max\, w$$

W is the largest Eigen value of pair-wise comparison matrix A.

The super matrix consists of a priority vector that is in the proper columns of a matrix. Then the initial super matrix must be transformed to a matrix in which each of its columns sums to harmony. For this reason, this matrix must be normalized by the weight of the clusters to get the column sums to harmony. Thus, the stochastic or weighted super matrix is obtained.

Example 1: Each car costs are given by calculating the Eigen vectors.

Table 27: **Car costs and Eigen vector calculation**

Costs	**A**	**B**	**C**
A	20000	0,00005	0,306
B	25000	0,00004	0,245
C	25000	0,00004	0,245
D	30000	0,000033	0,202
Total		**0,000163**	

Source: Author

In this example, the costs of cars have a negative effect on the costs. Therefore, the costs of cars are taken 1/ costs. Then, the eigenvectors are calculated. If the eigenvectors are cannot separated from each other, their values use relative comparisons using the Saaty Scale. For example, if the sight of a house values the sight of a house, the relatively good and aspects have to be considered. It will be seen in the port selection case. How can the eigenvectors for the sight of a house?

Example 2:

Table 28: **House comparison and Eigen vector calculation**

HOUSE	**A**	**B**	**C**	**Geo. Average**	**Eigenvector**
A	1	5	7	3,20	0,74
B	1/5	1	2	0,74	0,17
C	1/7	1/2	1	0,41	0,09
Total				**4,42**	

Source: Author

In Table 28, the sight of the house A is strongly preferred, 5, than the house B, if it is compared the house C, 7 times, which means is very strongly preferred. Then, a 3x3 matrix is created and then the geometric average for each row is calculated. At the last stage, the values that are calculated by geometric average are normalized and eigenvectors are calculated.

4.6. Arranging the super matrix whose columns are stochastic

The super matrix is represented with three levels are given as follows:

$$w = \begin{pmatrix} Goal \\ Criteri \\ Alternatives \end{pmatrix} = \begin{matrix} G \\ C \\ A \end{matrix} \begin{pmatrix} 0 & 0 & 0 \\ W21 & 0 & 0 \\ 0 & W32 & I \end{pmatrix}$$

W21 is a vector that indicates the power of the goal on the criteria; *W32*is a vector that indicates the power of the goal on each alternative, I is the identity matrix. W is a super matrix. Further, interdependence is shown by the existence of the matrix element W22 of the super matrix *W.*

$$w = \begin{pmatrix} 0 & 0 & 0 \\ W21 & W22 & 0 \\ 0 & W32 & I \end{pmatrix}$$

Generally, super matrix is indicated as follows:

		C_1	C_2……C_a
		e_{11}	e_{21}……e_{aa}
	e_{11}		
C_1	e_{11}	W_{11}	W_{12}……W_{1a}
W=C_2	e_{21}	W_{21}	W_{22}……W_{2a}
C_a	e_{a1}	W_{a1}	W_{a2}…… W_{aa}

In the matrix, Onut, Tuzkaya and Torun (2011) explained,

> C_a is the m cluster, eM is the element in the matrix and *Wij* is the eigenvector of the influence of the elements compared in the *Jth* cluster to the *Ith* cluster. If the *Jth cluster has no influence to the Ith cluster, then Wij=0.* The influence of a set off elements belonging to a cluster, on any element from another component can be represented as a priority vector by applying pair-wise comparisons.

If W is a column in the stochastic matrix, the result of all interactions are W∞. To approach the importance weight, the weighted super matrix is increased to power and called limit super matrix. Limiting priorities of this matrix rely on reducibility, permittivity and cyclist of the matrix. Not only multiplicity of super matrix eigenvalue but also reducible or cycles matrix are defined in the type of limit (Onut, 2011).

In the above matrix, the ANP is super matrix form. Each *W ij* value is the eigenvector that was calculated as a result of pair-wise comparisons and this matrix are called unweight matrix. The weighted super matrix consists of elements that each element of unweight matrix is divided to a summary of each column of the unweight matrix. At the same time, the weighted matrix is a stochastic and by increasing the huge force of the weighted matrix, the limit super matrix is created.

$\lim_{n\to\infty} W^n$Is a limit super matrix and all columns are the same and equal to the W weighted factor.

$\lim_{n\to\infty} W^n$=w e^n

4.7. The value of $\lim_{n\to\infty} W^n$

There are three positions to calculate $\lim_{n\to\infty} W^n$

If the matrix is primitive, it has a one root and it is equal to 1. Moreover, raising the value of matrix W is enough to get a result (Azis, 2003).

There are roots except 1, λ max = 1 and basic roots or times root. This situation is explained in this example;

$$W=\begin{bmatrix} 0 & W12 & 0 \\ 0 & 0 & W23 \\ W31 & 0 & 0 \end{bmatrix}$$

$$W^2=\begin{bmatrix} 0 & 0 & W12\,W23 \\ W23\,W31 & 0 & 0 \\ 0 & W31\,W12 & 0 \end{bmatrix}$$

$$W^3=\begin{bmatrix} W12\,W23\,W31 & 0 & 0 \\ 0 & W23\,W31\,W12 & 0 \\ 0 & 0 & W31\,W12\,W23 \end{bmatrix}$$

$$W^{3n}=\begin{bmatrix} (W12\,W23\,W31)^n & 0 & 0 \\ 0 & (W23\,W31\,W12)^n & 0 \\ 0 & 0 & W31\,W12\,W23 \end{bmatrix}$$

$$W^{3n+1}=\begin{bmatrix} 0 & (W12\,W23\,W31)^n\,W12 & 0 \\ 0 & 0 & (W23\,W31\,3W12)^n\,W23 \\ (W31\,W12\,W23)^n\,W31 & 0 & 0 \end{bmatrix}$$

$$W^{3n+2}=\begin{bmatrix} 0 & 0 & (W12\,W23\,W31)^n\,W12\,W23 \\ (W23\,W31\,W12)^n\,W23\,W31 & 0 & 0 \\ 0 & (W23\,W31\,W12)^n\,W31\,W12 & 0 \end{bmatrix}$$

As seen in the example, there is not one limit formula. There are three limits and the average of these three limits and the Cesaro Summary is used for the limits (Saaty, 2001, p. 110). In this situation, to find the root computer program are used.

If the λ max = 1 and there is a multiple zero.

In practice, the elements of each clusters priorities are normalized in the weighted matrix. In the unweight matrix, each column of the unweight matrix is normalized to calculate the weighted matrix. Then this stochastic matrix and by increasing huge force of the weighted matrix, the limit super matrix is created.

CHAPTER FIVE

ANP MODEL FOR THE HUB PORT CHOISE IN THE NORTH AEGEAN SEA

The first step has identified the main goal of the study which is hub port selection criteria for carriers. In this step, thirteen nodes and four cluster criteria are defined for the Candarli Port possibility of being a hub port in the region. The questionnaire survey for comparing all clusters and nodes were carried out with 11 persons. Three participants were port and commercial professionals, five participants are academician and two participants are governmental experts and one participant is post graduate student. This is defined as a problem for the ANP model. Moreover, the alternatives for being a hub port are defined in the Mersin Port, the port of Piraeus, Malta and Port Said.

