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A case study: feasibility analysis of container feeder vessel as a short sea shipping services in the Caspian Sea

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A case study: Feasibility analysis of container feeder vessel as a short sea shipping service in the Caspian Sea

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DECLARATION

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

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

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ABSTRACT

Title of Dissertation: **A case Study: Feasibility analysis of container feeder vessel as a short sea shipping services in the Caspian Sea**

Degree: **MSc**

This dissertation is a case study of an economic evaluation of a 700 TEU class container feeder vessel as an alternative short sea shipping service in the Caspian Sea. The proposed case study illustrates the introduction of container transportation services by feeder vessel between the Port of Baku (Azerbaijan) and the Port of Aktau (Kazakhstan).

The dissertation briefly outlines the background information related to the shipping industry and specifically to the container shipping and short sea shipping. The following part of the dissertation will discuss the possibility of the main assumption which lies in the number of containers that can be transported. The main question to be asked is whether it is possible to generate a satisfactory number of containers in each port or not? Hence, it requires an in-depth analysis of the projected transportation route, which covers Central Asia and the Caucasus. Consequently, the current condition of the main trade corridor, which covers Baku and Aktau ports will be analysed

The latter study will conduct rational and reasonable inferences and assumptions for the proposed case study based on collected fragmentary data which has been publicized. One key assumption is that the number of containers to be transported changes accordingly to previously given number order. This means, there are minimum and a maximum limit of containers that can be transported between those ports.

KEYWORDS: Containerization, Feeder Vessel, Short Sea Shipping, Caspian Sea

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LIST OF ABBREVIATIONS

ACSC – The Azerbaijan State Caspian Sea Shipping company
ADY – Azerbaijan Railways JSC
BOT – Build-Operate-Transfer
CAREC – Central Asia Regional Economic Cooperation
CSSS– Container Short Sea Shipping
DWT – Deadweight Tonnage
EC – European Commission
EU – European Union
GDP – Gross domestic product
IGC – Intergovernmental Commission
JSC – Joint Stock Company
KTS – Kaztransservice
KTZ – Kazakhstan Temir Zholy (Kazakhstan Railways)
LoLo – Lift on, Lift off ships (container ships)
OBOR – One Belt, One Road
OECD – Organization for Economic Co-operation and Development
PPP – public-private partnership
Ropax – RoRo Vessel for passengers and cargo in trailers
RoPax – Roll On, Roll Off Passenger
Ro-Ro – Roll-on Roll off ships; primarily for unaccompanied freight
SSS– Short Sea Shipping
TEU– Twenty-foot Equivalent Unit container
TIR – Convention on International Transport of Goods Under Cover of TIR Carnets
TITR– Trans Caspian International Transport Route
TRACECA – Transport Corridor Europe, Caucasus, Asia
UN – United Nations
UNCTAD – United Nations Conference on Trade and Development
UNECE – United Nations Economic Commission for Europe
UNESCAP – United Nations Economic and Social Commission for Asia and the Pacific
US – United States
WTO – World Trade Organization

I. INTRODUCTION

1.1 Background to the Study

The Caspian Sea is the largest inner body of water on Earth which is completely enclosed. Lacking a direct link from the global ocean is one of the first reasons behind less container activity within the given region. However, its strategic location, which plays a corridor role between Central Asia and Europe, is the source of promising opportunities by providing alternative routes for silk way projects. Recent developments and especially improving trade relations within regional perimeters is one of the reasons behind the proposed research, which will try to analyse containerization perspectives in the Caspian Sea Region.

Despite the revolutionary changes in ocean transportation, the past decades have also witnessed several initiatives to connect EU and China by enhancement of existing transport connections or establishment of the new alternative transport networks. Especially, the announcement of the enormous initiative, i.e., the Belt and Road Initiative (BRI) which seeks to provide an alternative to the established transport lines by creating new connections between Europe and Asia based on Eurasian railway networks and road connections to revive the historic Silk Road.

At first glance, a move towards railway transportation appears to be more useful for intermediate freight shippers. According to Li and Schemerer (2017), “Intermediates have to be shipped back and forth between the different constituent affiliates throughout the production process, and the sequence in which this occurs is determined to a large extent by production technologies”. In time delivery it is, therefore, an important qualification for modern supply chains. Air transportation can guarantee just-in-time delivery whereas the volume of the cargo or the dimension of the cargo are the main determinants of whether air transportation or railways are a more applicable option.

Eurasian railways have made significant progress in reducing the time and cost of international shipments in recent times. For example, existing Eurasian Rail’s transit time advantage over maritime transit time is almost double since the 2006 level in the region now (Raymond, 2018). It takes 10-20 days to transport cargo on these routes while around 35-40 days by maritime transportation from China to the EU. Especially, for high-value or perishable cargo, a saving of around 10-15 days of transit time may indeed result in cost cuttings. On the other hand, these transport corridors might significantly affect the economy of the land-locked countries by providing direct access to the European Market.

One of the above mentioned Eurasian Transport corridors covers Central Asia and hence the Caspian Sea region as well. The Trans Caspian Transport Corridor (Middle Corridor), which carries one of the most important components of the Modern Silk Road by a 4,766km-long multimodal route connecting China, Kazakhstan, Azerbaijan, Georgia and Turkey, reaching Europe as its final destination (Garibov, 2016). The corridor corresponds to the EU's TRACECA and Turkey's Middle Corridor visions to connect China to Europe. The trade route encompasses highways and railways from the western part of China to Kazakhstan crossing the Caspian Sea by ferries to Azerbaijan, then continues to Georgia, Turkey and Europe. Acar and Gurol (2016) stated that "This line allows the efficient use of Baku, Aktau and Turkmenbashi ports for maritime transport, and it integrates them to intermodal transport".

Trans Caspian Transport Corridor (Middle Corridor)

Figure 1: Source: The Trans-Caspian International Transport Website (Titr.kz)

Especially, the Chinese government collaboratively with the EU, Azerbaijan, Turkey, Georgia, Kazakhstan and other countries, which are situated alongside the Silk Roads made a huge amount of investments for improving infrastructure capabilities within the region. The main rationale behind these investments was to increase cargo transhipment by the land corridors within Eurasia, which covers railways and highway connections between China and the EU. In August 2015, the first container train 'Nomad Express' from China took the Trans-Caspian route and reached Baku International Sea Trade Port in 6 days, travelling approximately 4,000 km (Valiyev 2016; TITR Website).

1.2 Motivation

On April 5, 2018, the general cargo vessel, *Mahmud Rahimov*, owned by the Azerbaijan Caspian Shipping Company (CJSC), moored at the port of Aktau Port (Kazakhstan) to provide container transportation service to Baku Port (Alat), which is located on the Trans Caspian International Transport Route (Middle Corridor). The following day, after loading 70 twenty-foot containers (TEU) with wheat and lentils produced in Kazakhstan, the ship was sent in the opposite direction to call at the seaport of Baku (Alyat, Azerbaijan). Furthermore, discharged containers continued on their journey by the newly opened (2017) Baku-Tbilisi-Kars railway communication. This was the first time that the export of containers from Kazakhstan was conveyed by a feeder vessel (General Cargo Vessel), which entered the Aktau port.

These recent developments illustrate a promising future in the matter of the containerization process in the Caspian Sea, which might result in a demand for container feeder vessels soon. Yet there has not been any type of container vessels deployed in the Caspian Sea. On the contrary, increasing governments' interest and recent developments demonstrate that container feeder vessels will be plied on the Caspian Sea routes in upcoming years. Providing efficient container transportation services along these routes might significantly affect the advantage of the middle corridor, which will result in economic development for the landlocked countries.

1.3 Research objectives

The purpose of the research is to analyse containerization perspectives in the Caspian Sea and study the feasibility of the deployment of feeder vessels on the proposed route which covers Baku Port and Aktau Port. Consequently, the objectives which have been identified for the proposed research are:

- Outline existing container shipping trends both ocean and short sea shipping
- Evaluate the potential of Trans Caspian transport corridors for the containerization process
- Identify main barriers to opportunities
- Analyse the financial viability of the container feeder services along the Trans Caspian route

1.4 Research questions

Underlying questions for the research proposal are:

- How did the containerization process develop globally and what is a current existing trend for container transportation?
- What is the existing condition of alternative transportation routes for seaborne trade from China to Europe by land-based transport corridors?
- What are the advantages and disadvantages of these land-based transport corridors?
- What is the potential for transhipment of container cargo alongside the Trans Caspian transport corridor?
- How viable is it to deploy a feeder container vessel on the Baku-Aktau-Baku route?

