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Multimodal Transportation: An Innovative Ro-Ro Solution between Turkey and Europe

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Abstract

This paper presents, as a case study, a comprehensive review of Ro-Ro transportation system between some Turkish ports and the Italian port of Trieste. The system has many innovative elements such as the ownership of the system by Turkish transporters association, transfer of ownership of Italian port of Trieste to the same association, transfers of lorry-drivers by aircraft, using of railway services to central Europe that are surely points of interest in the framework of multimodal transportation and maritime sectors. The huge amount of trade relations between Europe and Turkey and the disturbances experienced on road transportation in 1990s necessitated the ro-ro system of transportation originated by Turkish International Transporters Association (UNDT) and its foundation named UN Ro-Ro. The cost comparisons of the already available transportation modes between Turkey and Germany which are sole road, road plus ro-la, ro-ro plus road and ro-ro plus ro-la reveal that ro-ro system has been the most efficient mode with a cost of Euro 2700 and total travel time of 5 days per round trip as of 2017.

Keywords:

multimodal transportation, Ro-Ro, Ro-la

1. Introduction

The changing needs of the modern society since the early 20th century has resulted with new approaches to transportation, shifting from highway-focused to multimodal. Multimodal transport, which is also named as combined transport, is the transportation of goods under a single contract by using at least two different modes. In legal sense, the carrier is liable for the entire carriage, despite the transportation is performed by several different modes of transport by different transporters. The term multimodal transport was officially introduced in 1980 in the United Nations sponsored

Multimodal Transport Convention and as a term it gained legal recognition on 1 January 1992 with the introduction of the 1992 UNCTAD/ICC Rules for Multimodal Transport²⁰.

Specifically, the use of containers in the sea transport has been accepted to be firstly realized by Malcolm McLean who was the owner of a trucking company and founded the first container shipping company, Sea-Land Inc in 1956. He was well equipped with road/rail combination operations for land transport and developed the idea of containers with “the standard dimensions to be fitted with special devices for the ease of switch between different modes of transport” (UNCTAD, 1993). The container shipping has been regularly spread by the adoption of standard container sizes in the mid-1960s and acknowledgement of the cost savings resulting from faster vessel turnaround times. The result was the development of multimodal transport especially in international trade which enabled transport service providers to extend their services to provide door-to-door services using a combination of carriers’ notes, consignment notes, waybills, bills of lading, etc., each with their own terms and conditions of service and limit of liability (Rodrigue et al., 2006, p.20).

Since that time, several public and private efforts have been made to integrate separate transport systems through intermodalism which was initiated by setting of maritime networks. The evolution of intermodalism has been realized through mainly two different configurations. In intermodal transportation, several modes of transportation are used for the movements of passengers or freight by different carriers each of which issuing its own ticket (passengers) or contract (freight). The intermodal transportation generally takes place at a specifically designed terminal. In multi-modal transportation, the movements of passengers or freight from an origin to a destination are realized by using several modes of transportation under one ticket or contract (Jaržemskienė, 2007, p.296).

There exist some peculiarities of each multimodal transportation system (Rodrigue et al., 2006 p.141):

The nature and quantity of goods transported: The infrastructure requirements are determined by the nature and quantity of goods transported. It is accepted that intermodal transportation is usually suitable for intermediate and finished goods in load units of less than 25 tons.

The sequence of transportation modes: In a multimodal system, for long distances maritime or rail modes are utilized and for flexible local pick up and deliveries trucks are used. The entire trip is designed as a series of legs, each marked by an individual operation with separate sets of documentation and pricing.

The distance between the origin and destination: At least 500 km is required for a multimodal system to be efficient referring to the costs of transfer to the next mode.

The value of the cargo: Multimodal transportation is suitable for intermediate cargo values rather than low and high value shipments. As a rule, high value shipments will tend to use the most direct options (such as air cargo) while low value shipments are usually realized by one mode such as rail or maritime.

The frequency of shipments: Intermodalism functions well when cargo flows are continuous and in similar quantities in order to better utilize the capacity by the optimum use of modes.

The benefits of multimodal transport are generally based on savings in cost and time due to the optimum use of each mode of transport which end up with reduced energy costs. Those savings also ensure the realization of higher returns on infrastructure investments. The increasing environmental hazards resulting from especially road transportation is also reduced by using complementary modes such as maritime (Stank, T.K. and A.S. Roath, p.20). Furthermore, some other issues such as the

²⁰ <http://www.bus.tu.ac.th/usr/ruth/thesis/chapter2.pdf>

development of regional trading blocs, the increasing importance of time-based competition, the requirements of the global supply chains, e-commerce have contributed to the development and widespread use of multimodal transportation systems. Multimodality contributes to the economic performance of a transport chain by using modes in the most productive manner. The establishment of each peculiar multimodal transportation system has different backgrounds. Some of them emerged as a publicly sponsored system and the others are innovative solutions to the disruptions in the existing lines of transport.

The basic aim of this paper is to introduce an already existing multimodal transportation system between Europe and Turkey in the form of Ro-Ro system between some Turkish ports and the Italian port of Trieste. The origination of this system can be specified as an innovative solution to the problems of cross-boarding created by Bulgaria in 1987. This solution of Ro-Ro transportation of vehicles was also utilized as a remedy for the disruptions in road transportation to Europe from Turkey due to the war in Balkans in 1991-1999. After the restoration of the peace in the region, the use of multimodal system has been continued with an increasing pace in order to overcome the quantitative restrictions and permit fee applications by the countries in the region.

