

SUPPLY AND DEMAND PROJECTION OF CONTAINER CARGO AT AEGEAN REGION

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ABSTRACT

Maritime transportation has been always becoming an important concept for the countries and the communities throughout the centuries. The Empires, states and countries having a connection with sea, have an advantage and more developed compared to the other empires, states and countries which had no land near the sea and no seaway transportation. Over the years, seaway transportation has been changed and re-shaped based on the demand of the communities and countries. After World War Two, "container transportation" concept has emerged, American trader and entrepreneur named Mr. Malcom Mclean has used different loading methodology model by using boxes for seaway transportation without using bulk shipping concept. This new transportation model has resulted a revolution for the shipping industry and ports and terminals, and it caused the beginning of the new era for the industry.

In consequences, the purpose of this study is to forecast the container cargo demand and supply of the Aegean region of Turkey by 2040 years. In addition to that we give the clear picture about "Kuzey Ege Candarli Port Project" how much capacity that the port can commence operational in the region based on the study. According to the results of the study, container market in Aegean region of Turkey can reach to 3,12 million TEU by 2040 year and 0,5 million TEU operational capacity can be enough for the first phase of the Kuzey Ege Candarli port project.

Key Words: Aegean, Port, Capacity, Demand, Candarli

1. INTRODUCTION

Throughout history, ports have stood out as one of the most important structures for the survival of countries. For centuries, countries bordering the coast have prospered, developed, and steered politics. Ports are a component with the most critical function in supply chain management. "Ports" have always been at the top with importance in the supply of raw materials needed for countries to reach their goals, to support production, and in the shipment of products produced within the borders of the country to the requested point. Therefore, the capacity supply and demand forecasts of the ports and coastal structures in the region where they are in their countries are important in terms of predicting and constructing the future.

In this study, to emphasize the importance of our country's port management sector in terms of supply chain management (SCM), to make container supply and demand estimations based on units and TEU by applying the multiple regression analysis method of the ports that provide container handling services in the Aegean Region, and to make the North Ege Candarli project, whose investment is considered and projected in the region. It aims to provide information about the port and how much capacity it needs to enter the market.

2. LITERATURE REVIEW

The port includes the facilities where the ships are protected against environmental factors such as waves, currents, storms, and ice, where the ships and sea transport vehicles can berth and moor at the quays or piers or anchor in water areas, transport of cargo or people from the shore to the shore, the mooring or anchoring of the boats, the mooring of the goods on land or limited land and sea areas with facilities and possibilities for storage until delivery at sea (Guler et al, 2006).

Maritime transport is the most actively preferred mode of transport around the world. Compared to the road, air and rail transport model, it has a large share in delivering the cargo to the end user with the most cost-effective model. Considering the economy of scale and distance economy for the cargo owners, the most preferred transportation model for the internationally circulating cargo is seaway and ports. It is possible to transport large amounts of cargo between countries and continents at a much lower cost than other transportation systems, by sea transportation (Hitay B. and Çınar A., 2010).

According to another definition, ports, which are the backbone of maritime transportation; sea, lake shores or river mouths, with sufficient depth to the quays or piers where the ships can dock and moor in water areas, naturally or protected against the waves by a breakwater or a breakwater, transport of cargo and people from boat to shore, from boat to boat, from shore to boat, cargo and passenger's other They are restricted land and sea areas that have the necessary facilities (passenger lounge, pier, quay, warehouse, warehouse, shed, silo, fuel tank, crane, etc.) for transferring them to transportation lines.

“Today, ports have a functional place in the dynamic logistics system of the world, far beyond just the areas where cargoes are loaded and unloaded on ships” (Roh et al., 2007). Due to the international nature of the services, they provide, ports are heavily affected by the international environmental conditions they are in (TURKLİM, 2007). One of the most important elements in the mentioned environment is the regions that make up the commercial hinterland and demand areas of the port. The globalization trend that started around the world especially after the 1980s and the goals of minimizing the costs in the production activities of the countries showed the importance of ports and logistics management. Globally state-controlled ports and coastal facilities quickly entered the privatization process.