1.5 Limitation

This research study is likely to encounter limitations, and the possible barriers are likely to occur in the following areas:

- Limited information access from government agencies
- Restricted access to information from private stakeholders who operate in the local maritime and railway sector
- Lacking sufficient time and word limit to capture all related information of trade patterns and cargo flow dynamics

1.6 Methodology

To accomplish the objectives of this study, a combination of methods, both quantitative and qualitative approaches have been applied to analyse the feasibility of feeder container services in the Caspian Sea. The main part of the qualitative methodology will be carried out through literature reviews, which are based on two parts. The first part was carried out by evaluating existing container shipping trends including the global container shipping industry and short sea shipping, which are also busy with container transportation as. The second phase of the qualitative part will assess containerization potential in the Caspian Sea. To do so, the transport corridors which pass through the Caspian Sea and especially those that overlap with the scope of the study will be analysed. The existing condition of these transport corridors, and their disadvantages will touch upon in order to ascertain its real potential.

The quantitative part of the study is based on a case study, which tries to analyse the financial feasibility of the deployment of container feeder vessels in the Caspian Sea. Therefore, several scenarios have been developed to reflect possible market conditions in the region. Since the main revenue generator is the number of containers that can be transported, therefore, the Monte Carlo Simulation was applied to check for different scenarios, which are a possible outcome of market fluctuation. Moreover, the cost structure of the case study has been developed based on the assumption that it reflects real costs which might appear in the Caspian Sea. Consequently, that was one of the main constraints during the study, i.e., to get accurate information which reflects real shipping cost in the Caspian Sea. Especially, for the regional study, it is difficult to collect relevant and up to date data.

Oracle Crystal Ball is the leading spreadsheet-based software suited for predictive modelling, forecasting, simulation, and optimization. Oracle Crystal Ball helps to reveal insight into the critical factors affecting risk, and calculates the likelihood to reach the objectives. The main fundamental concept of the software is the Monte Carlo Simulation allows to automatically compute and record the results of multiple 'what if' scenarios. The platform assists you in analysing given case scenarios to expose a range of possible outcomes, predict the possibility of their occurrence, and possible sensitivity analyses which will demonstrate the underlying element of the created model.

1.7 Outline of dissertation

This dissertation has been constructed in the following chapters to guide the reader from concept to implementation.

- Chapter 1 outlines the background information of the study and the motivation of the research, limitations, the objectives, the research questions, and methodology.
- Chapter 2 provides a summarised literature review of related publications on the development of the containerization process and especially short sea shipping. Since the Caspian Sea shipping services fall under the short sea shipping services, consequently this topic and container transportation within the short sea shipping has been touched upon.
- Chapter 3 reveals the potential of the containerization process in the Caspian Sea. Especially, the trade routes which cover the Caspian Sea have been analysed to reveal both its advantages and the existing trade barriers on these international transport corridors.

- Chapter 4 provides an in-depth analysis that was conducted on the case study of the establishment of container feeder services to disclose the analytical applications of different scenarios. Therefore, statistical methods were used to determine the relationship between the number of containers that can be transported and shipping costs which occur during the transportation process.
- Chapter 5 provides a conclusion, which presents the outcome of the research and clarifies the fundamentals of the findings. Afterwards, an appropriate series of recommendations are outlined to provide the best-fit solutions to the challenges affecting the transportation potential of the Caspian Sea.

Structure of the proposed dissertation

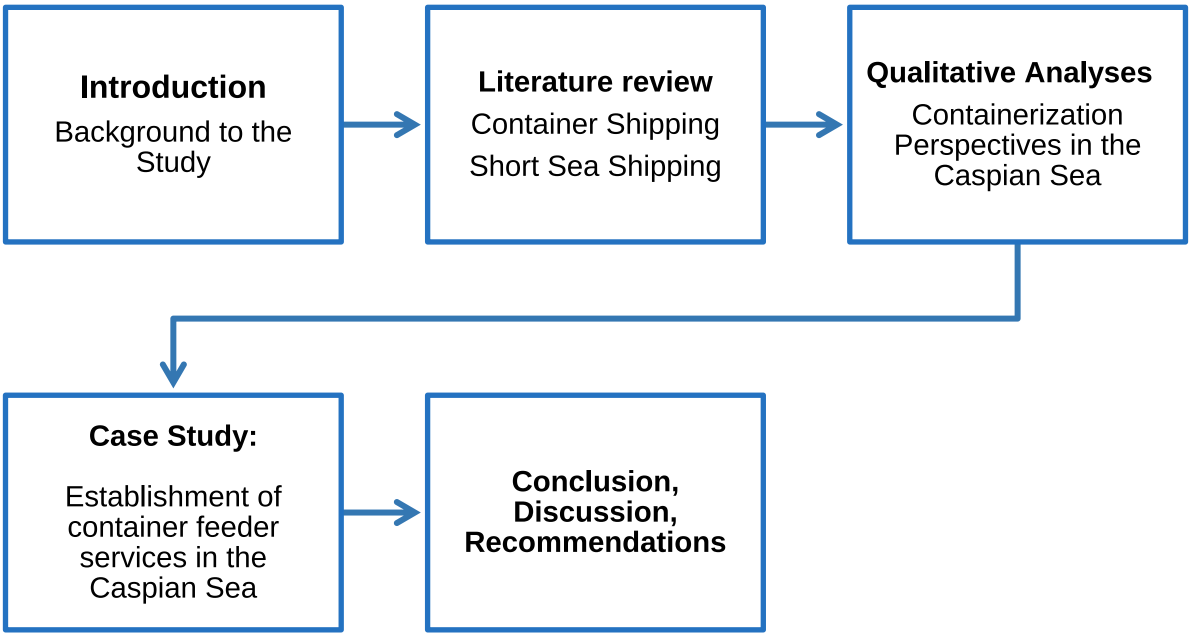


Figure 2

II. LITERATURE REVIEW

2.1 Evolution of Global Container shipping

The Ideal-X, which was set afloat in 1956, was the first successful container ship that has been constructed. Its valuable advantages distinguished it from others type of vessels, especially from break-bulk vessels by cost and time reduction. The protection of the cargo during the process was another hindrance where the entitled party should maintain the loading/unloading process to avoid damaging the goods. According to Tomlinson (2009), a study in the late 1950s demonstrated that 60-75% of the cost of transportation of cargos by ships was due to portside costs, while another study of a specific ship voyage found cargo handling made up about 37% of total costs. A significant cost was occurring in general cargos due to time and labour expenses, which arose during the loading and discharging process.

On the contrary, the first containership was loaded in eight hours with around fifty-eight containers and left the port on the same day. Loading cargo on a breakbulk vessel cost 5.83 dollars per ton and took many days. With Ideal-X the cost was 15.8 cents per ton (Levinson, 2008). The cost reductions related to the container attracted new firms to enter the market, which led not only to greater competition but also to greater international trade flows (Levinson, 2008). The idea of Malcolm Mclean, in the light of Idea X, has shaped the global maritime industry by introducing a cost-effective and less timely logistics solution.

Today, global container trade reached more than 140 million TEU (20-foot equivalent units) in 2017, which was carried by more than 11,150 vessels with 22 339 798 total TEU capacity (UNCTAD, 2017). The carrying capacity increased, from 3.17 m TEUs (4772 ships) in 1990 to 22.3 m TEUs (11 150 ships) in 2017 (UNCTAD, 2017). A considerable share of the growth was due to the container shipping lines (CSLs) in the top 20. Their capacity portion in the global fleet was from 39% to around 75% (Tran, 2014). Together with the robust growth of the world fleet, it has been the trend of ever-increasing vessel capacity. The maximum size was 7100 TEUs in 1996, then 15,500 TEUs in 2006, and is 21,000 TEUs now.