The system has many innovative elements such as the ownership of the system by Turkish transporters association, transfer of ownership of Italian port of Trieste to the same association, transfers of lorry-drivers by aircraft, using of railway services to central Europe that are surely points of interest in the framework of multimodal transportation and maritime sectors. The success of the presented multimodal system made the owner company a subject of an acquisition in the amount of nearly 1 billion Euro for 98% of the shares by the largest integrated company of northern Europe in 2018. After a literature review about the ro-ro transportation, in the first section, the trade relation and the transportation activities between Europe and Turkey will be summarized. In the next section, the originators of the ro-ro system namely Turkish International Transporters Association (UND) and its foundation UN Ro-Ro which is the private operator of largest intermodal infrastructure between Europe and Turkey since 1990s will be introduced. In the next section, the cost comparisons of the already available transportation modes between Turkey and Germany which are sole road, road plus ro-la, ro-ro plus road and ro-ro plus ro-la by the use of most update data provided by UND. In the last section some concluding remarks will be provided in relation with the existing problems and future prospects of the multimodal transportation between Turkey and Europe.

2. Literature Review

Ro-Ro is short for Roll-on Roll-off which describes how cargo is loaded and discharged from a ro-ro vessel. As opposed to being lifted using cranes, in ro-ro transportation wheeled cargo such as trucks, trailers, semi-trailers or railroad cars and the freight in them can move through the large doors or ramps that are normally situated at the stern, the side or at the bow of the vessel (Arof, 2016, p.3). Trailers are usually carried without their tractors due to space limitations. Drivers of trucks travel either in the Ro-Ro vessels or fly to the port location in order to drive for the remaining part of the road. The decks of Ro-Ro vessels have been generally accepted as the seaway equivalent infrastructure of a roadway or railway (Baird, 2007). Ro-ro transportation is usually used in short sea operations in which Ro-Ro vessels carry a combination of freight and passengers (Daduna, 2013).

The main advantage of ro-ro transportation as compared to conventional sea transportation stems from the cargo handling speed since vehicles can drive straight on to the ship at one port and drive off the ship at the other. This attribute creates cost saving for the shipper as it also allows for a fast turnaround time in port. It can be easily integrated with other transport facilities such as various types of containers and has a high cargo-mix versatility (Kantharia, 2010). Apart from operational cost,

analysis on external costs of transportation always favored maritime as it is much more environment-friendly than road haulage (Kotowska, 2015, p.37.) Castels et. al. (2012) compared on three model vessels: a container ship, a Ro-Ro and Con-Ro vessels, and one road truck (of up to 50- ton capacity) and the results revealed that the external costs generated by Ro-Ro and Ro-Pax ships present higher values than road transport.

The main disadvantage of a Ro-Ro vessel as compared to the traditional ships is its high construction cost. This negative attribute is generally overcome by the way of using second-hand Ro-Ro and Ro-Pax vessels with an initial age of 5 years (Martinez-Lopez et al., 2015). Another important disadvantage of a Ro-Ro vessel is its cargo has high stowage factor which means that they occupy more space relative to their weight (Branch, 2007). Furthermore, the typical cargo of ro-ro which is cars and trailers must be individually positioned in the vessel with some space around them to avoid damage by possible friction (Branch, 2007). There also exists double load factor problem for ro-ro vessels which stems from half full trailers on half-full deck that can jeopardize the comparative advantage of maritime transport (Hjelle, 2011). Although, there exist many research in relation with the optimization of stowage plans for Ro-ro ships (see Wathne, E.(2012), Øvstebø, B.et.al.(2011), Hansen, J.R.et.al.(2016)), the research about the cost positioning of ro-ro transportation as compared to other modes of transportation is rather limited. This paper aims to contribute to the relevant literature by providing an update case analysis on cost basis.

3. Trade and Transportation Between Turkey And European Union

As being close to the region, Turkey has close links with Europe since the establishment of the European Economic Community (EEC) in 1958. By the signing of Ankara Agreement on 12 September 1963, it was mainly aimed to accelerate mutual economic progress, expand trade relations, and reduce the disparity between Turkey and the EEC. Since that time, EU-Turkey economic relations have expanded dramatically. The milestones of the progress of the trade relations was the commencement of EU-Turkey Customs Union (CU) in 1995 and finally the application for full membership to the European Union (EU) in 1999. The accession negotiations that commenced in 2005 have been still continuing. It is fact that those developments have played a pivotal role in facilitating the integration of Turkish economy with the EU by means of eliminating the customs duties and other restrictions on industrial and processed agricultural products²¹.

3.1 Trade Between Turkey and EU

Referring to Table 1, it is observed that Turkey has been on the rank of 5th in terms of total trade between third part countries and Europe as of 2017 when the total amount of trade was realized as EUR154.3 billion. During the period of 2013-2017, annual average growth in imports from Europe is 8.3% and export to Europe is 2.1%.