5.1. What factors derivers shipping lines for the choice of specific ports?

In the past, a port could be used as a gateway of its hinterlands and incidence areas so, seaborne trade volume, freight flow and cargo destination are in the port selection criteria. However, ports were governed and administered. Therefore, port competition, choosing the port and increasing trade were not important issues because of the monopolistic market (Voorde & Winkelmans, 2002). However, container ports have been faced with high competition circumstance especially the high power bargaining. The global alliances have an inevitable force to provoke port competition in recent years. According to Chang, Lee and Tongzon (2008), as a result, either the port keeps the captured cargo or loses the cargo and its title of hub. It is illustrated that Maersk-Sealand changed its transshipment base from the port of Singapore to the port of Tanjung Pelapas (PTP). Therefore, ports are facing extreme

sector competition with worse effects of alliances' bargaining power (Chang, Lee & Tongzon, 2008).

Today, not only the alliances` bargaining power but also supply chain management systems are a vital point for being a hub port. The new seaports have become an important part of complex supply chain systems. Seaports that have not improved in parallel of this trend have come across with losing the customers in the extremely competitive market. Consequently, all these factors in port selection have been investigated in many volumes of scientific literature about port related studies. It is important because the appropriate port selection is directly affected by the reduction of costs for the carriers directly.

In addition, the trade-offs between service quality and cost has become a dominant factor. Apart from this, port efficiency and reliability, port infrastructures, feeder service intervals, diversification and accessibility of port services and connectivity to trade routes have become more and more essential factors for being in competition among the other ports and a hub port. In these days, port customers focus on not only advantages and disadvantages of ports but also efficiency and quality of port services compared to other competitors in the supply chain (Bichou, 2009). According to Voorde and Winkelmans (2002), the main aims of the utility of cargo transportation steps are to reduce maritime costs, storing and transferring costs and hinterland transportation costs. Therefore, because of the standardization of freight, the hinterland costs have become more expensive, and also that may benefit the ports in terms of value added services and their revenues.

In Wiegmans, Hoest and Notteboom (2008), the main port selection criteria is defined in different titles. This is shown in Table 29.

Table 29: Port selection criteria

Port selection criteria
Port Physical and Technical Infrastructure • *Nautical accessibility profile (max draft, max vessel length, tidal windows, and restrictions)* • *Terminal infrastructure and equipment terminal capacity, number of berth, number of quay, and yard cranes, stacking heights)* • *Hinterland accessibility links trucks, rail, barge and short sea*
***Geographical Location**:* • *Vis-a-vis the immediate and extended hinterland (centerlity index versus main economic centers in the hinterland)* • *Vis-a-vis the main shipping lanes*
Port Efficiency: • *Port turnaround time* • *Termınal productivity (moves per hour)* • *Cost efficiency (out of pocket and time cost of port calls and cargo handling)* • *Port operating hours (7/24/365)*
Interconnectivity of the port (sailing frequency of deep sea and feeder shipping service)
Reliability, capacity, frequency and cost of inland transport service by truck, sail and barger
Quality and costs of auxiliary services such as pilotage, towage, repairing
Efficiency and costs of port management and administration
Availability, quality and costs of port community system
Port security safety and environmental profile of the port.
Port reputation (satisfactory ranking in benchmarking studies)
Source: Wiegmans, Hoest and Notteboom (2008)

5.2. Geographical Port Location

The cost and its control are an important issue for the carriers that assume the cost saving by way of choosing an ideal hub position. Because of these issues, the

location of a port that is selected as hub not only improves the value but also increases the demand of the port. Therefore, some ports which are called pure hub ports have a comparative advantage among others like the port of Singapore. There are two important selection sub criteria related with geographical port location, namely deviation distance from the main shipping lines and immediate and extended hinterland. As mentioned before, these two elements are directly related to cost. In other words, a port that has paid less cost to carriers has a relative advantage. However, there is no comparative advantage even if the port is close to the hinterland and main shipping lanes, for instance the port of Singapore and the port of Tanjung Pelapas case.

The hinterland extension was interpreted by Notteboom and Rodrigue (2009), As inland connectivity and the local port distribution system are supported by the corridors. Furthermore, the control of the local port distribution system and inland connectivity relies on the world and national economic situation. Therefore, the port valorisation has increased the value with the control of inland connectivity and distribution system in recent years. The logistical compressions, the shipping links and the infrastructure method are the nascent hub port selection factors. Because of the new location issues and new restraints in the geographical layer, the ports could not handle the cargo as before. In other words, the port location valorisation is based on the logistical needs, shipping links and infrastructures.

Apart from this, gateway ports should be in a good hinterland connectivity and wider incidence area in order to capture the cargo in the region. In other words, the centrality in the hinterland is the vast important features for gateway ports. In addition to centrality, Notteboom and Rodrigue (2009) explained that maritime transport and inland transport should be integrated in ports that are identified as a hub besides the integration of the modes proposing a new prospect to the customers.

The deviation distance from the main shipping lane has also affected shipping costs. In some studies, there should not be a far diversion distance from the main lanes

because some pure hub ports like the port of Singapore, Algeciras or Port Said have used its competitive advantage in terms of transhipment cargoes.

In the Candarli Port case, the port has a 350 nm division distance from the main shipping lanes. Therefore, the cost of shipping lines would increase if they called the Candarli Port compared to Algeciras or Port Said. Consequently, the possibilities of being regional hub port are higher than the possibilities of being a pure hub port in terms of geographical port locations.

In the ANP analysis, the geographical position is coded GP and there are two kinds of sub criteria identified. The first one is "Vis-a-vis the immediate and extended hinterland (centrality index versus main economic centres)", GP.1. is the code. The second one is "Vis-a-vis the main shipping lanes-main routes", GP.2. is the code.

5.3. Physical Port and Technical Infrastructure

Another important selection criterion is physical port and technical infrastructure for hub ports.

In successful operations, the infrastructures have a significant role. Berth numbers, the draft of approach channel and at berth have become more and more important for choosing a hub port. Today, port operators have to consider the increasing size of vessels that are important for the draft and length of quay cranes. Furthermore, pilot services and towage services should also be at a satisfactory level for 7/24 services. The large terminal space for working and transferring containers and sufficient warehousing facilities for cargo space of any transit or transshipment facilities are also important point for hub ports.

5.4. Apply ANP to Port Selection

The port selection criteria, clusters and nodes are selected in Table 30.

