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RESEARCH OF A DRY PORT WHICH CAN SUPPORT CONTAINER TRANSPORTATION FROM KOCAELI PORTS IN TERMS OF POSSIBILITIES AND CAPABILITIES

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ABSTRACT: While the containerization and intermodal transportation become widespread, dry ports within the transport network in the hinterland of a sea port have begun to play an important role in freight transport. In addition to providing the opportunity to expand the hinterland of sea ports, a dry port can also relieve a sea port that is experiencing capacity problems.

It is thought that the total capacity of Kocaeli container terminals, which play an active role in Turkish foreign trade, may be insufficient to meet the needs in the coming years and therefore a dry port to be established in the region may support the seaports in increasing their throughput volumes. The Köseköy logistics center, which is considered to be a suitable candidate in this regard, has been examined in terms of the facilities and capabilities it has to possess, and the minimum land area of that dry port has been determined by taking into account the demand of 2035 through a mathematical model.

In this study, it is assessed that the Köseköy logistics center has enough space to construct the required facilities in supporting the ports in the region in terms of container transportation, however, it must acquire new abilities. On the other hand, it is considered necessary that TCDD (Turkish Republic State Railways) complete its infrastructure investments to increase the freight transport capacity to a minimum one million TEU a year between Gebze and Köseköy.

Keywords: Dry port, container transportation, intermodal transportation, maritime management.

1. INTRODUCTION

Containerization, since its first launch in 1956, has boosted the maritime transportation and the globalization within a few decades [1]. The invention of the container at first was targeting take place in maritime transportation, but in time it also took place in inland transportation [2]. In addition to the possibility of storing the goods to be carried, containerization has provided great flexibility to the logistics system [3], making it feasible to integrate the maritime and inland transportation [4].

While opening new global markets by the way of quick distribution method [2], container transportation also brought in a new concept, “Door – to – door” service, which stimulated the development of intermodal transportation [5]. Intermodal transportation requires the development of proper infrastructure such as roads, railways, and terminals [6]. It is also seen as a solution for congestion on roads [7]. The increase in global trade brings in the need to develop the transportation network as well as the terminals which are having difficulty to accommodate the increasing throughput [8, 9].

While the carriers take into account the total cost of transportation inland transportation is getting higher importance as an important dimension of maritime transportation [10]. The increase in demand for inland freight transportation has triggered the emergence of dry ports [11]. Intermodal transportation enabled the carriers to transport their goods through the environmental and cost-friendly systems, such as railway and inland waterway, to the dry ports before distributing to the markets.

UN ECE [12] defines the dry port as the “Inland terminal which is directly linked to a maritime port.” This definition mainly emphasizes the direct linkage between the seaport and the dry port. Leveque and Roso [13] added the quality of the linkage in the definition as stating that; “A dry port is an integrated intermodal terminal directly connected to the seaport(s) with high capacity transport mean(s) where customers can leave/pick up their standardized units as if directly to/from a seaport”. According to Leveque and Roso, it should enable high capacity transportation between the seaport and the dry port. Another detail in this definition implies that the direct link should ensure the customers so that their goods will easily flow through it.

Dry ports are crucial nodes assisting efficient global freight transportation by connecting the consumption centers, production centers and seaports [14]. These inland terminals can be regarded as extended gates of the seaports and they can serve as reducing the dwell time of the containers [15]. According to Werikhe and Jin [16], the evolution of a dry port creates a cycle in the continuous development of containerization and intermodal transport.

According to Cullinane and Wilmsmeier [17], the dry port concept recently has been being applied mainly for two reasons. One of them is to overcome the problems of capacity constraints [18] in a container port. The other reason is expanding the hinterland of a container port.

Unlike the general situation of the world, in Turkey, the distribution of freight from seaports to inland destinations to a large extent is accomplished by road transportation. The contribution of the railway system to this transportation is unfortunately at a level of 2% [19]. However, the Ministry of Transport and Infrastructure (MTI) targets a rate of 20% for railway freight transport between 2023 and 2035 [20]. Therefore, it is assessed that the Turkish Republic State Railways (TCDD) will provide higher transportation capacity in the future.

The aim of this study is to evaluate the capacity of the ports of Kocaeli and intermodal transportation facilities in the region by taking into consideration the possible container traffic in 2035 and to make a proposal in line with the emerging needs.

2. CONTAINER TERMINALS

Currently, there are six container terminals within the Kocaeli Gulf. The locations of these ports are seen in Figure-4.1. Among them, SAFIPORT has been undergoing a modernization phase since 2015 after the privatization process, and BELDEPORT is a newly constructed seaport which is in service since 2018 with limited capabilities.