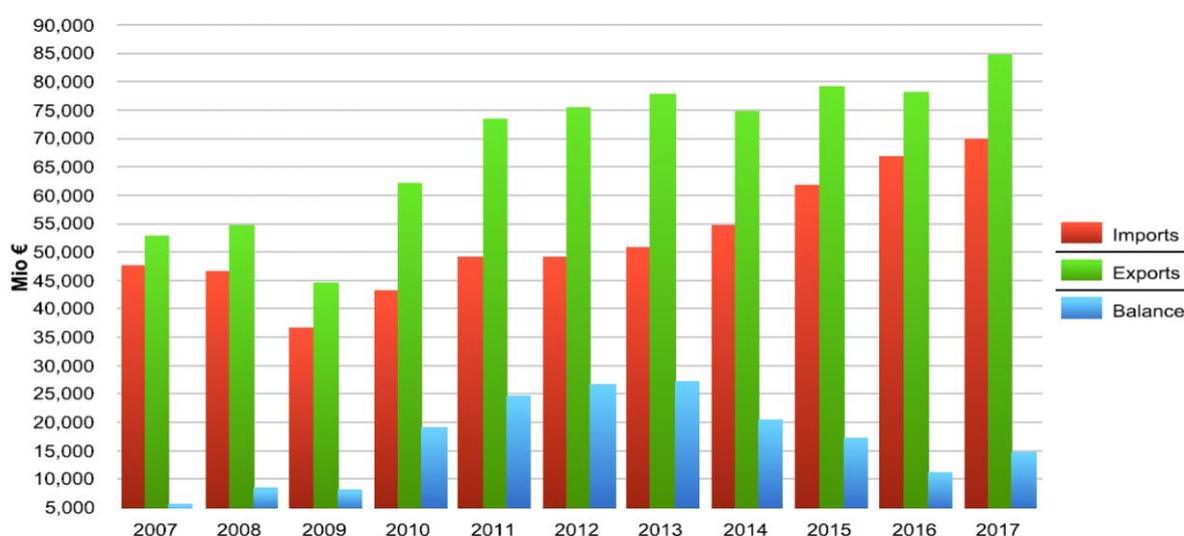
²¹ <https://www.avrupa.info.tr/en/economic-and-trade-relations-46>

Table 1. Trade Indicators between Turkey and Europe²²

Indicators	Unit	Period	Imports	Exports	Total trade	Balance
Mio euros	Mio Euro	2017	69,76	84,49	154,25	14,73
Rank as EU partner		2017	6	5	5	
Share in EU trade %	%	2017	3,80	4,50	4,10	
Annual growth rate %	%	2016 - 2017	4,50	8,40		
Annual average growth	%	2013 - 2017	8,30	2,10		

Source: EUROSTAT

Figure 1 stipulates the evolution of the trade relation between EU and Turkey over the period 2007-2017. The EU has a trade in goods surplus with Turkey since 2007, the surplus hit a low in 2009, but subsequently recovered and continued to grow. In the period between 2009 and 2013 exports grew more strongly than imports resulting in a trade surplus peak of EUR 27 billion in 2013. After that, imports grew more strongly, causing the trade surplus to fall to EUR 11 billion in 2016 before recovering somewhat in 2017, when it stood at EUR 15 billion.



Source: EUROSTAT

Figure 1. Total Goods: EU Trade Flows and Balance, Annual Data 2007 - 2017

The major items exported from Europe are machinery and appliances (26.4), transport equipment (16.8%), base metals and articles thereof (11.9%), products of the chemical or allied industries (11.6%) and plastics, rubber and articles thereof (7.7%). On the import side, Turkey sells to Europe mainly transport equipment (26.1%), textiles and textile articles (20.8%), machinery and appliances (17.2%), base metals and articles thereof (11%) and plastics, rubber and articles thereof (5.5%).

As of 2017, amongst the EU countries Germany has highest share (9.6%) in the exportation from, as well as importation to Turkey (9.1%). United Kingdom, Italy, France, Holland and Spain are the other EU countries that have higher amounts of trade relation with Turkey.

Generally, the transportation mode of the exportation from Turkey has been mainly by sea (62.5%), and by road (28.1%). On the importation side, the share of maritime transportation increases to 65.9%

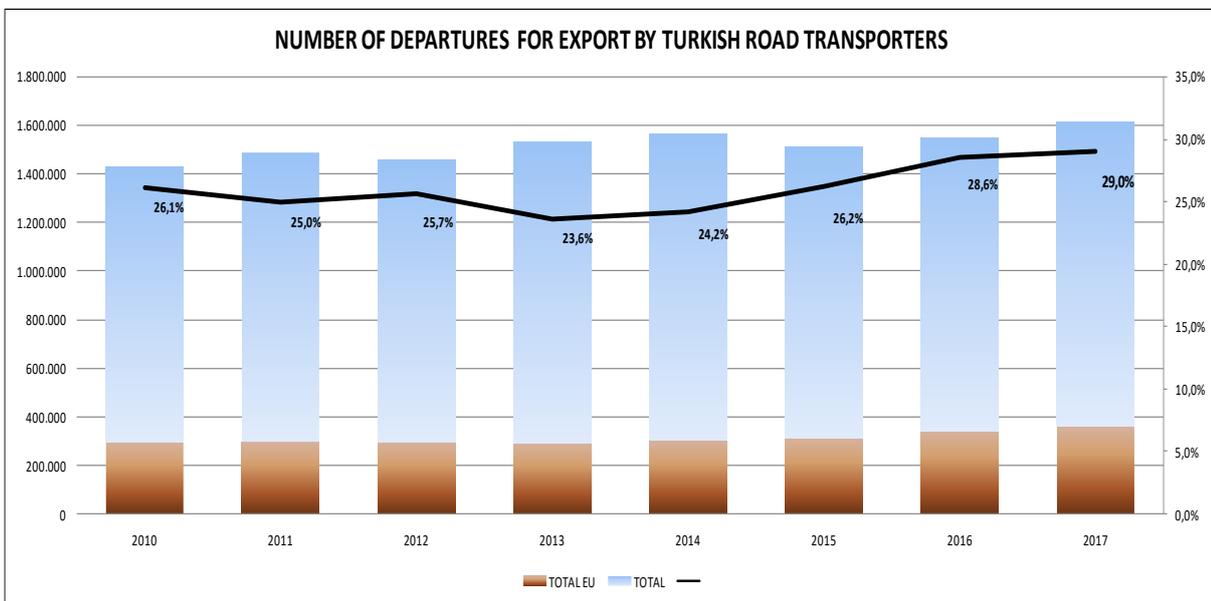
²² http://trade.ec.europa.eu/doclib/docs/2006/september/tradoc_113456.pdf

and that of road is 15.8%. While 31% of Turkish exports to the EU by value are carried by road, the share declines to 17% in the case of imports²³.