While the geographical location is important in the planning of container ports (Ateş et al., 2010), the merger and partnership of shipping companies (such as Maersk and MSC), especially in recent years, has led to the growth of ships, increases in capacity, and a decrease in the number of port calls. However, the number of containers unloading and loading operations per ship call has increased. Growing ship sizes and capacities have caused different demands on port preferences, especially for ship line operators. Berth length, depth level, cranes used in dock operations, field equipment and operation system models preferred in container storage areas, solutions offered in port gate operations, other value-added services offered by ports (empty container storage area, partial container loading operations, etc.) have been the important criteria preferred by container line operators in port selection with price policy.

3. METHODOLOGY: MULTIPLE REGRESSION ANALYSIS

Every business operating in the world economically, whether large or small, always invests, grows, and develops on the future-oriented supply-demand situation in the sector or market it serves. Whether these large or small-scale companies are in the service sector or the production sector, making demand forecasts for the future, calculating possible market shares, and managing their institutions by seeing the potential both provide advantages in the long term and take a step from locality to globalization.

Ports and coastal facilities have always been the exit gate for the region and hinterland they serve. It invests and expands according to the future supply-demand projections of existing ports and their targeted market share and positioning. From another point of view, calculations are made by looking at the past and future term business volume projections in the region where there is a port or coastal facility to be invested from scratch in a targeted region. It is very important to design the ports and coastal facilities that are planned to be invested in order to carry out the pier, field and gate operations according to the previously and subsequently estimated numbers, and to evaluate the demands from customers and stakeholders in the market in the hinterland, where they will be present, to choose the right equipment and to establish port operation systems. Global and regional container port operators and container line operators usually go for pre-investment load demand forecasts and capacity analysis calculations.

The Aegean Region has always taken its place in history as an important region for our country. The existing industrial facilities that have developed over the years, the organized industrial zones that came into service in the hinterland where the ports serve, the increasing exports, population and migration have always pushed the port and coastal facilities in the Aegean Region to capacity increases and modernization studies. In parallel with the trend of container transportation in the world, we have encountered it as a preferred type of transportation for companies located in the Aegean Region, and TCDD İzmir port went down in history as the first port in the region to provide container handling services (Oral, 2008). In the

2010s, Ege Gubre (TCE EGE) and Nemport container handling services started to be provided in the Aliğa Region, and SOCAR Aliğa Port became operational in the region in 2016.

This study has been prepared to predict the container business volume and the capacity supply of the ports for the next twenty years in the Aegean Region, to provide information about the capacity of the "North Aegean Çandarlı Port" project, which is planned to be invested with the "Public-Private Partnership" model.

Demand forecasting is the process of estimating the quantity of a product or service that consumers tend to purchase. It helps the company decide whether to enter a new market and matches supply with demand to evaluate optimal production and casting capacities. In forecasting, quantitative methods such as historical sales data or current data from markets and methods such as forecasts are used. Demand forecasting is one of the most important aspects of running a business, although it is very important for the future success of any business and provides benefits in areas such as resource allocation, resource waste prevention, production direction, pricing, sales policy formulation, business risk reduction and inventory management. (Doğusel, 2020).

The results of the study were obtained by using the multiple regression analysis method by examining the relationship between a dependent variable and three different independent variables to determine the freight demand forecasts for the ports that provide container handling services and the new container ports that are planned to be invested in the Aegean Region. The dependent variable is Ton and TEU (container) units handled by the Aegean Region ports, and the independent variables are the total exports, population, and gross domestic product information of the cities of İzmir, Aydın, Manisa, Muğla, Kütahya, Afyon, Uşak and Denizli located in the hinterland of the region. In the analysis made, the correlation analysis made with the import information in dollar terms did not overlap, and it was not used in the formula prepared for the forecast scenario.