The revolution in the shipping industry including containerization and port development has allowed liner shipping companies to take advantage of higher productivity in cargo handling only to a certain extent. However, industry practitioners obtained an additional advantage by the economies of scale associated with ship size. McLellan (1997), Cullinane and Khanna (1997) show detailed analyses which illustrate that, since early 1995, the container ships with a capacity larger than 4500 TEU and other post-Panamax designs have been rapidly deployed on the traditional liner routes, which are busy with a large number of cargos.

According to the Clarkson intelligence (2018), there are 20 new container vessel orders which are planned to be delivered in 2019 and 2020 with 22,000 TEU slot availability. However, these cost savings of bigger vessels are crucially depending on the extent to which the ships are being filled. That utilization level of the vessels is one of the main issues which disturbs the liner shipping industry. According to Grimstad and Neumann-Larsen (p.4 2013), "if the utilization rate drops by only 3-5%, the cost advantage of a vessel that is "one size" larger will be evened out" (OECD/ITF, 2015). Table 1, illustrates a different type of container vessels with respective dimensional features.

Table 1: Type of container vessels

Type	Number of TEU	LOA in meters	Average Beam in Meters	Average Draft
Feeder	100-1000	122	19.6	7
Handysize	1000-2000	166	25.5	9.3
Sub-Panamax	2000-3000	209	31	11.4
Panamax	3000-5000	256	32.2	12.2
Post-Panamax (I Generation)	5000-8000	280	39.7	13.7
Post-Panamax (II Generation)	8000-12000	330	45.2	14.5
Post-Panamax (III Generation)	12000+	374	51.4	15.4

Source: Based on own elaboration through Clarkson Intelligence.

The largest container ships are used on the Far East-North Europe trade route, which is the leading maritime route between Asia and Europe. The average ship capacity on this route is 11,500 TEU (see Figure 3), a growth of 62% between 2007 and 2014, and one of the largest increases in ship size. Other trade routes with large ships include the Far East-Med and the Transpacific (OECD/ITF, 2015) Additionally, on these trade lanes the average container ship size has increased rapidly over the last years, in particular on the Far East-Med trade route, which has the average container vessel increased by 79% in size over 2007-2014 (Dynamar, 2015a).

Vessels size on main trade routes 2014

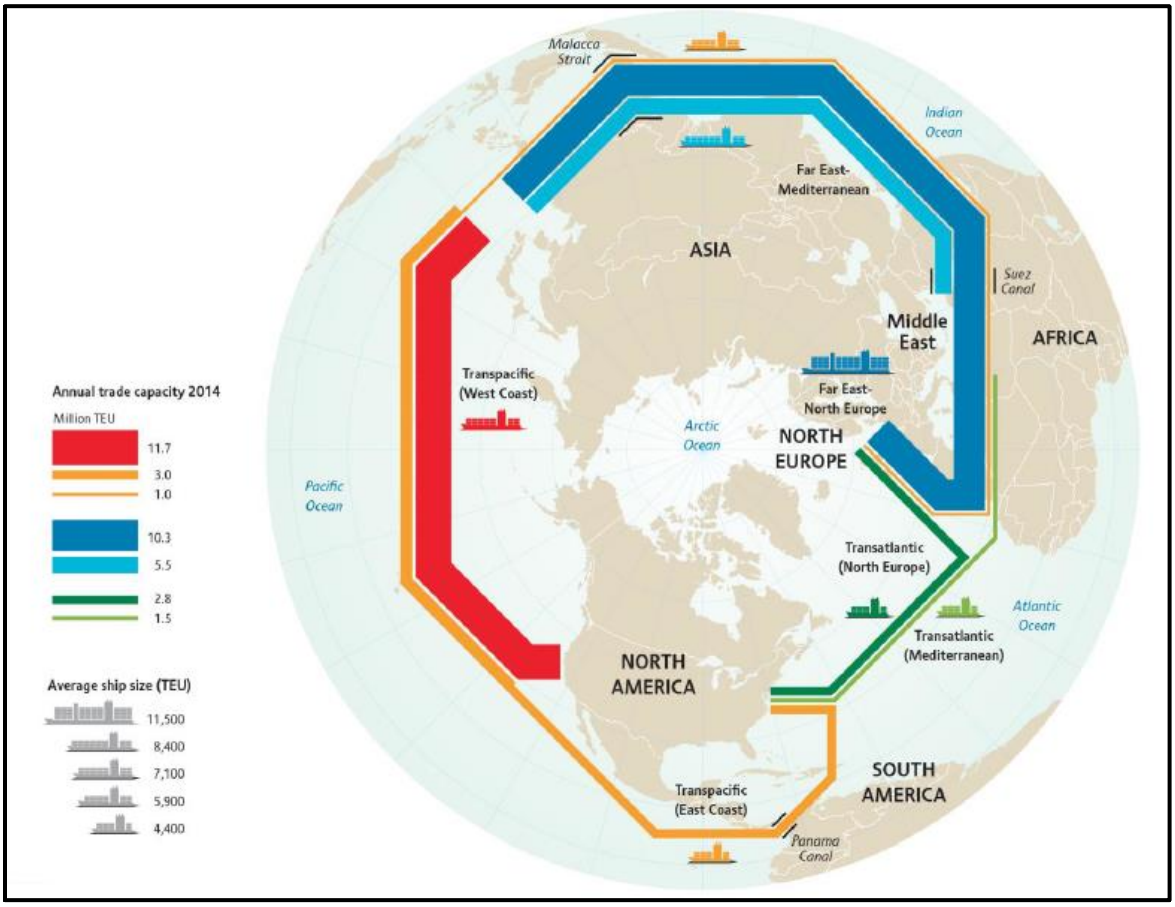


Figure 3: Source: OECD/ITF, 2015

2.2.1 Feeder Services

At the beginning of containerization, a deep-sea containership was calling on a large number of variously sized ports (multi-port calling). Since mega-sized containerships deployed on the routes with more efficient transportation costs over long distances, the number of calls decreased due to dimensional issues in ports. Regional ports had low productivity; therefore, as an alternative, practitioners started to the developed hub and spoke models where feeder services were deployed to decrease the number of port calls. The evolution of so-called Hub and Spoke networks has led to some classification of container ports into three categories: hub ports, feeder ports and trunk ports (Zeng & Yang 2002).

Hub ports are the main ports where container transhipments may take place between trunk and feeder line vessels, and they are located in the main trade routes. The hub ports have commonly high productivity for loading and unloading of container vessels to trunk and feeder ships. Feeder ports, on the other hand, are regional hinterland gateways linked to other seaports with feeder line containerships. Due to both their geographical location, technological and low productivity limitations, feeder ports are commonly not visited by big vessels which serve in trunk routes (Olcay, 2013). Trunk (main) ports are local ports called by trunk lines due to their comparatively high cargo volumes (Olcay, 2013). Further, trunk ports usually have medium to high productivity, favourable geographical location, and good inland connectivity.

Moreover, the fundamental concepts, components and issues are generally similar for trunk and feeder lines (Andersen, 2010). The differences between feeder and trunk shipping lines could be expressed as the trunk lines operate in deep seas between regions and feeder lines operate in short seas. Whereas the trunk lines usually cover a global service network, feeder services cover limited regional networks. Consequently, feeder lines are serving as mediators of the complex service networks, such as between hub and trunk lines. While trunk lines link main global hub ports to each other, feeder lines help secondary ports, which have an unbalanced and relatively low volume of freight, to survive. Figure 6 illustrates connectivity structure example between Hub, Trunk and Feeder ports with respective vessels type.