3.2 Transportation between Turkey and EU

Turkish freight & logistics market has been one of the fastest growing sectors with an estimated size of USD 100 billion in 2017 representing nearly 14% of GDP²⁴. The strategic geographic location that bridges Europe with Middle East and Asia, growing economy, increasing urbanization, developing transport infrastructure, and increasing investments have been determinants of the growth of the sector. It is expected that, in line with the vision of Turkey to become one of the top 10 economies of the world by 2023 and the exportation target of 500 billion USD as proposed by the government, will pave the way for further growth of transportation sector. Turkey has one of the biggest road vehicle fleet in Europe with 45.000 active vehicles owned by nearly 1.300 international transporter firms. Turkey also is amongst the largest users of TIR carnets (Togan, 2016).

In 2017, Turkish international transportation sector realized a volume of 1.585.068 departures for export, 79% of which belongs to Turkish vehicles. 33.6% of total departures are directed to Europe with a total number of 532.273.



Source: Turkish Central Bank Statistics Portal

Figure 2. Number of Export Departures from Turkey - 2017²⁵

There exist many operational standards for transportation in EU legislation. The main motivation under the road transport policy of EU is creating a sustainable, efficient, secure and safe road transport system via decreasing its negative environmental effects. In this framework, the EU aims to promote efficient transport of passengers and goods under fair competition terms and safer and more environmentally friendly technical standards²⁶.

There exists a long lasting problem of “non-tariff and discriminatory restrictions” in the form of quotas and permit fees imposed upon transit operations performed in EU member states by international road freight transporters registered in Turkey. Turkish side, represented by UND,

²³ <https://theforum.erf.org/2018/06/12/liberalising-road-transport-markets-turkey-europe/>

²⁴ <https://www.mordorintelligence.com/industry-reports/turkey-freight-logistics-market-study>

²⁵ <https://evds2.tcmb.gov.tr/index.php?evds/dashboard/1494>

²⁶ https://www.ab.gov.tr/chapter-14-transport-policy_79_en.html

proposes that such transit restrictions imposed by the EU upon Turkish transporters, apparently violate the rights currently held by Turkish transporters on the legal basis of the Turkish-EU association.

In EU legislation, Ro-Ro transport is accepted as an important mean of Short Sea Shipping (SSS) scheme which has been proposed for the freight transportation as an alternative mean of freight movement. The basic aim is to reduce use of trucks that daily congest about 4000 km of road networks and also the associated social costs (Douet and Cappuccilli, 2011, p.968) The introduction of Ro-Ro system between Trieste and Turkish ports in 1991 constituted a structural turning point in transportation of goods between Europe and Turkey.

4. Organizational Aspects of The Ro-Ro Line Between Turkey And Europe

4.1 UND (Turkish International Transporters Association)

UND is a leading professional association in Turkey, established in 1974 by seven entrepreneurs who had already been working in Turkish road transport industry. UND is a non-profit organization organized under membership of transporters paying a yearly fee. It is managed by a lean and efficient board of directors, made up of seven members, led by a chairman. The chairman is selected every 2 years at a general meeting, which is attended by representatives of the member companies of the association.

The enduring organizational success of this system was made possible by the strong leadership shown by the chairmen. The existing and ex-chairmen, as well as management boards, of the association have succeeded to preserve the supports and willingness of both large and small members to join in the initiatives proposed by the board, despite a number of small sized disassociations experienced in the tenure of business. It is observed that the management boards have implemented a strategy of neutrality towards each member regardless of their size. They provide many kinds of service in order solve the most prevalent problems of the road transport companies. With the support of nearly whole of the international transporters, UND, has been in collaboration with the governments, as well as international bodies to serve for tackling the most pressing problems of the sector. Since its establishment various problems were addressed at international level such as disruptions in road transportation to Iraq, Iran and Syria, the acquisition of road permits, checking the compliance with bilateral and multilateral agreements etc. The main problems at national level of the sector have been in the form of legal proceedings for claims of fiscal reimbursement, proposals to the government for plans to rationalize incentives for investment in order to favor the solution to the structural problem of idle capacity and intervention to improve the national legislation on safety (Torbianelli, 2000, p.276).

Today, UND represents almost all modes of international transportation and logistics, through the membership of 1.159 transport and logistics companies based in Turkey. UND has a network of offices, both in Turkey and abroad, which can offer direct assistance to road transporters, such as information and administrative support with paperwork and documentation. The UND board has been developing strategies in order to continue to take active role in determining the country's transport policy. direct access to the Ro-Ro sea transport market, made possible by the creation of two shipping companies to manage the routes between Turkey and the northern Adriatic, was certainly the most significant step in this direction.

4.2 History of Ro-Ro Transportation between Turkey and EU

The history of the Ro-Ro maritime route between Trieste and the Turkish ports was began in March 1987, by the decision of Turkish State merchant shipping company (Turkish Cargo Line- TCL) to offer

a specialized service for the transport of heavy goods vehicles between Istanbul and Trieste (Italy). The creation of this line was a response to the pressure from UND (Turkish International Transporters Association) on the Turkish Ministry of Transport. The main reason for its initiation was the problem of border crossings into Bulgaria, which can result in long and uncertain journey times which makes the route to and from Europe extremely difficult for Turkish road transport companies.

The TCL service began with two ships, each having a capacity of 55 lorries and their drivers, with a departure every 5 days and a round trip lasting 10 days. Two new ships carrying 120 vehicles and 120 passengers (drivers) were bought as excess demand is definite. At the beginning of 1990s, there were four ships operating on this route and the transit time was shortened to 3 days and a round trip to 8 days.