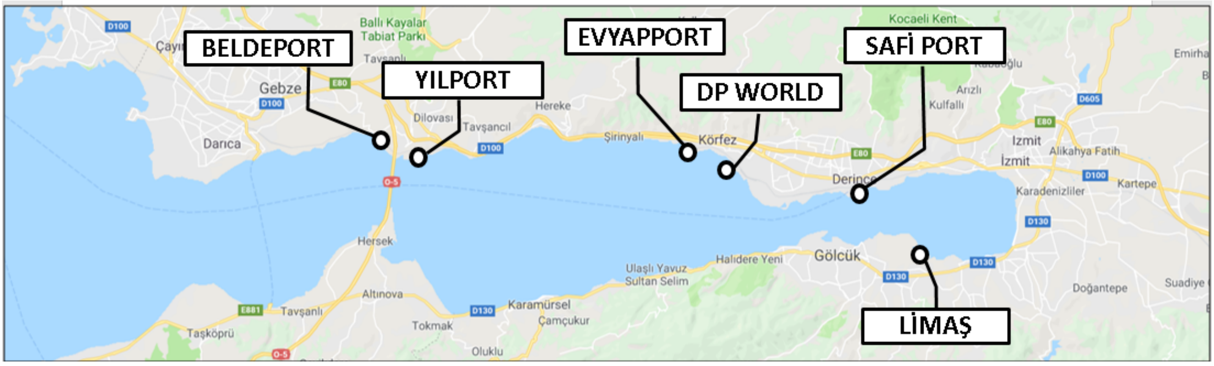

Figure 1. The locations of the Kocaeli container terminals.

The statistics of these terminals are seen in Table-2. BELDEPORT and SAFIPORT are not included in this table since their construction periods are not completely finished.

Table 2. Container Throughput Values and Annual Change in Kocaeli Ports.

Year	YILPORT		EVYAP		DP WORLD		LİMAŞ	
	Value (1000 TEU)	Change %	Value (1000 TEU)	Change %	Value (1000 TEU)	Change %	Value (1000 TEU)	Change %
2010	184		248					
2011	230	25,0	283	14,1				
2012	230	0	400	41,3				
2013	305	32,6	457	14,3			46	
2014	354	16,0	522	14,2			25	-45,6
2015	375	5,9	605	15,9			13	-48,0
2016	396	5,3	688	13,7			13	0
2017	499	26,3	369	-46,3	437		16	23,0
2018	552	10,6	465	26,0	576	31,8	16	0

Source: TURKLIM (Port Operators Association of Turkey).

Recently, YILPORT and DP WORLD have exhibited remarkable performance, with an annual increase of 26.3% in 2017 and with that of 31.8% in 2018 respectively. The involvement of DP WORLD affected adversely the neighbor of EVYAP in 2017. Although EVYAP showed another remarkable increase last year with 26.0%, it was not sufficient to meet the loss of the previous year. The values of LİMAŞ are very low compared to the other terminals. This situation derives from the feature of the accessibility of the main routes. The ports located at the north side of the gulf are in advantageous situations since both highways and the railways pass very closely to those ports. Their location makes it easier to reach inland locations in Anatolian part and also to Istanbul which takes the lion's share in traded goods. On the contrary, the distance of LİMAŞ from Istanbul is more than that of other ports. That its access to highways takes longer time than other ports is another disadvantageous feature. Besides that, LİMAŞ lacks the railway alternative which provides a highly important advantage to the other ports located at the northern side of the Kocaeli Gulf.

When examining the last eight years of performance, the Compound Account Growth Rate (CAGR) of YILPORT has been 14,72% whereas it has been 8,17% for EVYAP. Although the throughput values are quite lower than the world's leading ports, the performance of Kocaeli ports is on the rise with higher CAGR values than the world average. Approximately 5% of Turkey's total foreign trade is formed in Kocaeli. The position of the Kocaeli Gulf is very influential on this continuous rise. Considering the contributions of the neighboring cities, especially Istanbul with a contribution of 55%, it is seen that the ports in Kocaeli Gulf serve a region where approximately two-thirds of Turkish foreign trade is formed. Transportation to almost every side of Turkey can be easily managed from Kocaeli Gulf. So, the Kocaeli ports whose hinterland covers a substantial part of the Anatolian peninsula plays an important role in maritime transportation in Turkey. Last year, 16% of all goods in tonnage were handled in

Kocaeli Port. Based on the assumption that the added value created by the Kocaeli economy and the proportion of foreign trade volume reached by country does not change until 2023, Erdoğan [21] estimated that the container load of the Kocaeli region can reach 4 million TEUs by 2023. The projections of the authors also imply similar values as seen in Table-3.