Hub, Trunk and Feeder connectivity

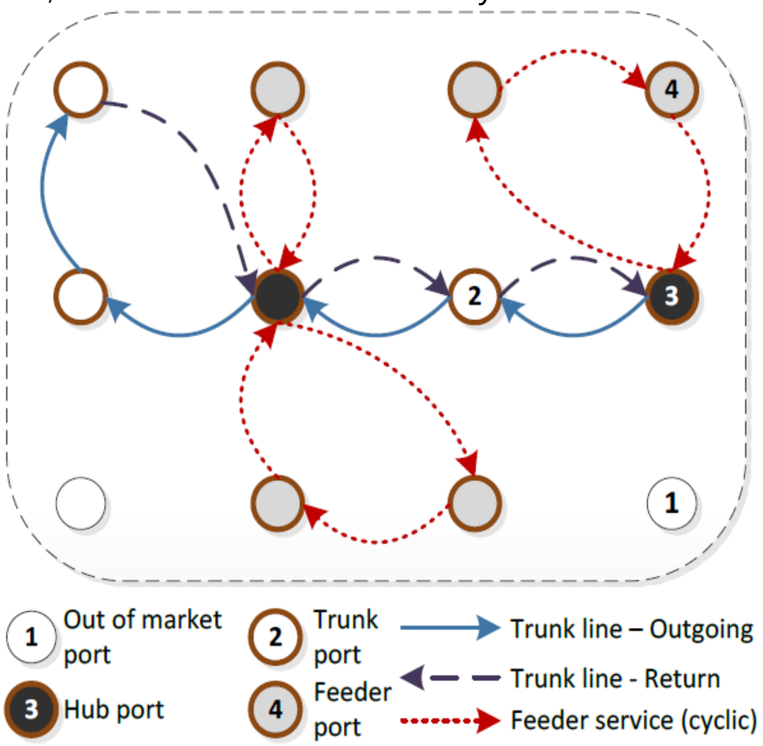


Figure 4: Source: Adapted from Polat Olcay (2013)

2.2 Short Sea Shipping

Due to difference on the length of the voyage, shipping can be categorized as deep sea shipping (DSS), and short sea shipping (SSS). Deep sea shipping is the long haulage between regions, connecting main industrial areas such as Asia and Europe, and Americas with Europe and etc. “These trades are most commonly operated by larger vessels taking advantage of economies of scale for either low-cost bulk transport or more expensive container liner service” (Stopford 2009). Short sea shipping is the transportation of goods and passengers within perimeters of the any given regions (short distance). Yet, there is not any standardized definition that sufficiently describes what Short Sea Shipping is. Many definitions have arisen encompassing several different criteria such as geographical, legal, and others aspects which can occur for SSS. Hence, for this research, a general definition of SSS was adopted as “the movement of goods and people within littoral waters on routes that do not involve transit through the oceans”.

The modern terms which embedded with short sea shipping, such as motorways of the sea or marine highway refer to the historical expressions, i.e. coastal trade, coasting trade and coastwise trade, which encompass the movement of cargo and passengers mainly by sea, without directly crossing an ocean. Moreover, by definition, Short Sea Shipping (SSS) is the transport of goods and passengers in the European Union, or between non-European waterside countries in the Mediterranean, Black and Baltic Seas and Norway and Iceland. While these concepts have been defined as sea motorways on the other hands ‘marine highway’ accepted as a similar concept in the United States (Brooks 2009).

Musso and Marchese (2002) examined the competitiveness of SSS by considering different market conditions and their advantages and disadvantages. These conditions describe the thresholds for the optimum trip distances and the corresponding costs that could enable SSS to be more competitive than the other modes of transportation. The authors highlighted that SSS competitiveness depends directly on the sea-leg distances. Moreover, from the supply chain standpoint, SSS is one of the chains of the logistics process. Hence, the freight which will be transported by SSS involves neither the points of origin nor the points of destination for the freight (Becker, Burgess, & Henstra, 2004).

Likewise, Suarez-Aleman et al. (2014) argue that the time spent by SSS in port is the main concern as compared to deep sea shipping, where the difference in port time may not be as relevant. It has been suggested that to improve port efficiency in SSS operation, the time spent in port should be included as another important output beside the amount of cargo moved; passengers boarding and disembarking; and movement of vehicles on and off the SSS and Customs, Immigration, Quarantine and Security (CIQS) efficiency (Suarez-Aleman, Trujillo, & Cullinane, 2014).

The European Committee has actively supported SSS by financing SSS projects since 1992, under its public transport policy. SSS has developed as a central basis of EU's transport policy, a major component of the Marco Polo programs and a part of the Trans-European Networks (Denisis, 2009). In 2001, the 'White Paper on European transport policy for 2010' emphasized the significant role that SSS can play in curbing the growth of truck traffic, rebalancing the modal split and bypassing land bottlenecks (Commission of the European Communities, 2001).

The most significant short sea markets globally are the Asian and the European regions. The total gross weight of freights transported as part of EU short sea shipping was estimated at around 1.9 billion tons of goods in 2016. Moreover, short sea shipping made up close to 60 % of the total maritime transport of goods to and from the main EU ports in 2016, gaining one percentage point compared to 2015 according to Eurostat (2018). Looking at the fleet deployed to the short sea container market at the beginning of 2016, Clarkson Research Services found that 26% of the world container fleet operated intra-Asia and 13% intra-Europe. Then, 4% operated in other short sea markets, making a total of 42% operating intra-regional (short sea).

2.2.1 Structure of Short Sea Shipping

The most used combination is a short sea vessel with a truck and railways. Other possibilities are short sea shipping with rail and inland shipping. To meet with the regional demand, the types of vessels which are being used in short sea services are also changing. Moreover, several types of vessels can be deployed to realize cheaper transportation of the freights by sea. As a result, four categories of ship types which are deployed as a means of short sea shipping have been identified by Paixão and Marlow (2002).

Type of the vessels which are being utilized in Short Sea shipping

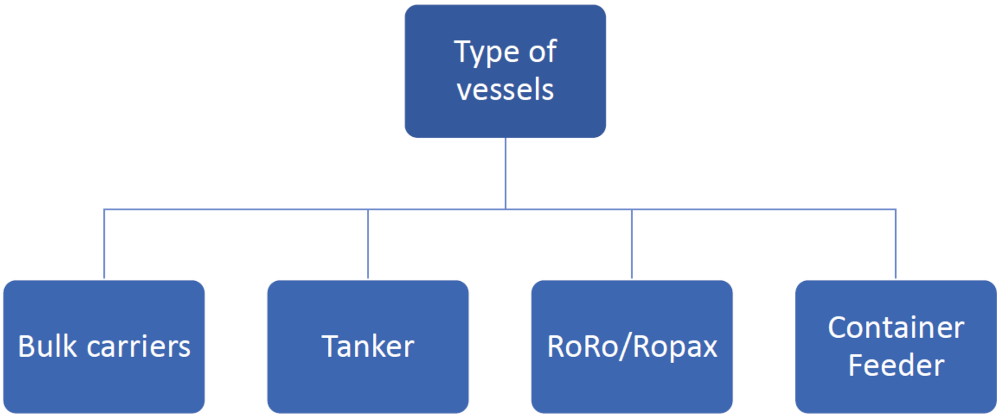


Figure 5: Source: Paixão & Marlow (2002)

2.2.2 Container Short Sea Shipping

Yet, profound clarification regarding the type of the vessels or characteristic of the vessels which are being used for the short sea shipping services is missing due to changeable concepts. However, natural barriers, such as a geographical characteristic of seas or lakes, including draft restriction, limits the economy of scale by the bigger vessels. Therefore, the operated vessels are mostly under 13 000 DWT (Eurostat, 2018). Short sea shipping consisted of about 60 % of the total maritime transport of goods to and from the main EU ports in 2016, one per cent ahead compared to 2015. However, the share of short sea shipping in total maritime transport varies significantly between the different countries as can be seen from Figure 6.