Beginning in 1991, the crisis in the former Yugoslavia was resulted with serious difficulties and risks in crossing the country located in the route to central Europe from Turkey. In order to overcome those disruptions on road transportation, UND compelled TCL and the Turkish government for an increase in the fleet and the number of departures on the Ro-Ro line.

In 1991, as the state-run TCL was included in the privatization list as the limited financial holding did not permit to realize new investments necessary to supplement the services offered on the Ro-Ro route. In these circumstances, two shipping companies were formally separated from UND decided in 1992 to offer maritime services directly.

Two companies were established as open share holding in which the subscribers are transport companies (either Turkish or foreign). There was a minimum and maximum allocation of shares allowed, to prevent any investor having control over the company and to guarantee neutrality to its customers. Each one of the two companies started its activities with one Ro-Ro vessel on the route between Haydarpaşa (Istanbul) and Trieste. The growth in demand has been continuous since 1993, and, therefore, the line has continued well beyond the duration of the Balkan crisis of this decade. Furthermore, the success of Trieste Ro-Ro line motivated UND shipping companies to invest in the fleet and widened the number of ports available, establishing a new route from the port of Çeşme (Izmir). The success of Ro-Ro lines attracted companies other than UND and new routes are created by them since 1998. Today there exist 13 different routes to 9 different destinations in 8 different countries. The followings are Ro-Ro Routes between Turkish and European ports:

Pendik - Trieste (Italy)

Yalova - Trieste (Italy)

Mersin - Trieste (Italy)

Pendik – Toulon (France)

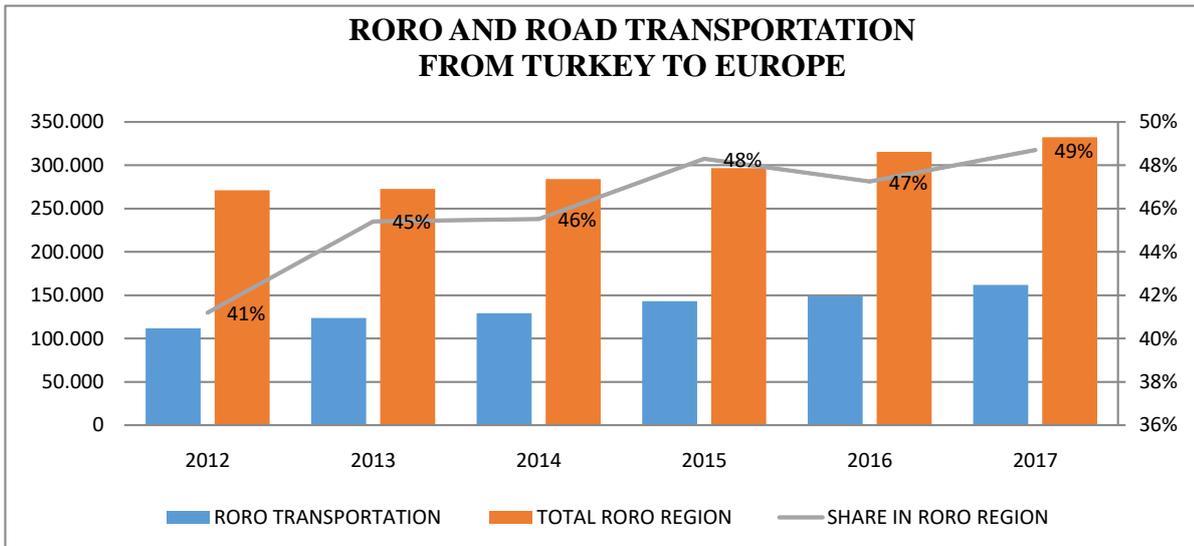
Çeşme – Trieste (Italy)

Alsancak – Sete (France)

Yalova – Lavrio (Greece)

The introduction of Ro-Ro after 1991 constituted a structural turning point in transportation of goods between Europe and Turkey. While the share Ro-Ro in exportation from Turkey using road transport was 36% by both Turkish and foreign vessels, it increased to 49% in 2017 as it is presented in Figure

3 which stipulates the developments in the use of Ro-Ro transportation as a percentage of total road transportation in the region²⁷.



SOURCE: UND Statistics

Figure 3. RO-RO and Road Transportation between Turkey and Europe²⁸

As of 2017, apart from the lines of UN Ro-Ro, there exist 2 Turkish maritime companies operating Ro-Ro line to Trieste. Ulusoy Sealines Management S.A. has commenced operating regular voyages between Çeşme and Trieste in 1999. The company has acquired the management rights of Port of Çeşme for 30 years with an agreement signed with Privatization Administration and Turkish Maritime Lines on June 6, 2003.

The other company, Ekol Logistics owns Ro-Ro ships for intermodal transportation routes connecting the ports of Haydarpaşa and Alsancak to Lavrio, Trieste, and Sète. Subsequent to the completion of the construction, all freight operations currently at the Port of Haydarpaşa will be transferred to the Yalova Ro-Ro Terminal. Ekol Logistics recently acquired a 65% share in Europa Multipurpose Terminals (EMT), the operator of the port it uses for its Ro-Ro and unit train services in Trieste, Italy.

In 2010, UND Deniz Taşımacılığı A.Ş. (UND Deniz), which was established by a different set of members of UND, opened two new lines from Tekirdağ (Turkey) to Toulon (France) and to Trieste (Italy). However, UND Deniz quit the market at the end of 2010. The company brought the predatory pricing behavior of UND Ro-Ro to the Turkish Competition Board (TCB). TCB concluded that the relevant market is the Ro-Ro transport between ports of Turkey and Europe, UN Ro-Ro is the dominant firm in this market and its pricing strategy was predatory and consequently, UN Ro-Ro was fined (TCA 2012; Çelen and Kalkan (2018), 67).