It is foreseen that the container transportation will continue to increase. Lloyd's List Intelligence (LLI) predicts a 3,1% annual growth rate for seaborne trade and a 4,6% annual growth rate for containerized trade between 2017 and 2026. UNCTAD predicts a bit more like 3,8% annual growth rate for seaborne trade and a 6,0% annual growth rate for containerized trade between 2018 and 2023 [22]. Three different scenarios are predicted for the transaction volumes of Turkey's and Kocaeli ports (see Table-3) that may occur in the future. In these scenarios, the predictions of LLI and UNCTAD are accepted as the average rates. The pessimistic scenario is based on lower rates than LLI and UNCTAD predict, and the optimistic scenario is based on that Turkey's ports will be able to maintain a rate close to the increase they have shown over the last period.

Table 3. Predictions for Future Throughput Values of Turkey's Ports.

<table>
<tr><th colspan="2" rowspan="2"></th><th rowspan="2">Year</th><th colspan="2">Turkey Total</th><th colspan="2">Kocaeli Ports</th></tr>
<tr><th>Value (1000 TEU)</th><th>CAGR %</th><th>Value (1000 TEU)</th><th>CAGR %</th></tr>
<tr><td colspan="2">Recent Throughput Value</td><td>2018</td><td>10.843</td><td></td><td>1.597</td><td></td></tr>
<tr><td rowspan="9">Projected Throughput Values in Scenarios</td><td rowspan="3">Scenario-I (Pessimistic)</td><td>2023</td><td>12.570</td><td>3,0</td><td>1.851</td><td>3,0</td></tr>
<tr><td>2029</td><td>15.009</td><td>3,0</td><td>2,210</td><td>3,0</td></tr>
<tr><td>2035</td><td>17.922</td><td>3,0</td><td>2.639</td><td>3,0</td></tr>
<tr><td rowspan="3">Scenario-II (Average)</td><td>2023</td><td>14.510</td><td>6,0</td><td>2.137</td><td>6,0</td></tr>
<tr><td>2029</td><td>20.583</td><td>6,0</td><td>3.032</td><td>6,0</td></tr>
<tr><td>2035</td><td>29.198</td><td>6,0</td><td>4.301</td><td>6,0</td></tr>
<tr><td rowspan="3">Scenario-III (Optimistic)</td><td>2023</td><td>15.567</td><td>7,5</td><td>3.212</td><td>15,0</td></tr>
<tr><td>2029</td><td>24.025</td><td>7,5</td><td>5.690</td><td>10,0</td></tr>
<tr><td>2035</td><td>34.080</td><td>6,0</td><td>8.072</td><td>6,0</td></tr>
</table>

Source: Prepared by the Authors.

The optimistic scenario predicts that the Kocaeli container terminals can load and unload an approximate value of eight million TEUs in total in 2035. As mentioned above there are six container terminals located within Kocaeli Gulf. The annual throughput capacities of these container terminals are seen in Table 4.

Table 4. The Total Throughput Capacity of Kocaeli Container Terminals.

Container Port	Current Annual Capacity (TEU)
YILPORT	1.000.000
EVYAP	855.000
DP WORLD	1.300.000
LİMAŞ	200.000
SAFİPORT	1.500.000
BELDEPORT	550.000
Total Capacity	**5.405.000**

Source: Web sites of each port authority and authors' own source.

SAFIPORT will gain an additional one million TEUs capacity at the end of the renovation period. This extra capacity will increase the total capacity of Kocaeli container terminals to approximately 6,4 million TEUs. If there will be no additional capacity increase in the medium term, the total capacity of Kocaeli container terminals will not be able to meet the possible demand in the years the 2030s according to the optimistic scenario.

In Turkey, most of the ports have difficulty because of the limited area [23]. One of the constraining disadvantages of the ports located on the shores of Kocaeli is that they are surrounded by cities and there is no expansion area. The only possibility of expansion of the ports, in this case, would be filling the sea, which is a very laborious and costly process. For example, SAFIPORT is undergoing such a process, filling the sea, a very large area will be gained and the stacking capacity of the container will be increased in this way.