Table 30: Port selection clusters and nodes

Code	Port selection criteria
	***Geographical Location**:*
GP.1	• *Vis-a-vis the immediate and extended hinterland (centerlity index versus main economic centers in the hinterland)*
GP.2	• *Vis-a-vis the main shipping lanes*
	Port Physical and Technical Infrastructure
PL.1	• *Nautical accessibility profile (max draft, max vessel length, tidal windows, and restrictions)*
PL.2	• *Terminal infrastructure and equipment terminal capacity, number of berth, number of quay, and yard cranes, stacking heights)*
PL.3	• *Hinterland accessibility links trucks, rail, barge and short sea*
	OTHER CRITERIA
I	• *Interconnectivity of the port (sailing frequency of deep sea and feeder shipping service)*
R	• *Reliability, capacity, frequency and cost of inland transport service by truck, sail and bargan*
QC	• *Quality and costs of auxiliary services such as pilotage, towage, repairing*
AC	• *Availability, quality and costs of port community system*
PS	• *Port security safety and environmental profile of the port.*
	ALTERNATIVES
PIR	• *Port of Piraeus*
PSAD	• *Port Said*
MAL	• *Malta*
CAN	• *Port of Candarli*

Source: Authors

In this table, all clusters and nodes are identified and explained. However, some of these are not. Figure 13 indicates that the influence between the clusters.

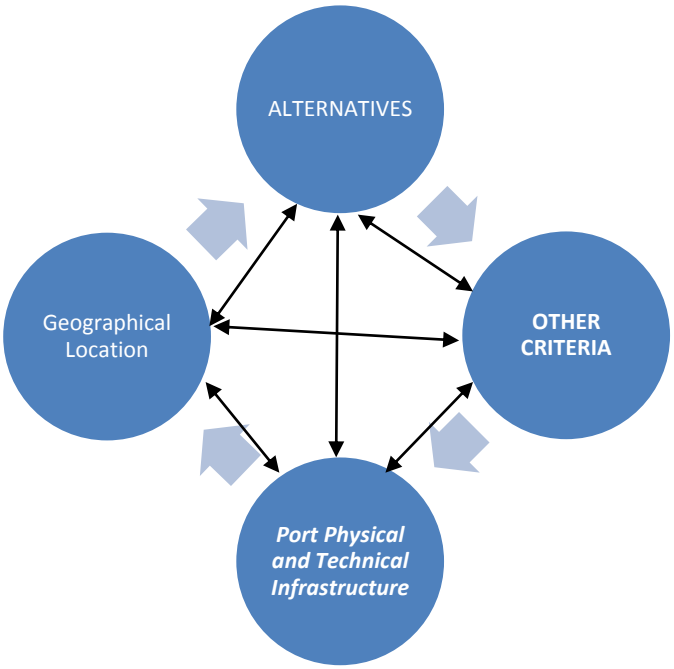

Figure 13: Cluster relations.

Source: Author

5.5. Port Geographical Location Influence

Related cluster effects on the GP1 in Table 31:

Table 31: Cluster and node effects on the GP 1

GP1	PL1	PL2	PL3	Geometric Average	Eigenvector
PL1	1.00	5.00	0.11	0.819	0.271
PL2	0.20	1.00	7.00	1.119	0.370
PL3	9.00	0.14	1.00	1.080	0.357
				3.018	

GP1	I	R	QC	AC	Geometric Average	Eigenvector
I	1.00	5.00	7.00	9.00	4.213	0.634
R	0.20	1.00	4.00	9.00	1.638	0.246
QC	0.14	0.25	1.00	2.00	0.514	0.077
AC1	0.11	0.11	0.50	1.00	0.279	0.0419
					6.644	

GP1	Pire	PSaid	Malta	Candarli	Geometric Average	Eigenvector
Pire	1.00	3.00	1.00	7.00	2.141	0.345
P Said	0.33	1.00	5.00	0.33	0.859	0.138
Malta	0.11	0.20	1.00	0.20	0.258	0.041
Candarli	5.00	3.00	5.00	1.00	2.943	0.474
					6.200	

Source: Author

Related cluster effects on the GP2 in Table 32:

Table 32: **Cluster and node effects on the GP 2**

GP2	**PL1**	**PL2**	**PL3**	**Geometric Average**	**Eigenvector**
PL1	1.00	0.33	0.20	0.404	0.096
PL2	3.00	1.00	0.20	0.843	0.202
PL3	5.00	5.00	1.00	2.924	0.700
				4.172	

GP2	Pire	P Said	Malta	Candarli	Geometric Average	Eigenvector
Pire	1.00	0.11	0.14	1.00	0.352	0.047
P Said	9.00	1.00	5.00	9.00	4.486	0.605
Malta	7.00	0.20	1.00	7.00	1.769	0.238
Candarli	1.00	3.00	0.14	1.00	0.805	0.108
					7.413	

5.6. Port Physical and technical Infrastructure Influence

Related cluster effects on the PL1 in Table 33:

Table 33: **Cluster and node effects on the PL1**

PL1	I	R	QC	AC	Geometric Average	Eigenvector
I	1.00	5.00	5.00	9.00	3.872	0.640
R	0.20	1.00	0.25	2.00	0.562	0.092
QC	0.20	4.00	1.00	3.00	1.244	0.205
AC	0.11	0.50	0.33	1.00	0.367	0.060
					6.047	

PL1	Pire	PSaid	Malta	Candarli	Geometric Average	Eigenvector
Pire	1.00	0.33	0.33	0.50	0.483	0.109
P Said	3.00	1.00	2.00	0.50	1.316	0.298
Malta	3.00	0.50	1.00	0.50	0.930	0.210
Candarli	2.00	2.00	2.00	1.00	1.681	0.381
					4.411	

Source: Author

Related cluster effects on the PL2 in Table 34:

Table 34: Clusters and nodes effects on the PL2

PL2	I	R	QC	AC	Geometric Average	Eigenvector
I	1.00	0.20	6.00	5.00	1.565	0.241
R	5.00	1.00	7.00	5.00	3.637	0.562
QC	0.16	4.00	1.00	0.33	0.677	0.104
AC	0.20	0.20	3.00	1.00	0.588	0.090
					Total6.468	
PL2	Pire	PSaid	Malta	Candarli	Geometric Average	Eigenvector
Pire	1.00	0.50	0.33	0.33	0.483	0.108
P Said	2.00	1.00	2.00	0.50	1.189	0.266
Malta	3.00	0.50	1.00	0.50	0.930	0.208
Candarli	3.00	2.00	2.00	1.00	1.861	0.416
					4.464	

Source: Author

Related cluster effects on the PL3 in Table 35:

Table 35: Cluster and node effects on the PL3

PL3	I	R	QC	AC	Geometric Average	Eigenvector
I	1.00	6.00	9.00	9.00	4.695	0.658
R	0.16	1.00	7.00	8.00	1.730	0.242
QC	0.11	0.14	1.00	2.00	0.418	0.058
AC	0.11	0.12	0.50	1.00	0.285	0.039
					7.129	
PL3	Pire	PSaid	Malta	Candarli	Geometric Average	Eigenvector
Pire	1.00	0.50	0.33	2.00	0.757	0.176
P Said	2.00	1.00	3.00	2.00	1.861	0.432
Malta	3.00	0.33	1.00	0.50	0.838	0.195
Candarli	0.50	0.50	2.00	1.00	0.840	0.195
					4.298	