3.1. Forecast Inputs

In the prepared study, the business volumes of the Region between 2010 and 2020 are considered as the dependent variable in the estimations to be made based on tons and TEU until 2040 for the ports located in the Aegean Region and providing container handling services. In the business volume projection prepared until 2040, the total Gross Domestic Product (GDP), exports, imports (dollars) and population figures (units) belonging to the cities of İzmir, Manisa, Aydın, Muğla, Kütahya, Afyon, Denizli and Uşak, which are treated as an independent variable. In the analysis of the regression study, it was determined that the import figures in dollar terms were not dependent on the basis of tons and TEU. The formula and method used for container cargo estimation analysis prepared for the Aegean Region are as follows.

Aegean Region Ports cargo estimation in TON:

- ✓ Aegean Region Ports Total Cargo Demand Forecast: $A + BX_1(\text{Hinterland GDP}) + CX_2(\text{Hinterland Exports}) + CX_3(\text{Hinterland Population})$

Aegean Region Ports cargo estimation based on TEU (Container):

- ✓ Aegean Region Ports Total Container Demand Forecast: $A + BX_1(\text{Hinterland GDP}) + CX_2(\text{Hinterland Exports}) + CX_3(\text{Hinterland Population})$

In the multiple regression analysis formula prepared, TÜRK LİM (Turkish Port Operators Association) and TÜİK (Turkish Statistical Institute) data were used for dependent and independent variables.

Table 1. Turkey and Aegean Region for the Years 2010-2020

Year	Dependent Variables		Independent Variables		
	Aegean Region		Aegean Region		
	Total Cargo TON	Total Container TEU	GDP \$'000	Export \$'000	Population In Person
2010	53.854.853	966.515	147.820.408	13.433.064	9.666.005
2011	54.298.271	1.075.098	177.210.531	16.477.287	9.653.427
2012	58.680.870	1.134.379	201.140.529	16.976.973	9.743.714
2013	57.292.684	1.174.770	229.070.892	17.146.208	9.836.902
2014	59.565.203	1.221.042	260.000.137	17.729.927	9.960.295
2015	65.478.727	1.240.971	290.694.086	15.463.117	10.063.606
2016	67.819.303	1.320.653	324.972.811	15.699.222	10.177.621

2017	74.098.504	1.432.244	388.492.757	17.595.642	10.296.434
2018	72.281.772	1.585.441	480.811.966	19.656.045	10.414.267
2019	83.923.544	1.727.693	545.606.157	19.688.713	10.503.743
2020	85.889.153	1.686.568	536.596.782	19.031.809	10.580.063

3.2. Research Findings

As a result of the study, the cargo demand forecast on a ton basis for the Aegean Region hinterland until 2040 resulted in 151,693,565 metric tons. It is predicted that the hinterland, which was 85.9 million metric tons in 2020, will increase 1.77 times in the next twenty years.

Table 2. Forecast data on a ton basis for the Aegean Region

TON	Pessimistic Scenario	Base Scenario	Optimistic Scenario
2020	85.889.153	85.889.153	85.889.153
2025	90.674.152	100.749.058	110.823.964
2030	105.701.973	117.446.637	129.191.300
2035	121.496.387	134.995.986	148.495.585
2040	136.524.208	151.693.565	166.862.921