The proximity of the ports to the highway and railway is considered to be an advantage except for the case of LİMAŞ. However, it is necessary to pass by a certain route to reach the highway from the ports, except the cases of EVYAP and DP WORLD. These are the roads that mostly pass through urban settlements. Sometimes there occur great congestions causing loss of time for transporters on these routes. The time loss means an increase in transportation costs. One advantage of the EVYAP and DP WORLD is that they have direct entrance and output to the highway. However, the zone between Istanbul and Kocaeli is one of the busiest highway zones in Turkey. The whole freight transportation in relation to these five ports is carried out in this zone. As the country's volume of foreign trade increases, the number of heavy vehicles on the highway also increases which brings in a higher risk of an accident on the roads.

In Kocaeli, due to the fact that highways and railways remain in the city and that transit and urban transportation are carried out on the same route, traffic congestion is high. Reducing freight traffic to the highway will benefit in many ways. The most important benefit is the cost. The railway, which is known as an environmentally friendly transport system, is very advantageous in mass freight transportation. This advantage increases even more as the distance increases. The more widespread use of rail will reduce the turmoil in port cities, and contribute to the reduction of air pollution as well as noise and visual pollution.

In relation to the reasons mentioned above, a seaport with a railway connection will have a higher competitive power against its competitors. Among the ports connected to the railways, the one that allows a more rapid flow of the cargo and which brings in the minimum cost would be preferred by the carriers. Being connected to a dry port and providing a high capacity freight transportation to that dry port will provide a great advantage in competitiveness. Another advantage that a dry port can provide for sea port is that it can offer additional room to the port which has problems in terms of stacking capacity. If it is a well-established dry port, it will be able to relieve the seaport in terms of every activity other than loading and unloading to and from the vessels. If all the operations that previously were being managed in a seaport can be carried out in the dry port with a suitable location for the final destination of the cargo, it will be the reason for the preference of the transportation provider.

3. ASSESSING THE FUTURE REQUIREMENTS AND THE CAPABILITIES, TO SUPPORT CONTAINER TRANSPORTATION

The Kocaeli region hosts settlements where significant demand is generated for consumption centers as well as an important industrial power. This region and the ports in Kocaeli Gulf are expected to play active roles in the future too in forming Turkey's foreign trade and fulfilling the transportation of the goods. A "Common Mind Forum" event in the coordination of the Kocaeli Chamber of Industry was held on 16 September and 21 September 2011 with the participation of 69 people in two separate sessions in order to reveal the needs of the Kocaeli ports [21]. The prominent requirements can be listed as follows:

(1) Integration of ports with industrial organizations via railways,
(2) Integration to Anadolu via railways,
(3) Planning logistics villages and dry ports,
(4) Connecting the North Marmara Highway with Kocaeli ports.

Dry ports in Europe are generally operated by partnerships. Municipalities and other local authorities, the chambers of commerce and industry of the region, transport organizations (usually railway operators) are among these partners.

In our country, a dry port operating in accordance with the concept is not yet available. In this regard, TCDD has taken the initiative to encourage railway freight transportation by establishing logistics centers. Currently, there are nine logistics centers that are in service. Additionally, two of them are newly completed and about to come into service, two are under construction and eight are in the project phase. All these logistics centers are seen in Figure 2.

Figure 2. The logistics centers of TCDD.

Other than the two lines of high speed-train, a third railway line between Köseköy and Gebze is on construction for the purposes of conventional and freight transportation. To support the freight transportation on this line, TCDD is planning to construct some siding sites. Those siding sites ensure the traffic flow and line capability by providing meeting points. In a working group meeting held at the "First Regional Directorate of TCDD" on 13th February of 2019, the Capacity Department Manager stated that, after the construction of all planned siding sites over the aforementioned railway line, the capacity of the line can rise to 72 train services reciprocally in a day.

3.1. Köseköy Logistics Center

When examining the potential facilities to become dry ports in the region it is observed that Köseköy Logistics Center is a powerful candidate. It has a large area of more than 300.000 m2, in terms of its size and the additional capabilities it may have in the future, it is considered to be an ideal dry port alternative that can solve the problems of the region. The factors to determine the Köseköy logistics center as a close dry port candidate for Kocaeli container terminals can be listed as follows:

(1) In addition to being close to Istanbul, it is also close to the central warehouses of large industrial facilities in the surrounding provinces.

(2) It has a large and entire geographical area that can meet the needs of ports and industrial facilities in the region by means of the logistics facilities to be built on it.

(3) It is the most easily accessible intermodal terminal for Kocaeli ports through the railway.