Another distinguishing operational property of the Ro-Ro system is related with the transportation of the drivers to Trieste port from Turkey. Starting from 1993, UND itself began to organize charter flights between the airports of Ljubljana in Slovenia (nearly 1 hour by road from Trieste) and Istanbul in order to overcome the burden and cost of transporting the drivers with their trucks in Ro-Ro ship. The flights were scheduled to coordinate with the arrivals and departures of the ferries. By that way, the drivers, whose lorries were loaded onto the ferries with the tractor, load their trucks into the ship

²⁷ Germany, Austria, Belgium, UK, Czech Republic, France, Holland, Spain, Sweden, Italy, Polonia, Portugal and Slovenia are the countries that have existing Ro-Ro connections and are defined as Ro-Ro region.

²⁸ www.und.web.tr/upload/NISAN-2018.xlsx

in Turkish port, receives their trucks nearly after three days in Trieste port to go to the final destination. This innovative approach has increased the efficiency of the system, as the shipping company do not only pay less for vessels of the same loading capacity (which are, therefore, no longer fitted out with cabins), but also remove the restrictions imposed by the transport of dangerous goods, the laws related to which are very stringent on passenger carrying vessels. Another positive aspect of aircraft transfer of truck drivers is about the improvements in the working conditions of drivers, allowing them more days of leisure on land (Torbianelli, 2000, 382).

4.3. U.N. RO-RO: Private Operator of Largest Intermodal Infrastructure between Europe and Turkey

UN RO-RO has been the private operator of largest intermodal infrastructure between Europe and Turkey since 1994. In 1994, 48 Turkish freight operators established UND Ro-Ro, an intermodal short sea shipping operator with the purpose of transporting freight from Turkey to Europe (especially to the Port of Trieste in Italy) via the sea. In 2004, the company was renamed as U.N. Ro-Ro. In 2000-2005 period, 6 Ro-Ro ships were included into its fleet. The company was granted the 'Best Intermodal Project' award in 2005 by the European Intermodal Association (EIA) which is the only non-party European intermodal establishment that is recognized by the European Commission, with more than 90 members in Europe, America and Japan. In 2006, U.N. Ro-Ro Pendik Terminal started giving service and TAX free diesel service was commenced in Pendik Terminal for Turkish trucks carrying export goods. U.N Ro-Ro launched Mersin – Trieste line and Istanbul – France lines in 2009 and 2010 respectively. Since 2010, 5 new Ro-Ro vessels added to the fleet and the total number reached to 11. 2013 was a year of leap as ISU semi trailer²⁹ train has started to operate between Trieste and Wels (Austria), container transportation on roll trailers has started as a part of U.N. Ro-Ro's intermodal agenda and Samer Seaports in Trieste was acquired. Figure 4 shows the existing Ro-Ro lines between Turkey and Europe, as well as the succeeding modes of transportation through the central Europe. U.N. Ro-Ro network offers valuable, fast and reliable service to all types of cargoes ranging from trailers, containers and project cargoes.

²⁹ ISU is the short of Innovative Semi-Trailer Handling Unit. Under the framework of CREAM Project of EU and with the direction of Rail Cargo Austria ISU provides an alternative to road transportation for long haul traffic.