Share of containers in SSS in selected countries (2010-2016)

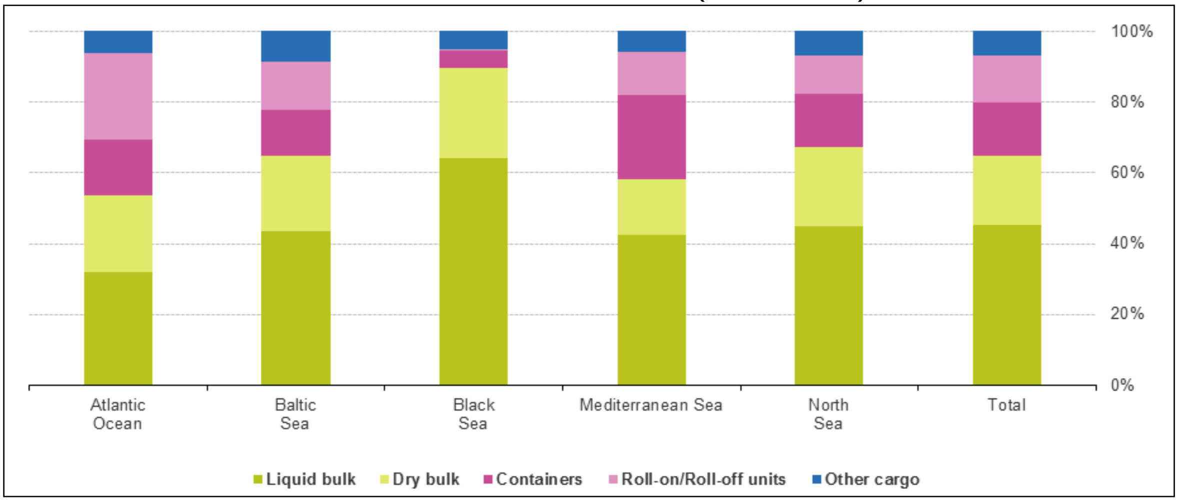


Figure 6: Source: Eurostat (2018)

According to Eurostat (2016), “Short sea shipping of liquid bulk goods was dominant in all sea regions in 2016, even though the composition of the short sea shipping cargo varies among the sea regions” Moreover, as a whole liquid bulk gained 45 % of the total short sea shipping of goods by 838 million tonnes which were imported and exported from EU ports in 2016 (Eurostat, 2018). While dry bulk accounted for 365 million tonnes (20 %), containers for 278 million tonnes (15 %) and finally Ro-Ro units concluded the year by 247 million tonnes, which account for 13 % of EU SSS. Goods transported in containers accounted for 24 % of the short sea freight in the Mediterranean Sea in 2016 although it only reached up to 5 % of the short sea shipping in the Black Sea.

Intermodal or multimodal transportation is an increasingly vital part of the logistics sector, and freight unitization is a fundamental necessity for intermodality as noted previously. ‘Freight unitization’ can be explained as the use of standardized packaging units that can simply be moved from one mode of transport to another without handling the goods themselves (Eurostat, 2018. In other words, ‘unitization’ defines how much of the total cargo has been transported in containers. The main categories of standardized packaging units, called intermodal transport units (ITUs), are:

- containers;
- swap bodies;
- trailers and semi-trailers.

The use of ITUs decreases the time need for the cargo handling process and advances safety, reduces damage and loss and allows freight to be transported quicker and more efficiently. The share of unitization in total freight transport has increased considerably in recent years. However, this growth in unitization varies between the different modes of transport. Rail and maritime transport, i.e. deep sea shipping, in particular, have the highest shares of freight unitization as previously discussed. However, short sea shipping, both at EU level and in most Member States have a significant share of seaborne transportation.

Table 2: Share of containers in SSS in selected countries (2010-2016)

	2010	2011	2012	2013	2014	2015	2016
EU-28	**12.0**	**12.8**	**13.4**	**14.0**	**14.8**	**14.6**	**15.0**
Belgium	36.9	34.4	33.3	33.0	34.1	33.2	35.1
Bulgaria	7.8	6.3	8.2	7.8	9.5	10.5	9.7
Czech Republic	-	-	-	-	-	-	-
Denmark	7.3	6.7	6.6	6.8	7.3	6.2	6.0
Germany	24.2	27.4	28.1	28.6	28.8	28.3	27.6
Estonia	4.6	4.9	6.4	6.3	6.6	7.4	7.8
Ireland	17.0	16.9	17.6	16.4	17.4	17.1	17.3
Greece	9.3	16.9	22.2	23.9	25.5	22.9	23.5
Spain	20.0	21.7	22.2	21.4	22.7	23.6	24.5
France	5.0	4.9	5.3	5.5	6.2	6.2	6.2
Croatia	5.4	6.5	6.4	6.2	8.8	8.3	7.3
Italy	13.0	11.8	13.1	14.4	16.3	18.4	18.2
Cyprus	31.3	36.8	31.7	24.8	25.8	27.0	28.8
Latvia	5.5	5.8	6.0	7.0	7.1	6.9	7.0
Lithuania	10.2	10.7	11.0	11.8	15.2	11.5	13.3
Luxembourg	-	-	-	-	-	-	-
Hungary	-	-	-	-	-	-	-
Malta	16.3	21.8	19.7	22.3	18.4	14.2	17.5
Netherlands	12.2	12.1	12.4	12.0	12.1	11.4	11.4
Austria	-	-	-	-	-	-	-
Poland	12.6	15.5	17.2	19.7	22.0	18.3	19.7
Portugal	22.9	26.5	25.1	26.9	26.3	26.4	26.8
Romania	6.2	7.0	7.7	7.0	10.9	11.0	12.8
Slovenia	31.2	33.9	30.3	36.8	40.0	41.9	43.1
Slovakia	-	-	-	-	-	-	-
Finland	11.5	10.2	11.3	11.3	11.2	11.5	11.2
Sweden	7.4	8.3	7.9	7.4	7.8	6.7	6.8
United Kingdom	6.6	7.0	7.3	7.8	8.2	8.9	9.1

Source: Eurostat (2018)

The unitization rate for maritime transport varies considerably between the Member States and between short sea shipping and deep sea shipping. In Slovenia, goods transported in containers made up 43.1 % of the transport volume (in tonnes) in short sea shipping in 2016 (see Table 2). High shares of unitization in short sea shipping were also recorded in Belgium (35.1 %), Cyprus (28.8 %), Germany (27.6 %), Portugal (26.8 %), Spain (24.5 %) and Greece (23.5 %).

Several of these countries have major container ports serving as transhipment points for containers. In these countries, the high unitization rates in short sea shipping reflect a large volume of feeder services to and from these hub ports. Eurostat (2018) stated that "In terms of a number of twenty-foot equivalent units (TEUs), short sea shipping of containers in the main EU ports increased by 9.8 % from 2015 to 2016 (to just over 33 million TEUs)" Nevertheless, it should be emphasized that the number of TEU handled in short sea shipping services was well above the levels noted before the economic downturn in 2009 (Eurostat, 2018).

2.3 Development of short sea services

Feeder services, which use small container vessels to connect the hub port(s), makes secondary vessels to be both operational or timetable depended on mother vessels. Conversely, container short sea shipping is a fully self-regulating service that has fixed liner services and its own departures/arrivals timing. In several cases short sea shipping operators are also integrated into the land service provision for road or rail transport. To appreciate container short sea shipping as a transport alternative, it is crucial to highlight the three roles performed by short sea shipping: (1) the intra-urban; (2) the regional; and (3) the international short sea shipping.

The intraurban SSS involves cities which are located along the coastline or if they are accessible by river or inland waterways (Delovic, 2015). On the other hand, regional transportation of containerized cargo by the usage of the feeder vessels highly depend on the cost and benefits, which might be generated through CSSS operations. Furthermore, short sea shipping including CSSS cannot be considered as a global market shipping industry segment; on the contrary, the way the industry provides its services is highly fragmented due to regional factors. These factors might include the type of vessels, destinations selection (direct shuttle services or multi calling services), or with regard to the region.

A case in point is, Motorways of Sea is directly related to general policy instruments, to grants contributing to the construction of infrastructures and the execution of feasibility studies and to assist in the establishment of new SSS routes. The concept of “Motorways of the Sea” is part of White Paper which suggests waterborne freight transportation as a proper way to cope with road congestion and constraints on railway infrastructure. In the US case, the main program which has been declared by a governmental statue has been embedded in the Code of Federal Regulation. The essential objective of the program is to decrease the congestions on roads, and also utilize advantages of short sea shipping within the region, such as to lower road maintenance and repair costs, and to reduce greenhouse gas emissions and oil consumption.

Despite these broad classifications, either shown in a sample of Motorways of the Seas in the EU or in the concept of Marine Highways, from a logistics perspective, these services may be summarized under three main categories which were proposed by Paixão and Marlow (2002). Its definition has been altered due to several reasons as above illustrated. Hence, it is important to categorize those differences and elaborate more which is necessary for the proposed study. Furthermore, the proposed case study illustrates transportation of containerized freight between two given destinations within the Caspian Sea. Hence, the type of logistics services, which are proposed for the future, might follow under dedicated CSSS.