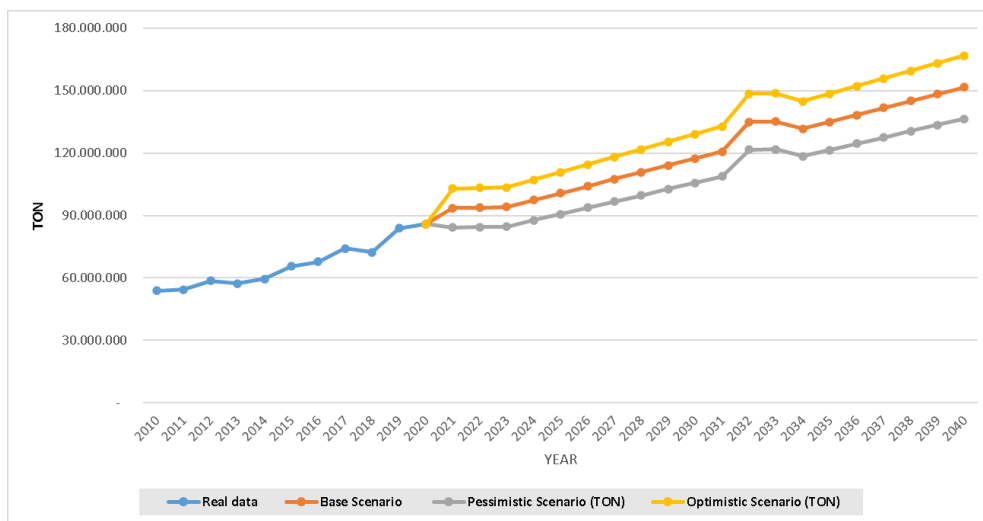


Figure 1: Aegean Region total ton-based load forecast graph

Table 3. Estimated data based on total container (In TEU) for Aegean Region

TEU	Pessimistic Scenario	Base Scenario	Optimistic Scenario
2020	1.686.568	1.686.568	1.686.568
2025	2.045.324	1.738.525	2.352.122
2030	2.410.547	2.048.965	2.772.129
2035	2.764.532	2.349.852	3.179.212
2040	2.660.292	3.129.756	3.599.219

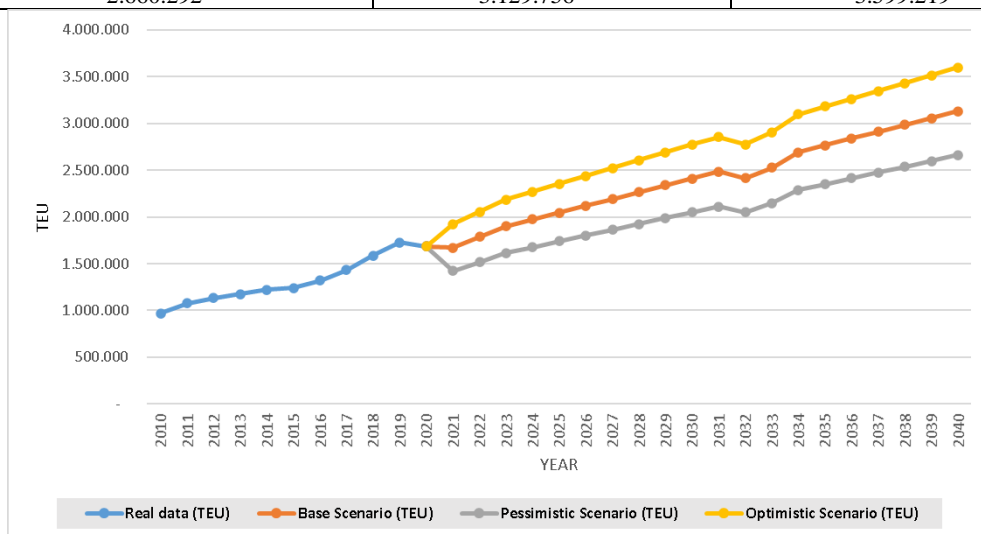


Figure 2. Aegean Region load forecast graph based on total TEU



The container load estimation projection prepared for the Aegean Region ports resulted in 3,129,756 TEU in 2040. Regional ports handled 1.68 million TEU of containerized cargo in 2020, and it is predicted that the market will increase 1.86 times in 2040. Ports serving container handling in the Aegean Region have an operational capacity (theoretical capacity) of 3.7 million TEU/year, according to officially declared data.