The first part of the Köseköy Logistics Center was put into service in 2010. It is located five kilometers away from Izmit city center, in an area close to large production facilities. It is an important project in terms of transferring the freight from road to railway since the main roads of Kocaeli are about to be blocked in the near future [24]. It is also the closest intermodal terminal to the Asian side of Istanbul, Adapazarı, and Bursa. There are five 600 m long railway lines for loading and unloading, an open storage area of 65.000 m2 and a temporary storage area of 6.000 m2 for customs clearance [25]. The 286,000 m2 land adjacent to the terminal was expropriated in 2012 by the decision of the Council of Ministers for the second part of the project [26]. According to the TCDD Köseköy Logistics Directorate, the logistics center reached a size of 360,000 m2 with the new land area and a capacity of 1.500.000 tons per year is targeted with the completion of the project.

3.2. Investigating the Rail Freight Transport Capacity between Kocaeli Ports and Köseköy Logistics Center

The total load a train can pull depends primarily on the capacity of the locomotive. It is generally accepted that the total load, including the weight of the carrier wagons, should not exceed 2000 tons. Depending on the railway infrastructure, there may be some restrictions in various sections. However, the restrictions in these sections can be overcome by using more than one locomotive.

A typical railway car to transport container is seen in Figure-3. The cars produced to carry 40 feet containers have a length of 13.86 meters between the two car-bumpers, and the ones to carry 60 feet container (generally two containers, 20 feet plus 40 feet) have a length of 19.64 meters between those bumpers [27].

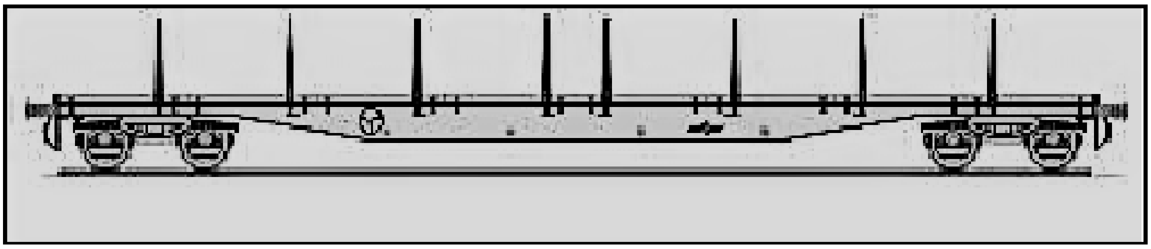

Figure 3. A typical railway car to transport container.

The capacity of these railway cars may vary between 50 to 80 tons. If the average weight of a container is assumed to be 20 tons, and taking into account the tare of the cars as varying between 18-25 tons, it can be inferred that a train shuttle may include 45 to 90 TEUs of containers in total. If the containers are transported with 60 feet long railway cars, a total of 75 TEUs require 25 railway cars, making a total length of 491 meters. The length of the locomotive in addition to 491 meters will make a total shuttle length more than 510 meters. EVYAPPORT and SAFİPORT are capable to accept such a train shuttle since having railway lines more than 600 meters. But DP WORLD has only one railway line with 500 meters. Taking into account the maneuver requirements, the length of the shuttle that DP WORLD can accept would be a little shorter than that. It is not yet possible to express anything about this subject for BELDEPORT, which is planned to have a railway connection. However, it is expected to have at least 600 meters of railway line within the terminal to meet the above-mentioned need.

According to the information mentioned above, it is assessed that a train shuttle between Gebze and Köseköy can carry 75 TEUs as an average value to transport the freight between the seaports and the dry ports or other load centers. If two-thirds of the capacity of the conventional railway line is allocated for freight transportation, 48 train services reciprocally could be implemented in a day. Allocation of this capacity for freight transportation would enable to transport 3600 TEUs of import containers from seaports to inland terminals in a day. Such a daily capacity creates a total of 1.314.000 (365*3600) TEUs capacity in a year. Although an assessment has been made on the capacity of the railway line between Gebze and Köseköy, the cargo arriving at Köseköy will also have the chance to reach all the points on the way that railway transport is possible. Similar capacity is considered to be valid for the road after Köseköy. In addition, it will be possible to carry out longer shuttle services to distant points by the combination of the load and including additional locomotive in Köseköy.

4. MINIMUM REQUIREMENTS OF A DRY PORT IN SUPPORTING CONTAINER TRANSPORTATION

The current total capacity of Kocaeli container terminals is calculated as 5,4 million TEUs as indicated in Table-4. This total capacity might rise up to 6,4 million TEUs according to the on-going development projects in SAFİPORT. Although there is no possibility of expansion of the ports, the ports are trying to increase their stacking capacity either by filling the sea or by making arrangements within the borders of the port. It is assumed that such efforts will bring in about 10% additional stacking capacity for other Kocaeli terminals. With this assumption, the total stacking capacity of Kocaeli container terminals is estimated to reach about 7 million TEUs by 2035. On the other hand, the optimistic scenario for the projections of future throughput volumes indicates that even the increased capacity may not meet the demands of 2035.