Table 3: Logistics classification of short sea shipping services

Type of services	Sub-type of services
Dedicated SSS	
Systems SSS (multi-port)	Self centered service
	Disenclavement service
	Network mixed service
Standard SSS	

Source: (Paixão & Marlow, 2002)

The concept of the Short Sea Shipping is not static and changes by adapting to regional factors. Consequently, each region may develop its own respective concepts which will tackle their existing issues and harmonize the trade. Nevertheless, in general, those concepts require collaboration and sharing the information among the different players to prevent the existence of bottlenecks in transport chains and provision for the optimization and rationalization of these transportable units, to fully utilize the advantage of multimodal/intermodal logistics solutions (Paixão & Marlow, 2002). What SSS needs is the provision and implementation of new policies to meet with the current demand of the global standards such as integrated supply chain solutions, or multimodal transportation. These factors might increase short sea shipping importance and to provide better transportation solutions depending on the demand, geographical locations and competitive advantages.

III. Containerization perspectives in the Caspian Sea

3.1 Introduction

The main underlying concept of the intended feasibility study is relying on the existing market condition of the region. In other words, the number of containers to be transported is a major factor which is the whole questioning acceptance of the project. Consequently, the main question to be asked is that whether it is possible to generate a satisfactory number of containers in each port or not? Hence, it requires an in-depth analysis of the projected transportation route, which covers Central Asia and the Caucasus. Hereafter, the transport corridors which pass through these areas and, are suitable for container transportation will be taken into consideration, especially trans Caspian routes.

3.2 Transport Corridors, The silk roads

Trading routes and networks across wide territories have existed for hundreds of years. Perhaps the best known of these is the ancient Silk Road connecting China to Central Asia and the Middle East and Europe. So-called Silk Roads, which crossed Central Asia, provided connections between the key commercial centres of China, the Middle East, and Europe since historical times (Starr et al., 2015). This ancient transport route granted wealth and prosperity to the landlocked countries within Central Asia and made the region to be a hub centre during its golden age.

Regional corridors are critical for landlocked countries, which suffer from serious trade and accessibility issues. Poor connections can damage economic prospects of landlocked developing economies, especially affecting their small and medium-sized enterprises (Arvis, Carruthers & Willoughby, 2011). Limão and Venables (2001) showed that a 10% fall in transport costs increases trade by 25%. Moreover, landlocked economies' transport costs are 50% higher compared to coastal economies (Limão & Venables,2001).

Transport corridors mostly refer to the infrastructure capabilities that provide physical links to an area in any given country or to the region, which previously lacked the connection (Nogales, 2014). The infrastructure capability includes multimodal transport corridors that generate more compound connections by integrating several types of transport modes, such as road, rail, inland waterways and short sea shipping (Inan & Yayloyan, 2018). Furthermore, a logistic corridor is another stage of corridor development, where physical links are found in regions which are accompanied by the harmonization of the institutional framework (Banomyong, 2008). The central goal of a logistic corridor is to enhance the flow and storage of goods, people, and related information. It includes improving logistics and all related technological, organizational and legal conditions to be achieved with the support of service providers and a facilitating institutional environment (Inan & Yayloyan, 2018).

These Eurasian transport corridors known as the New Silk Road crosses Eurasia via a number of transportation corridors and routes. There are several rail and road corridors across Eurasia classified by different international organizations, including UNECE, UNESCAP, ABD's CAREC and IRU (Ziyadov, 2011). Moreover, due to geographical and political factors, the Eurasian transport corridors have been segmented into three categories; Northern Routes, Central (TRACECA) routes and Southern Routes. The map in Figure 7 illustrates each transport corridor which connects Eurasia and Europe. However, due to the scope of the research only the central corridor, i.e. TRACECA routes will be discussed.

Eurasian Transport corridors

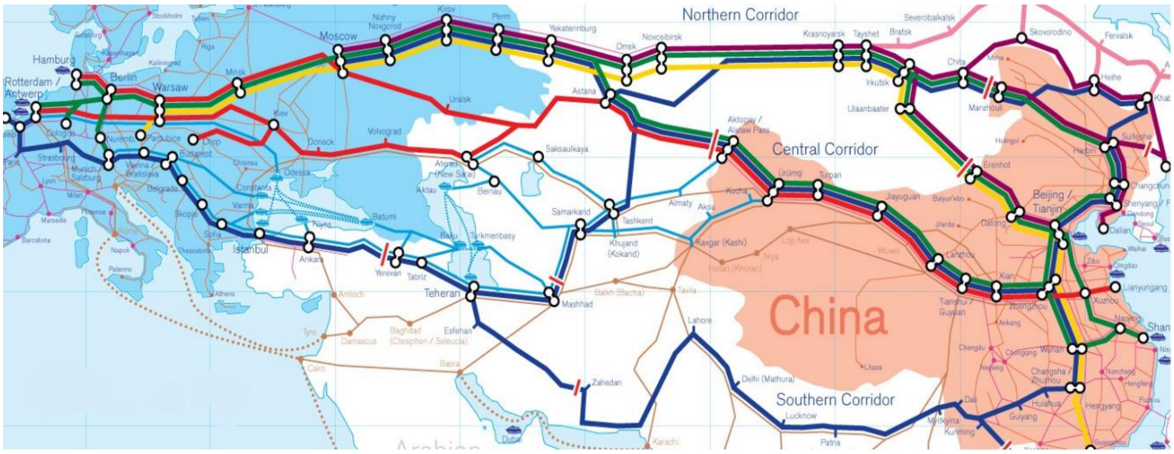


Figure 7: Source: Iron Silk Road World Map

3.2.1 Northern (Trans-Siberian) Route

The Trans-Siberian Route is the oldest of the 3 existing routes. Shown as the northern corridor in Figure 7, it was established in 1891, and the Trans-Siberian route was the first train-route to cover more than 11 000kms (Reijnders, 2017). The route has its own significance for the Russian Economy and internal transport but is also used by European countries to get their imports and exports from Asia (Reijnders, 2017). The TSR is the longest double track and electrified railway in the world, covering 9,852 km (6,122 miles) and linked to destinations in Europe such as Germany, Poland, Belarus and Finland. The Trans-Siberian route has around 26 days of transit time according to van Rooijen and Jackson (2012).

3.2.2 Southern Route

The Southern Corridor starts in Kunming, China and reaches up to Turkey and East Europe via Pakistan and Iran, while the southern branch of the Silk Road Corridor originates in the Port of Lianyungang (Eastern China) and travels through Central Asia, Afghanistan, Iran, and Turkey to Western Europe (Ziyadov, 2011). Iran has been transit bridge both for the East-West and the North-South corridors, moving goods from South Asia to Russia and northern Europe, and from China and East Asia and currently to Turkey, the Mediterranean region and South Europe.

3.2.3 Central Route

There are three main marshalling yards which have regional significance located on the Central corridor: Kandyagash, Arys and Dostyk and two freight yards: Shimkent and Almaty. The Dostyk station for the Kazakhstan - China border has it is own significance as its redistribution role in the corridor. Dostyk railway station provides a connection with the Central corridor, TRACECA rail routes to China. The main operations provided at the Dostyk terminal are the breaking - up and making-up of trains and performing the gauge change from broad gauge (1,520mm) in Kazakhstan to standard gauge (1,435mm) in China (Islam et al., 2013).

3.2.4 TRACECA

The Transport Corridor Europe, Caucasus and Asia (TRACECA) program is an East-West Corridor aimed at connecting the Commonwealth of Independent States to Europe through the Caucasus and/or the Black Sea (Ozyanik, 2015). According to Ozyanik (2015), "The key objective of the TRACECA Program is to harmonize customs and trade regulations among the member states, to facilitate trade and movement of goods, and to ensure the integration of the resource-rich regional countries with global markets". Moreover, the program also includes the development of the transportation infrastructure of the member states, facilitating access to European and global markets, strengthening their economies, connecting the TRACECA corridors and the Trans-European Network (TEN), supporting regional cooperation, and increasing foreign investment. Figure 8 shows the TRACECA rail and road networks, which include 22 (4 on the rail, 6 on the road and 12 on rail and road) and 12 ports (Keser, 2015).