There are different types of capacities defined in container ports. The most important factor that determines the capacity in a port is the physical characteristics of the port (the length of the pier, the shape of its depth, the size of the storage areas, etc.) as well as the characteristics of the equipment used in the port. Based on the theoretical capacity, the most important factor determining the capacity in a port is the physical characteristics of the port as well as the characteristics of the equipment used in the port. The optimum capacity utilization rate in container ports is generally accepted as 75%. For this reason, the following results emerge for the Aegean Region.

- ✓ In 2021, 4 different ports provide container handling services in the Aegean Region, and the total optimum capacity of the region (with a utilization rate of $3.7 \times 75\%$) has been determined as 2.8 million TEU.
- ✓ With the investments and planned capacity increases of the existing ports serving in the region until 2040, it will be sufficient for the North Aegean Çandarlı port project to enter the market with a theoretical capacity of 0.5 million TEU.
- ✓ The current market share of TCDD Izmir port is constantly decreasing due to not completing the investment requirements. On the other hand, the market share of the ports serving in the Aliğa region has increased in recent years. Due to the privatization process of the Izmir port, it was transferred to the Wealth Fund. After privatization, especially if one or more of the global port operators operate the facility, the market share of the port, which has shifted to the Aliğa region, may increase again. The port may also reach the planned 2.5 million TEU container operation capacity, and this capacity increase may adversely affect other ports in the region in terms of competition.

4. CONCLUSION AND RECOMMENDATIONS

In the study, the ton and TEU data of the total handling of the port and coastal facilities in the Aegean Region between 2010 and 2020 are dependent variables, and the dependent variables are the cities of Izmir, Manisa, Aydın, Muğla, Kütahya, Afyon, Uşak and Denizli in the Aegean Region. The total GDP, exports and population figures of the Aegean Sea Region are included as independent variables, and estimates are made for the total amount of cargo and containers for the Aegean Region ports. In the study, in which the importance of ports in terms of maritime trade and forecast demand studies in terms of ports is conveyed; The history of the region, current port operations and comparative statistics are included.

According to the estimations made for the year 2040, it has been reached as a result that the total container business volume in the Aegean Region will reach 3.12 million TEU. With the annual container operation capacities officially declared by the container ports in the region and the 1st Phase investment of the North Aegean Çandarlı Port (0.5 million TEU/year recommended and considered), the theoretical capacity of container terminals of the Aegean Region ports will increase to 7 million TEU in 2040 and the effective capacity is assumed to increase to 5.25 million TEU with a 75% capacity utilization rate. Another scenario is that due to the North Aegean Çandarlı Port project, the Izmir Port will complete its natural life and the current business volume will be handled gradually by the Aliğa Ports and the North Aegean Ports. In this context, it has been concluded that the annual capacity supply of the ports in the Aegean Region will be 5.50 million TEU and 4.12 with a capacity utilization rate of 75% in 2040, while the North Aegean Çandarlı Port can serve in the region with a design capacity of 1.5 million TEU.

In the last part of the study, the potential business volume of the ports and coastal facilities located in the hinterland of the Aegean Region on the basis of tons and TEU was estimated by applying the multiple regression analysis method. In addition, it provides information on the design of the North Aegean Çandarlı Port project with the resulting demand forecast analysis and how much operation capacity.

In order for the North Aegean Çandarlı Port project to be a regional port facility due to its location, it is recommended to concentrate on the following issues.

- ✓ It should be established with a port-based Logistics concept.
- ✓ A railway logistics center investment should be planned in the back area of the port.
- ✓ The facility should be designed to have direct access to the highway and highway connection.
- ✓ Within the facility, a truck parking area should be built, and a vehicle reservation system investment should be made for transportation vehicles that support port gate operations.
- ✓ Closed and open warehouse-warehouse facilities that can serve cargo owners, forwarders and logistics companies should be established in the port back area.
- ✓ In order to speed up the customs procedures, a "Candarlı customs directorate" should be established.

In future studies, research is recommended for the determination of the current situation and improvement of the logistics infrastructure supporting the ports in the Aegean Region.

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