Based on the optimistic scenario and the assumptions mentioned above, additional stacking area will be required for approximately one million TEUs of containers. In this circumstance, approximately 7 million TEUs of containers would be stacked and processed in Kocaeli terminals, whereas one million TEUs of containers could be directed to a dry port for the same procedures. As stated in the previous section, the conventional railway line between Gebze and Köseköy could produce a total capacity of approximately 1,3 million TEUs provided that the TCDD's projects of siding sites are completed. This capacity would be sufficient to meet the possible demand of transporting approximately one million TEUs of containers from Kocaeli terminals to a dry port via railways.

Transporting the containers just after unloading them from a vessel directly to a dry port, related to the dry port concept would require that every capability of a seaport, other than unloading from the vessels, should be acquired by the dry port. Those required capabilities for a dry port can be listed as follows [28, 29]:

(1) Container loading and unloading: To be capable of loading and unloading the containers to and from railway cars and trucks.

(2) Container stacking areas: The area should be allocated for each type; including empty, filled, and refrigerated containers. The area should be designed to provide convenience for unloading from railway cars, and loading to trucks, or vice versa.

(3) Railway lines: In order to unload the incoming cargo, load the departures and change the line of the locomotives, at least three lines should be constructed, each having minimum 700 m. length. The maneuvering areas for vehicles should also be taken into account.

(4) Customs inspection: Separate plant for inspection and separate stacking area for the containers waiting for inspection should be taken into account.

(5) Container freight station: Process for stuffing, stripping, and value-added activities.

(6) Container maintenance/repair: A separate station should be constructed for maintenance and repairing of the containers.

(7) Corporate buildings: Working offices and/or buildings should be allocated for the companies undertaking logistics roles.

(8) Parking space for carriers: For the trucks and other carriers a sufficient area should be allocated for parking and waiting.

(9) Social facilities: Social requirements for both personnel and customers should be taken into account.

Considering the capabilities required of a dry port, the Köseköy logistics center needs significant investment and modern equipment. A limited number of reach stackers are currently available for container loading and unloading operations. A dry port, which is likely to handle cargoes between 2000 and 3000 TEUs per day in the 2030s, will have to carry out these operations with the help of advanced crane systems such as Rubber Tyred Gantry (RTG) or Rail Mounted Gantry (RMG).

At the Köseköy logistics center, the areas over which the containers would be stacked have not been designated as ground slots. Stacking areas should be planned as designating the ground slots similar to Figure-4 in order to enable loading and unloading from railway cars, and high capacity cranes such as RTG or RMGs should be used in these areas. There are sufficient railway lines within the Köseköy logistics center. However, these lines should be evaluated and planned in conjunction with other systems in order to allow for the arrangement seen in Figure-4.

There is a need to establish a facility in order to carry out the customs inspections more systematically and quickly. There is no facility for stuffing, stripping, and value-added activities and for maintenance and repair operations. Arrangements are needed to meet these needs of customers. There is a need for a separate building in order to enable logistics companies and other relevant companies to carry out their operations within the dry port. A large parking space is needed for the carriers (trucks) to wait. Social facilities are also needed to meet the needs of both employees and customers. Meeting these needs will promote the Köseköy logistics center to a dry port which is demanded by many logistics actors.

5. DESIGNING A DRY PORT

The total terminal area is usually divided into three sections, as (1) the apron, (2) the primary yard area or the container storage area, and (3) the secondary yard area including the entrance facility, parking, office buildings, customs facilities, container freight station for stuffing and stripping, empty container storage, container maintenance and repair area [30].

The width of the apron may vary between about 15-50 m depending on the loading and unloading equipment. In seaports, apron states the area just behind the berthing front. Similarly, in an intermodal terminal, it states the area of loading and unloading to and from the railway cars.

The primary yard or the storage area is the area immediately adjacent to the apron and is used primarily for storing inbound and outbound cargo. The land requirement is mainly related to the storage density and the time that the cargo stays in the terminal. Thorosen [30] formulates the total yard area (AT) and explains each variable in formula (1) as stated below:

$$A_T = A_{PY} + A_{CFS} + A_{EC} + A_{ROP} \quad (1)$$

Where,

A_{PY} = the primary yard area or container stacking area. This area is approximately between 50-75% of the total area.