TRACECA map

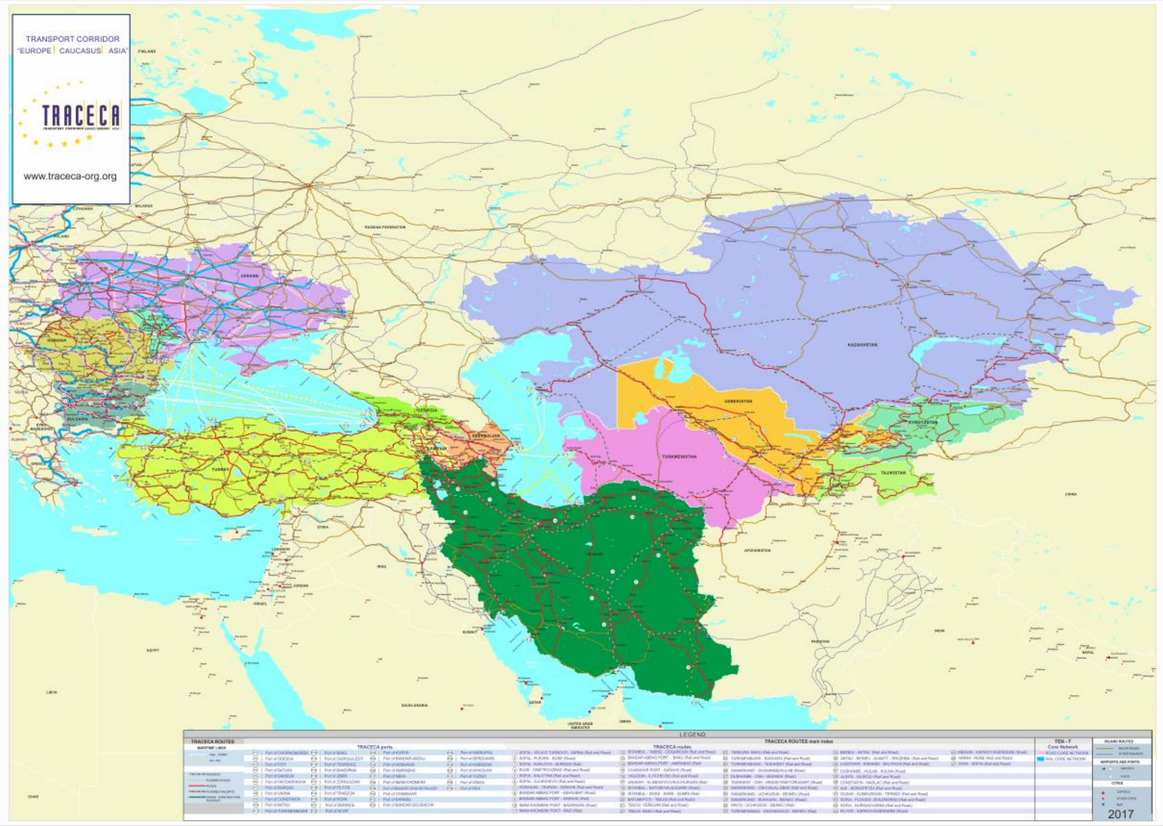


Figure 8: Source: TRACECA website

The TRACECA has been developed by the EU as an international intermodal transport corridor project between three South Caucasus and five Central Asian countries which dates back to May 1993 in a Brussels conference (Ziyadov, 2011). Moreover, five years later twelve countries have signed for "Basic Multilateral Agreement on International Transport for Development of Europe-the Caucasus-Asia Corridor". Signatory countries, which include Armenia, Azerbaijan, Bulgaria, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Romania, Tajikistan, Turkey, Ukraine, and Uzbekistan, established an Intergovernmental Commission (IGC) and the TRACECA Permanent Secretariat, which are based in Baku (TRACECA, n.d). Additionally, the Islamic Republic of Iran, joined the TRACECA in 2009, while Lithuania has acted as an observer (Ziyadov, 2011). To achieve its key objectives, TRACECA countries attempted to implement the following changes as highlighted by UN ESCAP (2017).

- Reformed national regulatory framework and adopted new national laws, codes and other regulations in order to strengthen and modernize transport institutions
- Improved monitoring and data gathering on transport
- Improved human resources training transport
- Created project-implementation bodies/commissions, plans, or completed or initiated a number of projects in the development of basic transport infrastructure;
- Implemented a number of measures for border-crossing facilitation (such as joining respective ECE conventions, implementing "single window" elements, modernizing border crossing facilities)

In the words of UN ESCAP (2017), "In total, within the period of the strategy's implementation, with the help of international financial institutions, the member countries invested $17,075 million into transport infrastructure development projects". To continue with the development of the corridor, the following strategic directions will be the focus for 2016-2026:

- Institutional - legal barriers to transport and international trade
- Motorways of the sea, train ferries and sea routes
- Railway sector
- Road sector
- Inland waterways
- Connections to the hinterland, multimodal and logistic opportunities

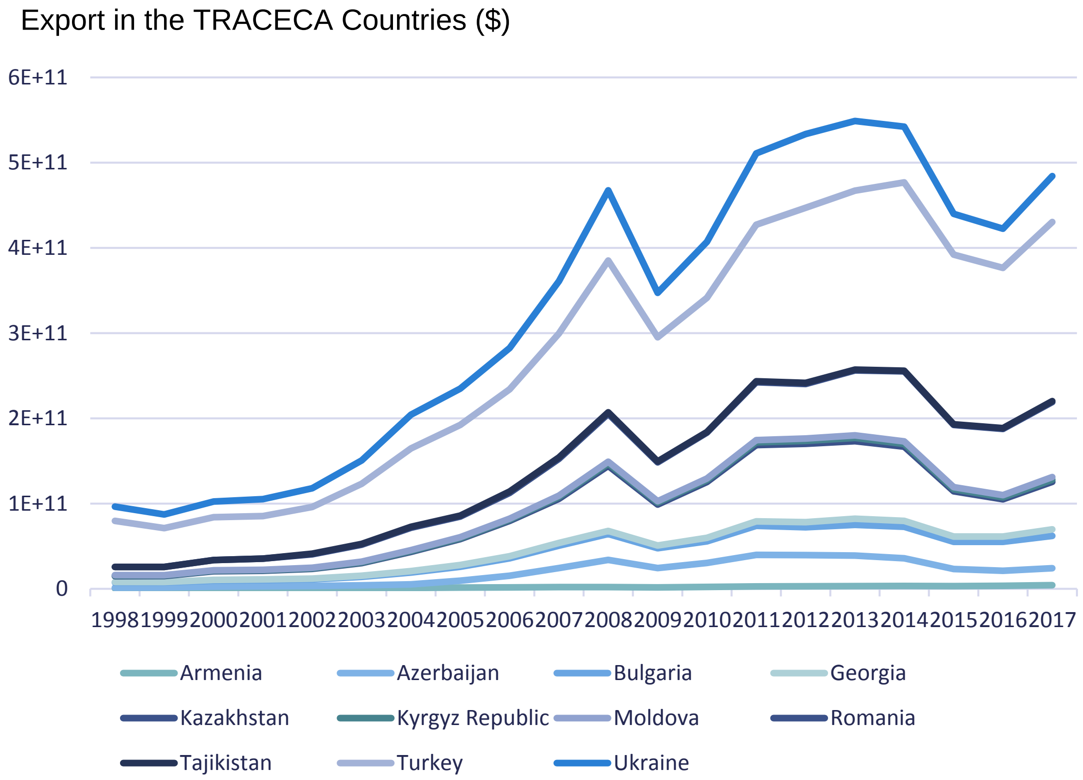


Figure 9: Source: World Bank Data (2018)

One possible explanation for the export growth in the selected countries (Turkmenistan and Iran due to lack of information have not been added to the figure) after 1998 as illustrated in Figure 9, might be explained as the establishment of the TRACECA program. According to Keser (2015), TRACECA transport corridor made a significant influence on the economic development in the member states and in Eurasia where these countries are located. The most significant one of these effects is at the dimension of international trade. With the TRACECA, fast and cheap transportation operations developed in the member countries have led to increasing their trading volumes. Especially, Turkey has the highest export rate among TRACECA countries, and that project has increased Turkey's role in the region (Keser, 2015).