Source: Author

5.7. Others Influence

Related cluster effects on the PL3 in Table 36:

Table 36: Cluster and node effects on the I

I	GP1	GP2	Geometric Average	Eigenvector
GP1	1.00	8.00	2.828	0.890
GP2	0.12	1.00	0.346	0.109
			3.174	

I	**PI1**	**PI2**	**PI3**	**Geometric Average**	**Eigenvector**
PI1	1.00	3.00	0.14	0.748	0.244
PI2	0.33	1.00	7.00	1.321	0.431
PI3	7.00	0.14	1.00	0.993	0.324
				3.064	

I	Pire	P.Said	Malta	Candarli	Geometric Average	Eigenvector
Pire	1.00	0.20	**3.00**	2.00	1.046	0.190
Psaid	5.00	1.00	**5.00**	5.00	3.343	0.609
Malta	0.33	0.20	**1.00**	3.00	0.667	0.121
Candarli	0.50	0.20	**0.33**	1.00	0.426	0.077
					5.483	

Source: Author

Related cluster effects on the R in Table 37:

Table 37: **Cluster and node effects on the R**

R	GP1	GP2	Geometric Average	Eigenvector
GP1	1.00	6.00	2.449	0.859
GP2	0.16	1.00	0.400	0.140
			2.849	

R	**PI1**	**PI2**	**PI3**	**Geometric Average**	**Eigenvector**
PI1	1.00	0.20	0.11	0.280	0.065
PI2	5.00	1.00	4.00	2.714	0.630
PI3	9.00	0.25	1.00	1.310	0.304
				4.304	

R	Pire	P Said	Malta	Candarli	Geometric Average	Eigenvector
Pire	1.00	2.00	2.00	0.20	0.945	0.168
P Said	0.50	1.00	5.00	0.25	0.889	0.158
Malta	0.50	0.20	1.00	0.14	0.343	0.061
Candarli	5.00	4.00	7.00	1.00	3.439	0.612
					Total 5.618	

Source: Author

Related cluster effects on the R in Table 38:

Table 38: **Cluster and node effects on the QC**

QC	GP1	GP2	Geometric Average	Eigenvector
GP1	1.00	3.00	1.732	0.750
GP2	0.33	1.00	0.574	0.249
			2.306	

QC	PI1	PI2	PI3	Geometric Average	Eigenvector
PI1	1.00	0.33	2.00	0.870	0.248
PI2	3.00	1.00	3.00	2.080	0.594
PI3	0.50	0.33	1.00	0.548	0.156
				3.499	

QC	Pire	PSaid	Malta	Candarli	Geometric Average	Eigenvector
Pire	1.00	2.00	0.50	0.50	0.840	0.216
P Said	0.50	1.00	2.00	2.00	1.189	0.305
Malta	2.00	0.20	1.00	0.50	0.668	0.171
Candarli	2.00	0.50	2.00	1.00	1.189	0.305
					3.888	

Source: Author

Related cluster effects on the AC in Table 39:

Table 39: **Cluster and node effects on the AC**

AC	Pire	Paid	Malta	Candarli	Geometric Average	Eigenvector
Pire	1.00	0.50	0.50	2.00	0.840	0.181
P Said	2.00	1.00	1.00	4.00	1.681	0.363
Malta	2.00	1.00	1.00	4.00	1.681	0.363
Candarli	0.50	0.25	0.25	1.00	0.420	0.090
					4.624	

Source: Author

5.8. Alternatives Influence

Related cluster effects on the Port of Piraeus in Table 40:

Table 40: **Cluster and node effects on the Port of Piraeus**

Port of Piraeus	GP1	GP2	Geometric Average	Eigenvector
GP1	1.00	4.00	2.00	0.80
GP2	0.25	1.00	0.5	0.20
			2. 50	
Port of Piraeus	**PI1**	**PI2**	**PI3**	**Geometric Average**	**Eigenvector**
PI1	1.00	0.16	0.20	0.317	0.081
PI2	6.00	1.00	0.50	1.442	0.368
PI3	5.00	2.00	1.00	2.154	0.550
				3.914	
Port of Piraeus	**I**	**R**	**QC**	**AC**	**Geometric Average**	**Eigenvector**
I	1.00	3.00	5.00	8.00	3.309	0.569
R	0.33	1.00	4.00	4.00	1.515	0.260
QC	0.20	0.25	1.00	5.00	0.707	0.121
AC	0.12	0.25	0.20	1.00	0.278	0.047
					5.811	

Source: Author

Related cluster effects on the Port Said in Table 41:

Table 41: Cluster and node effects on the Port Said

Port Said	GP1	GP2	Geometric Average	Eigenvector
GP1	1.00	6.00	2.828	0.890
GP2	0.16	1.00	0.346	0.109
			3.174	
Port Said	**PI1**	**PI2**	**PI3**	**Geometric Average**	**Eigenvector**
PI1	1.00	0.16	0.20	0.748	0.244
PI2	6.00	1.00	0.20	1.321	0.431
PI3	5.00	5.00	1.00	0.993	0.324
				3.064	
Port Said	**I**	**R**	**QC**	**AC**	**Geometric Average**	**Eigenvector**
I	1.00	3.00	5.00	9.00	4.695	0.658
R	0.33	1.00	3.00	5.00	1.730	0.242
QC	0.20	0.33	1.00	5.00	0.418	0.058
AC	0.11	0.20	0.20	1.00	0.285	0.039
					7.129	

Source: Author

Related cluster effects on the Malta in Table 42:

Table 42: **Cluster and node effects on the Malta**

Malta	GP1	GP2	Geometric Average	Eigenvector
GP1	1.00	0.11	0.331	0.099
GP2	9.00	1.00	3.00	0.900
			3.331	

Malta	**PI1**	**PI2**	**PI3**	**Geometric Average**	**Eigenvector**
PI1	1.00	0.16	0.20	0.317	0.077
PI2	6.00	1.00	3.00	2.620	0.636
PI3	5.00	0.33	1.00	1.181	0.286
				4.119	

Malta	**I**	**R**	**QC**	**AC**	**Geometric Average**	**Eigenvector**
I	1.00	5.00	2.00	5.00	2.659	0.485
R	0.20	1.00	4.00	0.50	0.795	0.145
QC	0.50	2.00	1.00	5.00	1.495	0.272
AC	0.20	2.00	0.20	1.00	0.531	0.097
					5.481	

Source: Author

Related cluster effects on the Candarli Port in Table 43:

Table 43: **Cluster and node effects on the Candarli Port**

Candarli	**GP1**	**GP2**	**Geometric Average**	**Eigenvector**
GP1	1.00	8.00	2.828	0.890
GP2	0.12	1.00	0.346	0.109
			3.174	

Candarli	**PI1**	**PI2**	**PI3**	**Geometric Average**	**Eigenvector**
PI1	1.00	0.20	0.25	0.368	0.090
PI2	5.00	1.00	0.20	1.00	0.244
PI3	4.00	5.00	1.00	2.714	0.664
				4.082	

Candarli	**I**	**R**	**QC**	**AC**	**Geometric Average**	**Eigenvector**
I	1.00	0.50	5.00	9.00	2.177	0.370
R	2.00	1.00	5.00	6.00	2.783	0.473
QC	0.20	0.20	1.00	5.00	0.668	0.113
AC	0.11	0.16	0.20	1.00	0.243	0.041
					5.873	

Source: Author

At this stage of calculation, all values that are calculated are put on unweight super matrix which is shown in Table 44. The super matrix consists of the priority vector that is in the proper columns of the matrix.