A_{CFS} = the container freight station (CFS) with area for stuffing and stripping, etc. This area is approximately between 15-30% of the total area.

A_{EC} = the area for empty container, container maintenance and repair area, etc. This area is approximately between 10-20% of the total area.

A_{ROP} = the area for entrance facility, office buildings, customs facilities, parking, etc. This area is approximately between 5-15% of the total area.

According to the information given above, a general prototype of a dry port terminal, which have the modes of road and railway transportation, could be as the one seen in Figure-4.

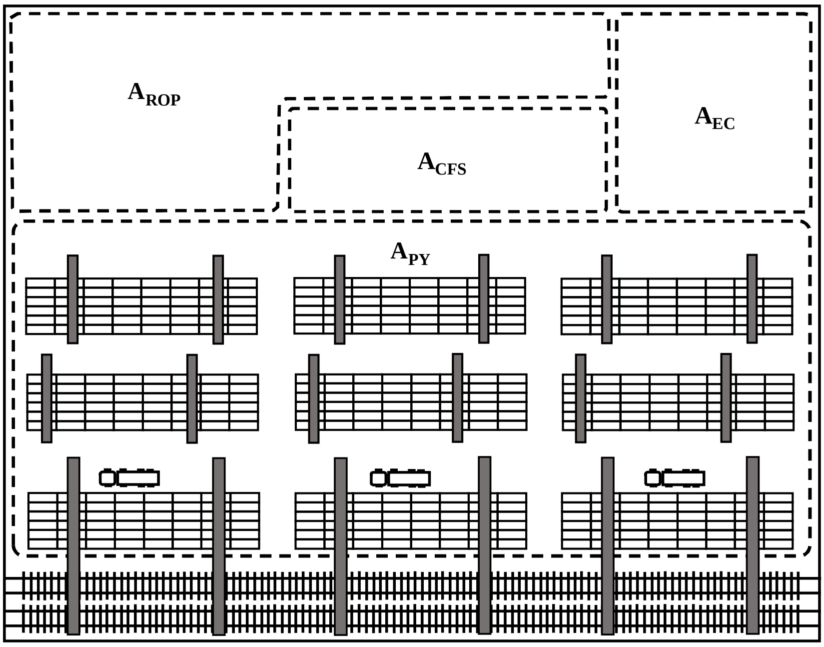

Figure 4. A general prototype of a dry port terminal.

Such a dry port terminal should have at least three railways within the port area; one line for maneuvering purposes, one line for loading and the other line for unloading purposes. The gantries next to the apron must be installed so that they can operate over the railway cars on two lines, for both loading and unloading purposes at the same time.

6. CALCULATING THE REQUIRED AREA FOR A DRY PORT

It has been discussed by various authors in calculating the surface area that a container terminal will need for the storage of the containers. Chu [31] includes studies on this subject within the scope of the source search. Hoffmann [32] proposed an equation including the variables of expected container volume (TEUs), average container dwell time (days), and peaking factor. UNCTAD [33] produced a procedure to calculate the required area, using the maximum stacking height (H) as a factor in addition to the factors proposed by Hoffmann in addition to some constant values in formulizing the required container yard area (m^2). Frankel [34] put in another factor, storage utilization, taking into account that the gantries cannot operate by constituting maximum number of tiers. This factor corresponds to the operational factor, aiming to keep the system in operative bands. Another factor added by Frankel was the total area utilization factor considering that the total area is affected by the choice of equipment, the width of lanes and other issues related to the design of the terminal. Güler [35], Tsinker [36], and Thoresen [30] used similar equations with Frankel. The below stated formula (2) has been produced by harmonization of those authors' studies.

$$A = \frac{C * a * DT * P}{W * S * H * U} \tag{2}$$

Where,

A = required container yard area (m^2),

C = expected container volume (TEU),

a = area (m^2) per one TEU container (21,60 m^2) [35],

DT = average container dwell time,

P = peaking factor ($P \geq 1$),

W = total number of working days in the period (365 days per year),

S = storage utilization/operational factor, as a proportion ($0 < S < 1$),

H = number of tiers/stacking height of containers,

U = total area utilization factor, as a proportion ($0 < U < 1$).

The total area utilization factor (U) is usually taken between 0,4 and 0,6 [35].

The size of the yard area required for container storage in the dry port, which is planned to be established to support container transportation through Kocaeli terminals, shall be calculated according to the formula explained above. The factors and the values to be applied in the formula are explained below.

(1) Expected container volume (C): As explained in the fourth section, one million TEUs of container is expected to be processed in a year, in the prospective dry port.