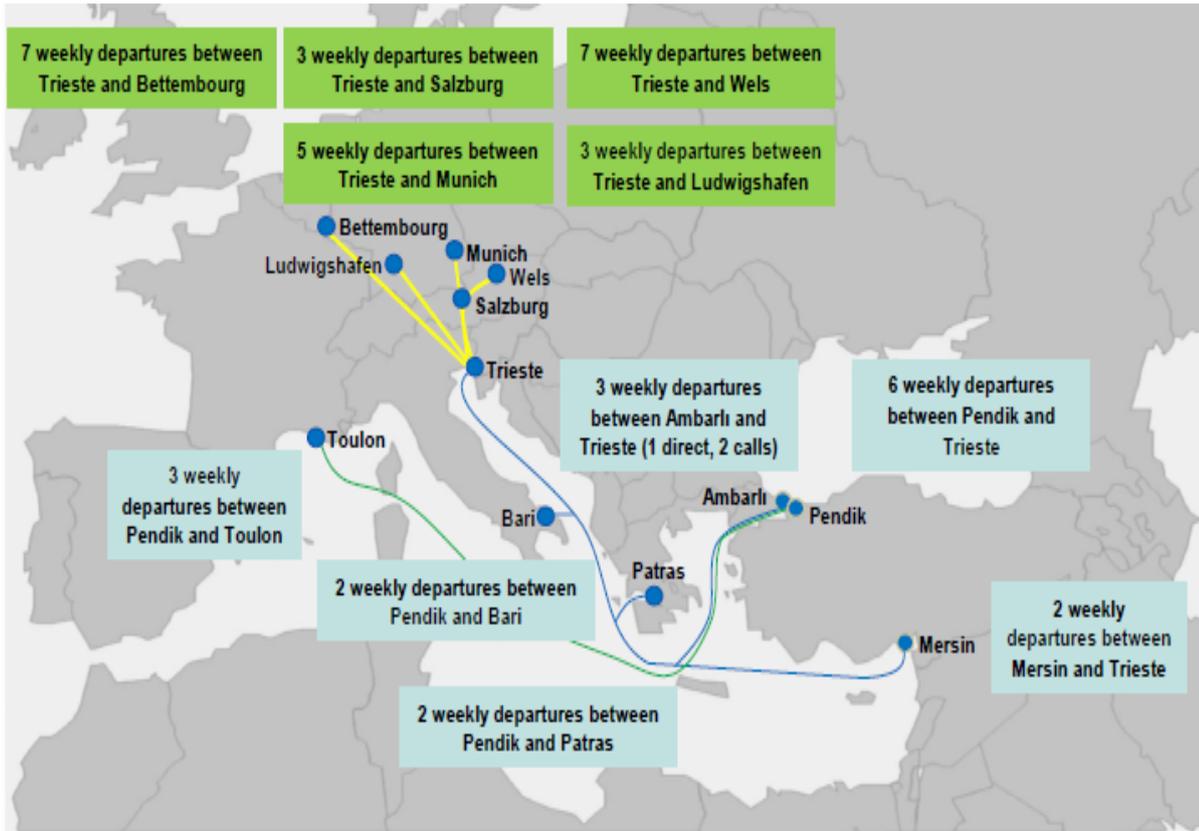


Figure 4. UN RO-RO lines between Turkey and Europe

UN RO-RO has gained 63% market share in Ro-Ro transportation to Europe in the number of units carried and has commenced train operations in Austria under the name of UN RAIL, shipping all types of units including containers and the establishment of collaborations with railroad connections leading from Trieste to every location in Europe. With the infrastructure investments in Trieste port, it aims to strengthen its position by increasing the number of connections and the frequency and decreasing costs. The cost management has been a priority for UN Ro-Ro since 2015 which focused on the improvements in the optimization of the trading routes. UN Ro-Ro has also made positive contributions to the environment with energy saving projects that were based on innovations and technological advancements in fleet and port management. With these changes, the achievements were to use 1,500 tons less fuel in 2015 and avoidance of 2,000,000 tons of carbon emission (UN Ro-Ro 2015 Annual Report). UN Ro-Ro has a relatively young vessel fleet, the details of which are given in Table 2 as of 2018.

Table 2. Vessels Fleet of UN RO-RO³⁰

No	IMO Number	Vessel Name	Build Year	Length	Lane Meter	Trailer Capacity	Speed	Flag
1	9215476	UND Ege	2001	193	3214	207	21.5	T.C.
2	9242390	UND Birlik	2002	193	3214	207	21.5	T.C.
3	9242388	UND Atılım	2002	193	3214	207	21.5	T.C.
4	9322425	UN Pendik	2005	193	3735	240	21.5	T.C.
5	9322437	UN Trieste	2006	193	3735	240	21.5	T.C.
6	9293416	Saffet Ulusoy	2005	193	3735	240	21.5	T.C.
7	9283428	UN Marmara	2005	193	3735	240	21.5	T.C.
8	9356737	UN Akdeniz	2008	223	4605	300	21.5	T.C.
9	9356749	UN Karadeniz	2008	223	4605	300	21.5	T.C.
10	9422122	Cüneyt Solakoğlu	2009	223	4605	300	21.5	T.C.
11	9422134	Cemil Bayülgen	2010	193	3735	240	21.5	T.C.
12	9506277	UN İstanbul	2013	208	4094	265	21.5	T.C.

Operational Properties Of Ro-Ro Line Between Turkey And Europe As Compared To Other Modes

The operational characteristics, mainly its flexibility of handling the flight, make Ro-Ro as the one of the main type of maritime multimodal transportation. Ro-Ro vessels carry trailers which can move directly and promptly after reaching the destination port and does not require special handling capacity. This lowers the cost of the ports, as well as the risk of damage. Furthermore, as Ro-Ro vessels are faster than other cargo ships, the frequency of navigation is generally higher and the delivery time is shorter. Additionally, as the need for loading and unloading diminishes, less labor is required in Ro-Ro transport than in other cargo ships. Whereas cargo ships are generally specialized by the type of the commodity they carry such as oil or dry freight, Ro-Ro vessels carry trailers which contain any kind of commodity. However, it is a fact that traditional container ships are mostly used for long distance shipping whereas Ro-Ro is a short-distance shipping mode. All of these differences in characteristics make Ro-Ro transport a different relevant product market than the other types of maritime transport (Çelen and Kalkan, 2018).

It is generally accepted that road transport and rail transport (ro-la) can be alternative modes to the Ro-Ro transport because the freight can be transported by trucks or railroad cars directly. They are considered as complementary modes because as vessels arrive at the targeted port, vehicles continue their road by land or rail transport to reach their final destination. Although Ro-la cannot be considered as an alternative mode of transportation between Turkey and Europe due to the insufficient capacity and infrastructure, it is used as a complementary mode for trucks while they pass into central Europe.

It is a fact that the mode of transportation with lower costs as compared to its benefits continue to operate. As for a transportation company, the most important advantage mainly stems from the lower depreciation of vessels. UN Ro-Ro specifies that a truck that operates round-trip between Turkey and Germany will make approximately 550.000 km in six years whereas the same truck will only make 200.000 km using the Ro-Ro service (UN Ro-Ro, 2014). Ro-Ro line operators also lower investment and operating costs of logistic firms by providing semi-trailer transport at lower rate than the rate for trailers. For the route from Istanbul to Trieste, as the drivers use aircraft rather than Ro-Ro ship, the relevant costs are not incurred.

As for the numerical finding of this study about the Ro-Ro transportation system between Turkey and Europe, Table 3 summarizes the cost calculations by the data provided by UND Ro-Ro. In the

³⁰ <http://www.unRo-Ro.com.tr/company-profile/en/665/fleet/48>

process of transportation by road, the permit fees are applied by the transit countries once the free of charge transit permit stock has been exhausted. The costs of permit fees and quota limitations applied the countries such as Bulgaria, Hungary and Austria in the route to Germany create additional financial burden to Turkish road transporters. These kinds of applications also cause delays and create inefficiency for logistic firms.