Table 44: **Unweight super matrix**

	GP1	GP2	PL1	PL2	PL3	I	R	QC	AC	PIR	PSAI	MAL	CAN
GP1	0.00	0.00	0.271	0.370	0.357	0.634	0.246	0.077	0.041	0.345	0.138	0.041	0.474
GP2	0.00	0.00	0.096	0.202	0.700	0.00	0.00	0.00	0.00	0.047	0.605	0.238	0.108
PL1	0.00	0.00	0.00	0.00	0.00	0.64	0.092	0.205	0.060	0.109	0.298	0.21	0.381
PL2	0.00	0.00	0.00	0.00	0.00	0.241	0.562	0.104	0.090	0.108	0.266	0.208	0.416
PL3	0.00	0.00	0.00	0.00	0.00	0.658	0.242	0.058	0.039	0.176	0.432	0.195	0.195
I	0.890	0.109	0.244	0.431	0.324	0.00	0.00	0.00	0.00	0.190	0.609	0.121	0.077
R	0.859	0.14	0.065	0.630	0.304	0.00	0.00	0.00	0.00	0.168	0.158	0.061	0.612
QC	0.75	0.249	0.248	0.594	0.156	0.00	0.00	0.00	0.00	0.216	0.305	0.171	0.305
AC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.181	0.363	0.363	0.090
PIR	0.80	0.20	0.081	0.368	0.55	0.569	0.260	0.121	0.047	0.00	0.00	0.00	0.00
PSAI	0.89	0.109	0.244	0.431	0.324	0.658	0.242	0.058	0.039	0.00	0.00	0.00	0.00
MAL	0.099	0.90	0.077	0.636	0.286	0.485	0.145	0.272	0.097	0.00	0.00	0.00	0.00
CAN	0.89	0.109	0.090	0.244	0.664	0.37	0.473	0.113	0.041	0.00	0.00	0.00	0.00

Source: Author

Then the initial super matrix must be transformed to a matrix in which each of its columns sums to harmony. For this reason, this matrix must be normalized by the cluster weight to get the column sums to harmonize. Thus, the stochastic or weighted super matrix is obtained.

CLUSTER WEIGHTS MATRIX: there are three types of super matrix in ANP which are unweight super matrix, the weighted matrix and the limiting super matrix. Except these, there is the cluster weights matrix which is constructed by the relation between clusters, which are port location, port infrastructure, others and alternatives.

In this case:

Table 45: **Cluster effects on others**

GL	PI	Others	Alternatives	Geometric Average	Eigenvector
PI	1.00	0.50	5.00	1.357	0.352
Others	2.00	1.00	5.00	2.154	0.559
Alternatives	0.20	0.20	1.00	0.341	0.088
				Total 3.853	
PI	**GL**	**Others**	**Alternatives**	**Geometric Average**	**Eigenvector**
GL	1.00	0.16	0.14	0.281	0.065
Others	6.00	1.00	0.33	1.255	0.292
Alternatives	7.00	3.00	1.00	2.758	0.642
				4.296	
Others	**GP**	**PI**	**Alternatives**	Geometric Average	Eigenvector
GP	1.00	0.50	0.20	0.464	0.128
PI	2.00	1.00	0.50	1	0.276
Alternatives	5.00	2.00	1.00	2.154	0.595
				3.618	
Alternatives	**GP**	**PI**	**Others**	**Geometric Average**	**Eigenvector**
GP	1.00	0.20	0.33	0.404	0.104
PI	5.00	1.00	0.20	1	0.258
Others	3.00	5.00	1.00	2.466	0.637
				3.870	

Source: Author

Then, the cluster weight matrix that is used for the normalization of weighted matrix can be seen in Table 46.

Table 46: **Cluster Matrix**

	Geographical Location	Port Infrastructure	Others	Alternatives
Geographical Location	0.00	0.352	0.559	0.088
Port Infrastructure	0.065	0.00	0.292	0.642
Others	0.128	0.276	0.00	0.595
Alternatives	0.104	0.258	0.637	0.00

Source: Author

After normalization, the weighted super matrix is shown in Table 47.

Table 47: **Weighted Super Matrix**

	GP1	*GP2*	*PL1*	*PL2*	*PL3*	*I*	*R*	*QC*	*AC*	*PIR*	*PSAI*	*MAL*	*CAN*
GP1	0,000	0,000	0,095	0,370	0,126	0,354	0,138	0,043	0,023	0,030	0,012	0,004	0,042
GP2	0,000	0,000	0,034	0,574	0,246	0,000	0,000	0,000	0,000	0,004	0,053	0,021	0,010
PL1	0,000	0,000	0,000	0,000	0,000	0,187	0,027	0,060	0,018	0,070	0,191	0,135	0,245
PL2	0,000	0,000	0,000	0,000	0,000	0,070	0,164	0,030	0,026	0,069	0,171	0,134	0,267
PL3	0,000	0,000	0,000	0,000	0,000	0,192	0,071	0,017	0,011	0,113	0,277	0,125	0,125
I	0,114	0,014	0,067	0,119	0,089	0,000	0,000	0,000	0,000	0,113	0,362	0,072	0,046
R	0,110	0,018	0,018	0,174	0,084	0,000	0,000	0,000	0,000	0,100	0,094	0,036	0,364
QC	0,096	0,069	0,068	0,164	0,043	0,000	0,000	0,000	0,000	0,129	0,181	0,102	0,181
AC	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,108	0,216	0,216	0,054
PIR	0,083	0,052	0,021	0,095	0,142	0,362	0,166	0,077	0,030	0,000	0,000	0,000	0,000
PSAI	0,093	0,028	0,063	0,111	0,084	0,419	0,154	0,037	0,025	0,000	0,000	0,000	0,000
MAL	0,010	0,232	0,020	0,164	0,074	0,309	0,092	0,173	0,062	0,000	0,000	0,000	0,000
CAN	0,093	0,028	0,023	0,063	0,171	0,236	0,301	0,072	0,026	0,000	0,000	0,000	0,000

Source: Authors

After the weighted matrix is created, this stochastic matrix and by the increase in the huge force of the weighted matrix, the limiting matrix is constructed as shown in Table 48. The limiting matrix is the main point for the decision making.