(2) Area (m^2) per one TEU container (a): This value indicates the total area allocated for one TEU, as a ground slot. It is a constant value, 21,60 m^2 [35].

(3) Average container dwell time (DT): It is assumed that the container dwell time will be similar to that of the seaports. It is taken as seven days (DT = 7).

(4) Peaking factor (P): Since the freight transportation to the dry port is predicted to go on related to scheduled programs, it is not expected to occur a considerable peak. However, it is assumed to make a peak about 10% (P = 1,1).

(5) Total number of working days (W): Since the period is one year, it is taken as 365 days (W = 365).

(6) Storage utilization/operational factor (S): It is assumed that the storage utilization will be realized as a proportion about 75% (S = 0,75).

(7) Number of tiers/stacking height (H): The storage equipment are assumed to have the capacity of making maximum six tiers (H = 6).

(8) Total area utilization factor (U): It is assumed that 60% of the total yard area is allocated for container storage (U = 0,60).

The formula (2) for the required container yard area is shaped as stated below related to the values explained above:

$$A = \frac{1.000.000 * 21,6 * 7 * 1,1}{365 * 0,75 * 6 * 0,6} = \frac{166.320.000}{985,5} = 168.767$$

This calculation states that an area of 168.767 m^2, or approximately 17 ha, is required for the purposes of container storage in the prospective dry port.

As explained in sixth section and simulated in Figure-4, a container terminal involves mainly four parts, as (1) primary yard area (A_{PY}), (2) container freight station (A_{CFS}), (3) area for empty container, container maintenance and repair (A_{EC}), and (4) area for entrance facility, office buildings, customs facilities, parking, etc. (A_{ROP}). The proportions of these four sections within the total area (A_T) are considered as follows taking into account the explanations of Thorosen [30].

A_{PY} : 65%,

A_{CFS} : 15%,

A_{EC} : 10%,

A_{ROP} : 10%.

Since we know the volume of A_{PY} as approximately 17 ha, we can calculate the total area of the dry port by constituting the following proportion:

$$\frac{65\%\ of\ AT}{100\%\ of\ AT} = \frac{17\ ha}{?}$$

$$A_T = (17 * 100) / 65 = 26,15 \text{ ha}$$

The study and the calculation exhibits that the prospective dry port which will be constructed with the intent of supporting container transportation through Kocaeli terminals should have an approximate total area of 26 ha, in other words 261.500 m^2.

According to the terminal design the volumes of the other parts of the dry port are calculated as follows:

A_{CFS} = 0,15 * 26 ha = 3,9 ha,

A_{EC} = 0,10 * 26 ha = 2,6 ha,

A_{ROP} = 0,10 * 26 ha = 2,6 ha.

7. CONCLUSIONS

Container transportation is expected to grow increasingly. The fact that general cargo loads are transformed into container loads is thought to be effective in this increase. This development is expected to be realized with a higher rate for Kocaeli ports. While it is estimated that the total capacity of the Kocaeli container terminals might reach seven million TEUs per year until 2035, the demand for those ports is expected to increase to eight million TEUs in that time with an optimistic projection. It would be appropriate to take measures to meet this possible surplus. The construction of a dry port to support container transportation through Kocaeli container terminals is considered a viable option.

It is obvious that rail transport will be the most important means for Kocaeli container terminals to adapt to the dry port concept. Currently, two ports have railway connections, construction for one port is in progress and a connection for one port is within the planning stage. On the other hand, TCDD is planning to increase the transportation capacity between Gebze and Köseköy. It is assessed that the railway capacity will be able to meet the possible demand in 2035, provided that those projects are completed.

A dry port constructed with the intent of supporting container transportation should have almost all abilities that a seaport has, except the capability of loading and unloading to and from a vessel. Therefore, a dry port terminal might be designed similar to a container terminal. Approximately two-thirds of a terminal shall be allocated for the purpose of storage. Taking into account this approximate ratio, it's been calculated that a minimum land area of 17 ha is required for container stacking, whereas a minimum 26 ha land area in total is needed to constitute such a dry port. Since the Köseköy Logistics Center has reached a size approximately 36 ha after the expropriation decision of the Council of Ministers in 2012, it is understood that this logistics center already has the required land area to meet the demand of 2035.

The development of ports and the establishment of dry ports to support the growth of the economy is an important component of the countries' maritime strategies. It is considered that if the capabilities stated in this study are brought in to the Köseköy Logistics Center during the ongoing project process, the potential demand that may arise in the coming years can be met appropriately.

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