Table 3 presents the cost calculations for 4 types of transportation system from Istanbul to Cologne (Germany). The transportation costs are calculated as round trip and transport times are calculated to be considered as minimum waiting time and include driving and resting periods. In all transportation modes except ro-ro plus ro-la, there exist some road mode usage. The average price requested by the transporters is 1.47 Euro based on the data provided by UND Ro-Ro. The cost of Ro-la from Maribor to Wels is 446 Euro for one direction and there is 30 Euro discount for round trip in one month³¹. The cost of Ro-Ro is based on UND Ro-Ro fare rates for the trip Pen-Tri / Tou-Pen for a complete unit³². The cost of air transportation of the drivers to the port region is also added to the cost calculation as 669 Euro.

Table 3. Cost Comparisons of Different Modes of Transportation between Turkey and Germany

Transportation MOD	Road	Road + ROLA	RORO + Road	RORO + ROLA
Duration of Shipment (one)	4 Days (Road)	5 Days (3 days Road, 2 days)	5 Days (3 days RoRo, 2 days)	6 Days (3days RoRo, 3 Rola)
Route	Ist. -K.kule (300 km) Bulgaria (370 km) Serbia (455 km) Croatia (370 km) Slovenia (60 km) Austria (330 km) Germany (650 km)	Istanbul -K.kule (300 km) Bulgaria (370 km) Serbia (455 km) Croatia (370 km) Slovenia (50 km) Maribor-Wels ROLA Austria (60 km) Germany Cologne (650)	Halkalı - Pendik (70 km) Trieste - Italy (200 km) Germany Cologne (750)	Halkalı - Pendik (70 km) Trieste (20 km) Trieste- Salzb. Train (20) Austria Salzburg (20) Germany Cologne (750)
Total km	2.535	2.255	1.240	880
TOTAL COST				
Road Transportation	3.724,00 €	3.312,67 €	1.821,00 €	1.292,75 €
ROLA Cost		862,00 €		862,00 €
RORO Cost			210,00 €	210,00 €
Cost for drivers			669,00 €	
TOTAL COST	3.724,00 €	4.174,67 €	2.700,00 €	2.364,75 €
Total Number of Trips in 2017 to Germany	25.243	24.124	30.640	19.036

Source: Data form UND Ro-Ro and own calculations

Apart from the environmental benefits achieved by the modes with lesser road usage, Table 3 presents the cost for a round trip between İstanbul and Cologne (Germany) by different available modes comparatively. The most expensive transportation mode is sole road although it takes shorter time. In this route, the cheapest mode of transportation is Ro- Ro plus Ro-la, however it takes longer time of 6 days. Ro-ro is considered to be the most efficient mode with a cost of 2.700 Euro and total travel time of 5 days. The relative cost advantage of the ro-ro transportation is reflected by its frequent use as compared to other modes as total number of ro-ro trips to Germany was 30.640 times as of 2017.

³¹ https://rola.railcargo.com/file_source/railcargo/rola/Downloads/Fahrplaene/ROLA-Wels-Maribor-en.pdf

³² http://www.unRo-Ro.com.tr/files/fiyat/information_on_freight_rates_v2_1.pdf

5. Conclusion

Despite Turkey's geographical advantages to become one of the most significant logistics hubs and transit countries in the region, the road transport dominates the system. The dominance of road transport creates imbalances in terms of congestion, environmental downsides, border-crossing problems, road taxation, restrictions on road traffic, permit shortages and customs constraints. In order to overcome this vulnerability and become more sustainable, Turkey needs to develop intermodal transport solutions.

This paper presents, as a case study, a comprehensive review of Ro-Ro transportation system between some Turkish ports and the Italian port of Trieste developed in 1990s. It is believed that the peculiarities of this successful multimodal system can contribute to design and development phases of similar new projects in Mediterranean shipping region.

The success of the system stems from many organizational factors. First of all, the main originator of the multi modal system, Turkish International Transporters Association UND, has been led by proactive leaders not only in 1990s, but in the following years as well. Their power paved the way to establish the private company UND Ro-Ro with the capital provided by its members. The structure of the ownership of the system increased the awareness by the member international transporter companies. The increasing demand for service motivated UND Ro-Ro to increase the number of ships in the fleet. Therefore, the profits arising from the shipping activities are benefited those who use the service. In such a win-win situation, the neutral approach of the UND Ro-Ro management towards the shareholder companies as a service provider regardless of their size created a supportive environment for further developing their business.

It is a fact that the ro-ro line is most frequently used mode of transportation between Turkey and Europe. This stems mainly from the cost advantageous as compared to duration of the trip. The cost figures provided by UND Ro-Ro shows that a round trip costs around Euro 2.700 and it lasts 5 days. This combination is superior than the other modes and this is also reflected in the number of trips comparison with other modes. Ro-ro line was used 30.640 times in 2017.

It is a fact that the success of the presented multimodal system depends also on the developments in the transportation sector. While in late 1980s the tractor cap with the semi-trailer coupled to it was transported by ship, by the time the piggyback method of loading of the semitrailer or the swap body without the tractor cap and also without the driver increased the efficiency of the system. It is fact that UND lead the piggyback system by organizing charter flights for the drivers. UND, has been able to determine the diversifying nature and increased amount of the transportation between Turkey and Europe and have responded to the rapid evolution by investing, as well as informing all stakeholders about new services.

From the perspective of individual international transporter companies, Ro-Ro system between Turkey and Europe constitutes an invaluable alternative against simply road transportation with most favorable terms. Referring to the scheduled dates of departure of Ro-ro vessels, the transporters can organize their activities in a more efficient way.

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