Table 48: **Limiting Super Matrix.**

	GP1	*GP2*	*PL1*	*PL2*	*PL3*	*I*	*R*	*QC*	*AC*	*PIR*	*PSAI*	*MAL*	*CAN*
GP1	0.08	0.04	0.04	0.16	0.11	0.23	0.14	0.05	0.02	0.07	0.18	0.07	0.14
GP2	0.06	0.02	0.03	0.12	0.08	0.17	0.10	0.03	0.01	0.05	0.13	0.05	0.10
PL1	0.06	0.03	0.03	0.12	0.08	0.18	0.11	0.03	0.01	0.06	0.14	0.06	0.11
PL2	0.06	0.03	0.03	0.12	0.08	0.18	0.10	0.03	0.01	0.06	0.14	0.05	0.11
PL3	0.06	0.03	0.03	0.12	0.08	0.18	0.11	0.03	0.01	0.06	0.14	0.05	0.11
I	0.07	0.03	0.04	0.13	0.09	0.19	0.11	0.04	0.02	0.06	0.15	0.06	0.12
R	0.07	0.03	0.04	0.13	0.09	0.19	0.11	0.04	0.02	0.06	0.15	0.06	0.01
QC	0.07	0.03	0.04	0.14	0.09	0.20	0.12	0.04	0.02	0.06	0.16	0.06	0.12
AC	0.04	0.02	0.02	0.08	0.05	0.12	0.07	0.02	0.01	0.04	0.09	0.03	0.07
PIR	0.07	0.03	0.04	0.13	0.09	0.20	0.11	0.04	0.02	0.06	0.15	0.06	0.12
PSAI	0.07	0.03	0.04	0.13	0.09	0.19	0.11	0.04	0.02	0.06	0.15	0.06	0.12
MAL	0.07	0.03	0.04	0.14	0.10	0.21	0.12	0.04	0.02	0.07	0.16	0.06	0.13
CAN	0.07	0.03	0.04	0.13	0.09	0.19	0.11	0.04	0.02	0.06	0.15	0.06	0.12

Source: Author

All in all, the result of the analytic network process analysis is stated. These numbers are an indicator for the possibilities of being a hub port with identified nodes and clusters in the region.

According to the analytic network process, Port Said has bigger possibilities which are % 31.06, according to the process. Malta and the port of Piraeus do not have much chance like Port Said. However, Candarli Port has 24.60 %. It is clearly seen that Port Said has comparative advantages in the region.

CHAPTER SIX

SUMMARY AND CONCLUSION

The objective of this research was to analyze the possibilities of the North Aegean Candarli Port being a regional hub port in the Mediterranean Sea region. In addition, the research has also emphasized the competition between ports which are located in the same proximity, namely Port Said, Malta, the port of Piraeus.

6.1. The Limitations of the study

This study is limited because of the container traffic in the Candarli Port region and its hinterland. To make a comparison among the competitor ports and demand forecast analysis, ANP and multi regression analysis were carried out to compare the competitor ports and to calculate the demand forecast. Firstly, in the demand forecast analysis, the data and hinterland populations provided gross domestic production and trade values used for the Candarli Port region were collected from the governmental institutions. Thus, calculations were based on these data without checking opportunities. Secondly, in the ANP analysis, the questionnaire surveys were done with 11 professional in the port sector. These are also limitations for the ANP. In addition, Port Said, Malta Port and the port of Piraeus were identified as competitors for the Candarli Port.

6.2. Summary of the study

In the second chapter, the basic information, importance of ports and selection possibilities in terms of political and geographical situations about ports were stated. The geopolitical advantages of Candarli Port are incontestable. Because of the European Union expansionary transport policy, Candarli Port has supported as a part

of the motorways of the sea concept and stated in TINA report. Candarli Port has comparative advantages in terms of the EU connection to the Middle East through Turkey, which has a wide hinterland and good connectivity. In addition, the Turkish Government has defined and supported the Candarli Port as a hub for the region. Consequently, these geographical, political and geopolitical advantages will probably provide a good position in the future.

To find the possibilities for Candarli Port to become a hub port, the demand forecasts are calculated in the chapter three. As a result of this chapter, the demand forecast level is given in chapter three up to 2030. Hinterland cargo, transshipment cargo and cabotage cargo are considered for the demand forecasts. When the hinterland forecast demand calculation is carried out, the gross domestic product values, hinterland area populations that direct or gateway and trade increased values are also taken into account for forecast.

It is clearly seen from the results that the forecast demand will be increased gradually for Candarli Port, although there are some other ports in the proximity. There are three scenarios, namely optimistic, normal and pessimistic. In 2030, the demand forecast will be around 1,51 million to 2,14 million TEU.

In the fourth chapter, the analytic network process is applied to the hub port selection among Candarli Port, Port Said, Malta Port and the port of Piraeus. ANP is applied to the decision making problems for port selection, in which the criteria that clearly but the constraints effecting the decision making process cannot be expressed mathematically.

In the fifth chapter, the port selection criteria are applied for Candarli Port, Port Said, Malta Port and the port of Piraeus. In ANP, all clusters and nodes which are related with the ports are taken into account. According to this analysis, Candarli Port is in the second place among the competitors, 24,60 %. However, Port Said is 31, 06 %. Port Said has comparative advantages if compared to the others. Candarli Port will use some important points as advantages, namely high value-added service, efficient

port operations, diversification of port services, liberalization process, available space for industrial productions and environmental developments. At the same time, Candarli Port avoids some threats (Musso, 2009) for the port, namely high competition between the ports, lack of bargaining power local problems with the administration, dredging requirements, lack of hinterland connectivity and customer deals.

6.3. Conclusion

As a general rule, the economic improvements that are an observable result of worldwide replacement of manufacturing issues have affected the port`s usefulness for the national, regional and global trade. In addition, ports should follow the new technological innovations, new perspectives in the supply chain and transportation modes to captivate the customers in the region. The result of "which criteria are important for successful ports?" question is much more different, if it was asked in the 1970s and in 2010. Therefore, the result of the question "which criteria are important for successful ports in the 2010s?" is behind the expectations of customers, new port infrastructure and superstructure technology, provided services as a value added, environmental consideration of ports and effective hinterland connections with rail or high ways. On the other hand, according to Meersman (2009), some uncertain questions and answers have identified the port futures basically.

- Will the globalization continue or trade is alive formed by a fresh concept, regionalism?
- Will free trade policy continue?
- Will the world economics dominate by the USA or not?
- Will Trade imbalances continue?
- Will oil prices increase more?

The answers of these questions will be the significant indicator for the world and regional economic growth. Consequently, Candarli Port is directly related to Turkish Government, Mediterranean region and global economic developments. This can be illustrated with the port of Piraeus and Greece economic crisis this year.

This dissertation reveals to analyze the Candarli Port suitability among the container ports in the Mediterranean region. First, as a result of the demand forecast analysis, it was found that the Candarlı Port ratio of transshipment container cargo will not satisfactory level compare to Malta and Port Said. Therefore, some actions should be discussed to captive transshipment cargo in the Mediterranean region.

Second, another important point which was stated the result of ANP analysis is that Candarli Port has potential as selected port by the global carriers among the competitors. ANP application results indicate in Table 48.

Table 48: Result of ANP analysis

Competitors	**%**
Port Said	31.06
Candarli Port	24.60
Malta Port	13.74
Port of Piraeus	13.56

Source: Author

According to the results, if comparing to ports, carriers would rather be close to Port Said than Candarli Port, Malta Port and port of Piraeus in terms of determinant as a hub.

Third, it was found that the ANP analysis can be used as a port selection method for the carriers.

In conclusion, Candarlı Port will benefit from the part of an extension of the trans-European transport network in the region and it will be used as a regional hub for the Mediterranean.

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APPENDIX- Questionnaire

Questionnaire of the possibilities for being hub port of Candarli Port

The purpose of this survey is to support the analysis the Candarli Port possibilities as a hub port in the region. I have identified 4 criteria and 13 sub-criteria of key factors for the port selection elements. I would like to know relative importance of those dimensions and criteria in your mind. This study uses for Analytic Network Process (ANP) method. The way to respond to this questionnaire is described on the next page. Your contribution to this will be highly recognized for our research. All provided information and your individual responses will be kept full confidential according to the World Maritime University Academic Rules.

I would like to thank you in advance for your ideas in this survey.

Bu sörvey çalışmanın amacı Candarlı Limanının Ana liman olabilme analizi çalışmasının desteklenmesini ve verilerin kullanılmasıdır. 4 adet ana kriter ile 13 adet alt kriter belirlenmiştir. Bu sorveyde sizden istediğimiz göreceli olarak önem değerlerini belirtmenizdir. Bu veriler Analitik Ağ Süreci için kullanılacaktır. Sizin katkı ve cevaplarınızbelirleyici olacaktır. Tim sonuçlar ve bilgiler Dünya Denizcilik Üniversitesi gizlilik ve akademik esaslarına gore gizlenecektir.

Katılımlarınız için şimdiden teşkkür ederim.

Hasan Tarcan

Port Management/Liman Idaresi Bölmü

World Maritime University

Address: World Maritime University Malmo, Sweden.

Email: hasantarcan@gmail.com;

Which sector (Calıştığınız Sektör): ☐ Scholar in Unıversity ☐Port Authority ☐Port Development ☐Urban Planning ☐Port Industry ☐Shipping Industry (if any, multiple-choice)

- **Job Experience Years (Meslek Tecrubeniz)**: _____ years

Thank you very much for spending your precious time in filling this questionnaire.

Questionnaire Interpretation

Analytic Network Process (ANP) is a useful method to evaluate and rank relative influence of potential choices by comparing paired dimensions and criteria. Decision making is a process which you choose one of the alternative action ways toward carrying the aims and goals out. Decision making makes up the core of the all managerial functions. This does not mean only collecting the information and implement, but also making the decision with the help of improved decision methods. The complex correlation between the other alternatives and clusters are given the way for solving through the ANP. The measurement scale that called Saaty Scale is 9 levels of the relative influence. The numbers are used to indicate the values compare to other choice.

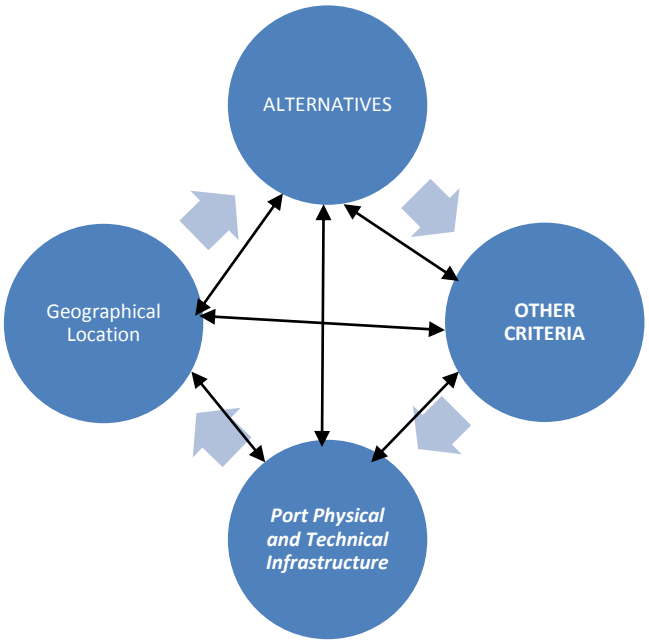

Figure 1: ANP structure of port selection criteria.

Table 1: Contents of Dimensions and Criteria

Code	Port selection criteria
	Geographical Location:
GP.1	• *Vis-a-vis the immediate and extended hinterland (centerlity index versus main economic centres in the hinterland)*
	• *Vis-a-vis the main shipping lanes*
GP.2	
	Port Physical and Technical Infrastructure
PL.1	• *Nautical accessibility profile (max draft, max vessel length, tidal windows, and restrictions)*
PL.2	• *Terminal infrastructure and equipment terminal capacity, number of berth, number of quay, and yard cranes, stacking heights)*
PL.3	• *Hinterland accessibility links trucks, rail, barge and short sea*

I **R** **QC** **AC** **PS**	**OTHER CRITERIA** • *Interconnectivity of the port (sailing frequency of deep sea and feeder shipping service)* • *Reliability, capacity, frequency and cost of inland transport service by truck, sail and barger* • *Quality and costs of auxiliary services such as pilotage, towage, repairing* • *Availability, quality and costs of port community system* • *Port security safety and environmental profile of the port.*
PIR **PSAD** **MAL** **CAN**	**ALTERNATIVES** • *Port of Piraeus* • *Port Said* • *Malta* • *Port of Candarli*

The followings describe the used scale of **Relative Influence** level of two elements with respect to another given element:

Scale	Numerical Rating	Reciprocal
Extremely Preferred	**9**	**1/9**
Very strong to extremely	8	1/8
Very strongly preferred	**7**	**1/7**
Strongly to very strongly	6	1/6
Strongly preferred	**5**	**1/5**
Moderately to strongly	4	¼
Moderately preferred	**3**	**1/3**
Equally to moderately	2	½
Equally preferred	**1**	**1**

One example is demonstrated to show how to fill in this questionnaire.

Example 1:

Each row in this questionnaire has one paired criteria: one is in the first left column and the other is in the last right hand column, "**Port Community system available**" and "**Interconnectivity**", which belongs to dimension "**Port reliability**".

Port Community system available	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	**Interconnectivity**

Step 1: According to their relative influence on "**Port reliability**" in your mind, please choose either of them, i.e. "**Port Community system available**" or "**Interconnectivity**" and circle its code number as shown above.

In this example, it is assumed that you have selected "**Port Community system available**" because you think it has greater influence on "**Port reliability**" than "**Interconnectivity**" does.

Port Community system available	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	**Interconnectivity**

Step 2: Evaluate its relative influence level of the chosen criterion "**Port Community system available**" over the discarded one "**Interconnectivity**", choosing score 1 to 9.

If you have selected "**Port Community system available**", now you should evaluate how much greater it has influence on "**Port reliability**" than the unselected criterion "**Interconnectivity**" does. 5 is chosen for the **Port Community system available** that means you preferred to Port community system availability is 5 degree, strongly preferred, relatively important than interconnectivity.

Formal Questionnaire

This questionnaire consists of four parts to extract respondent's preference structure over dimensions and criteria step by step:

1) This question of questionnaire is compared the relative importance among the four criteria "Geographical Location", "Port Phy. & Tech. Inf.", "Other Criteria", and "Alternatives" relating to the evaluation of the ımportance to hub port selection criteria.

GL	Geographıcal Location	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Phy & Tech. Inf.
GL	Geographıcal Location	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Other Criteria
GL	Geographıcal Location	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Alternatives
PI	Port Phy & Tech. Inf.	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Other Criteria
PI	Port Phy & Tech. Inf.	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Alternatives
O	Other Criteria	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Alternatives

2) These questions of questionnaire are compared the relative importance among sub-criteria under the each nodes.

Geographical Location critters.

GP1	Vis-a-vis the immediate and extended hinterland	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Vis-a-vis the main shipping lanes

Port Phy & Tech. Inf.

PI1	Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Terminal infrastructure
PI2	Nautical accessibility	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland

	profile																		accessibility
PI3	Terminal infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility

Other criteria;

I	Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
I	Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
I	Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
I	Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
R	Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
R	Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
R	Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
QC	Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
QC	Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
AC	port community system	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety

Alternatives;

a1	Port of Pireus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Said
a2	Port of Pireus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
a3	Port of Pireus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
a4	Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port

a5	Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
a6	Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

3) This part is focused on relative importance among all sub-criteria. The relative importance among all criteria by assuming existence of criterion dependency relationship under their dimensions:

This part of questionnaire is concerned with the relative importance among all criteria by assuming existence of criterion dependency relationship under their dimensions.

- In Geographical Location cluster, Influence on "**Vis-a-vis the immediate and extended hinterland".**

Vis-a-vis the immediate and extended hinterland	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Vis-a-vis the main shipping lanes

- In Port Physical and Technical Infrastructure cluster, Influence on "**Nautical accessibility profile".**

Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Terminal infrastructure
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Terminal infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility

- In Port Physical and Technical Infrastructure cluster, Influence on "**Terminal infrastructure".**

Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Terminal infrastructure
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility

Terminal infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility

- In Port Physical and Technical Infrastructure cluster, Influence on "**Hinterland accessibility".**

Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Terminal infrastructure
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Terminal infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility

- In Other criteria cluster, Influence on "**Interconnectivity of the port".**

Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
port community system	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety

- In Other criteria cluster, Influence on "**Reliability".**

Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Quality and costs of auxiliary servıce	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
port community system	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety

- In Other criteria cluster, Influence on "**Quality and costs of auxiliary service".**

Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
port community system	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety

- In Other criteria cluster, Influence on "**port community system".**

Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
port community system	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety

- In Alternatives cluster, Influence on "**Port of Piraeus".**

Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Said
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Alternatives cluster, Influence on "**Port Said".**

Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Said
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Alternatives cluster, Influence on "**Malta Port".**

Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Said
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Alternatives cluster, Influence on "**Candarli Port".**

Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Said
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

4) The relative importance among all criteria is evaluated this part. It is focused on relative importance among all sub-criteria for each sub-criteria. That means connectivity and deviation distance effect for Port of Piraeus is assessed.

- In Geographical Location cluster, Influence on "**Vis-a-vis the immediate and extended hinterland".**

Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Terminal infrastructure
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Terminal infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
port community system	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Said

Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Geographical Location cluster, Influence on "**Vis-a-vis the main shipping lines".**

Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Terminal infrastructure
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Terminal infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
port community system	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety

Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Said
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Port Physical and Technical Infrastructure cluster, Influence on "**Nautical accessibility profile".**

Vis-a-vis the immediate and extended hinterland	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Vis-a-vis the main shipping lanes
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
port community system	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Said

Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Port Physical and Technical Infrastructure cluster, Influence on "**Terminal Infrastructure".**

Vis-a-vis the immediate and extended hinterland	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Vis-a-vis the main shipping lanes
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
port community system	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Said

Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Port Physical and Technical Infrastructure cluster, Influence on "**Hinterland Accessibility".**

Vis-a-vis the immediate and extended hinterland	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Vis-a-vis the main shipping lanes
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Quality and costs of auxiliary servıce	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
port community system	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Said

Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Other clusters influence on "**Interconnectivity of the port**"

Vis-a-vis the immediate and extended hinterland	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Vis-a-vis the main shipping lanes
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Terminal infrastructure
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Terminal infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Said
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Other clusters influence on "**Reliability**"

Vis-a-vis the immediate and extended hinterland	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Vis-a-vis the main shipping lanes
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Terminal infrastructure

Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Terminal infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Said
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Other clusters influence on "**Quality and costs of auxiliary**"

Vis-a-vis the immediate and extended hinterland	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Vis-a-vis the main shipping lanes
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Terminal infrastructure
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Terminal infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Said
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Other clusters influence on "**Port Community System**"

Vis-a-vis the immediate and extended hinterland	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Vis-a-vis the main shipping lanes
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Terminal infrastructure
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Terminal infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Said
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Other clusters influence on "**Port Security Safety**"

Vis-a-vis the immediate and extended hinterland	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Vis-a-vis the main shipping lanes
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Terminal infrastructure
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Terminal infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port Said
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port
Port of Piraeus	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Malta Port

Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Alternatives clusters influence on "**Port Said**"

Vis-a-vis the immediate and extended hinterland	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Vis-a-vis the main shipping lanes
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Terminal infrastructure
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Terminal infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
port community system	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety

Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Alternatives clusters influence on "**Port of Piraeus**"

Vis-a-vis the immediate and extended hinterland	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Vis-a-vis the main shipping lanes
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Terminal infrastructure
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Terminal infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Quality and costs of auxiliary servıce	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety

port community system	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Alternatives clusters influence on "**Candarli Port**"

Vis-a-vis the immediate and extended hinterland	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Vis-a-vis the main shipping lanes
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Terminal infrastructure
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Terminal infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system

Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
port community system	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port

- In Alternatives clusters influence on "**Malta Port**"

Vis-a-vis the immediate and extended hinterland	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Vis-a-vis the main shipping lanes
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Terminal infrastructure
Nautical accessibility profile	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Terminal infrastructure	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Hinterland accessibility
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality and costs of auxiliary
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Reliability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety

Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	port community system
Quality and costs of auxiliary service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
port community system	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Port security safety
Interconnectivity of the port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Reliability
Port Said	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port
Malta Port	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Candarli Port