TRACECA has distinctive significance for the member countries because of being the only project that receives financial and technical support from international organizations which are directly related to Eurasian railways networks (Turkish National Secretariat). According to Valiyev (2016), "it was the European Union's TRACECA project that turned China's interests to the region by demonstrating its potential as a logistical hub for East-West trade". Since 1998, the investment which was made by EU increased to $800 million into capital projects which includes the renovation of ports, restoration of railroads, and roads along the

TRACECA corridor, in Central Asia and the Caucasus countries. Member states seek to achieve a higher level of integration of their infrastructure, tariffs, and logistical chains (Valiyev, 2016).

3.3 The Trans-Caspian International Transport Route (TITR)

The transport corridors such as TRACECA passing through several countries' borders, which most often resulting in delays, and lack of logistic performance due to severe integration level. As an example to tackle that issue the creation of logistic corridors have been shown as a tool to enhance the capability of the corridors. One attempt to overcome such hindrances in the TRACECA corridor is the Trans Caspian International Transport Route (TITR) project, which is an extension of TRACECA.

In 2016, railway and port authorities of Azerbaijan, Kazakhstan, and Georgia signed an agreement on developing the Trans Caspian International Transport Route Association (Nazarli, 2017). The objective of the Association is to harmonize transhipments across the Trans-Caspian corridor. To do so, several bilateral and multilateral cooperation schemes, are planned to be ratified to achieve effective tariff policy, easing barriers in customs and border crossings, therefore, reducing administrative costs (Inan & Yayloyan, 2018). Given map illustrates The Trans-Caspian International Transport route, which starts from Southeast Asia and China, runs through Kazakhstan, the Caspian Sea, Azerbaijan, Georgia, Turkey and further to European countries.

The Trans-Caspian International Transport Route

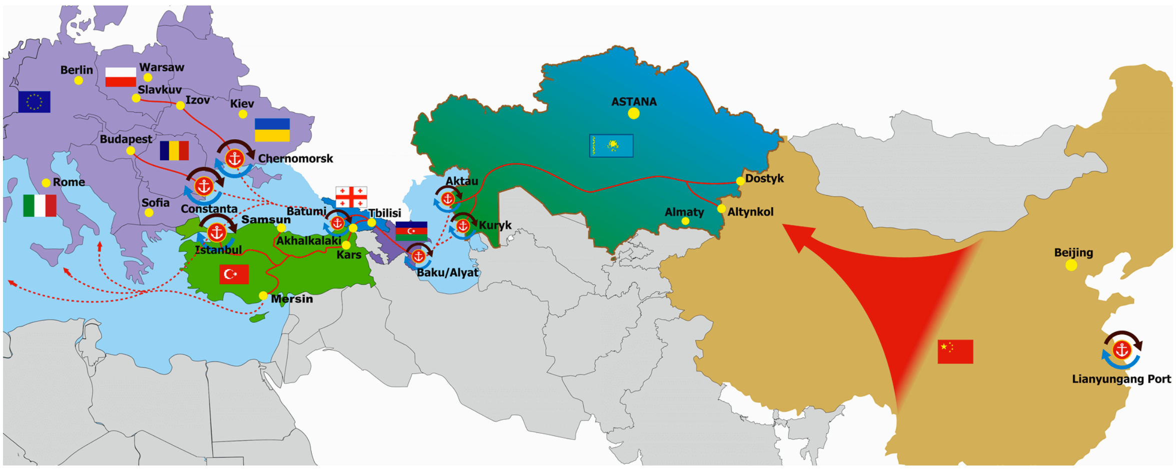


Figure 10: Source: The Trans-Caspian International Transport Website

For the Caspian Transit Corridor (the Middle Corridor), one of the most important components is the Modern Silk Road, which is a multimodal route with a length of 4766 km connecting China, Kazakhstan, Azerbaijan, Georgia and Turkey, reaching Europe as its final destination (Garibov, 2016). The corridor corresponds to the EU's TRACECA and Turkey's Middle Corridor visions for connecting China to Europe. The trade route encompasses highways and railways from the western part of China to Kazakhstan crossing the Caspian Sea by vessels to Azerbaijan, then continue to Georgia, Turkey and Europe. This line allows the efficient use of Baku, Aktau and Turkmenbashi ports for maritime transport, and it integrates them to intermodal transport (Acar & Gurol, 2016).

The Trans-Caspian International Transport Route (TITR) is intended for the supply of goods both from China to Europe through the territories of Kazakhstan, Azerbaijan, Georgia and Turkey, and in the opposite direction. Management and development of the route are supported by a consortium created by the participating countries: China Railway (China), KTZ Express (Kazakhstan), Azerbaijan Caspian Shipping Company (the Caspian Sea), ADY Express (Azerbaijan railways) and Trans Caucasus Terminals (Georgia).

Moreover, Azerbaijan, Kazakhstan, Georgia and Ukraine introduced competitive feed-in tariffs for cargo transportation on the route starting from June 1, 2016 (Shirinov 2016). In 2017, the International Association of TITR signed a memorandum of cooperation with the China Communications and Transportation Association in a meeting attended by 80 representatives of railway departments, port, shipping and logistics companies from Kazakhstan, China, Ukraine, Poland, Turkey, Azerbaijan, Georgia, Lithuania and Latvia (Israfilbayova, 2017).

The main goal of TITR is to coordinate collaboration of the participants in the transportation process of goods and containers along the route from Asia to Europe and in the reversed direction (TITR, website). Furthermore, by 2015, the container train 'Nomad Express' on China (Shihezi) - Kazakhstan (Dostyk- Aktau Port) - Azerbaijan (Kishly) route was launched as a result of efforts on the part of the TITR. In August 2015, the first container train 'Nomad Express' from China took the Trans-Caspian route and reached Baku International Sea Trade Port in 6 days, travelling approximately 4,000 km (Valiyev 2016; TITR Website). In addition to Azerbaijan and Kazakhstan, China was the main contributor in the implementation of this project (Valiyev 2016) Similarly, DHL Global Forwarding launched a multi-modal corridor service between China and Turkey in collaboration with Kazakhstan Temir Zholy Express and partners from Azerbaijan, Georgia and China (DHL, 2015). Figure 11 illustrates recent container transport volume and forecast for the future.

Container traffic in the direction of China-Caucasus-Turkey (thousand, TEU)

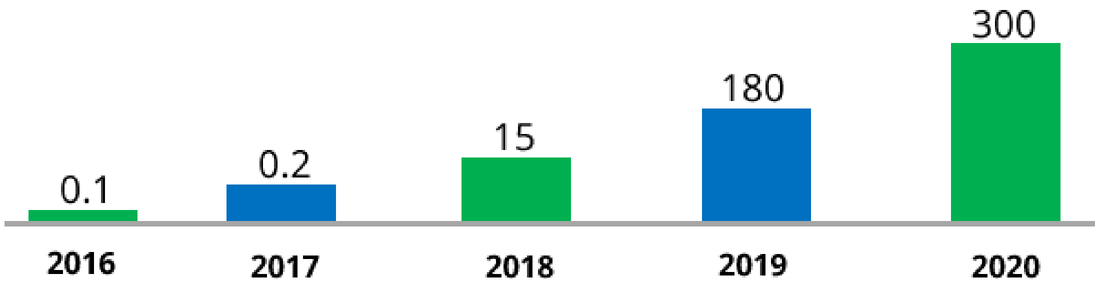


Figure 11: Source: TITR website

Ahmed Mustafin, the executive director for commercial affairs of Aktau Port, identified that in the next 5 to 10 years the 3-fold increase in cargo flow via Trans-Caspian transport corridor had been expected (transcaspian.az, 2017). Currently, Kazakhstan is already taking steps in this direction, particularly, the capacity of Aktau Port has been increased by 1/5 times. Construction of a new deep-sea port Kuryk was finished last year and due to that, time of cargo delivery to the port of Alat will be reduced, but the port is available for loading processes regardless of weather conditions (TransCaspian, 2017)

3.4 Advantages of TITR

Starting from Khorgos (China) the Trans Caspian route covers the least number of the countries among others the belt and road corridors between the EU and China (Kenderdine, 2017). The corridor involves three intermediary countries, namely, Kazakhstan, Azerbaijan and Georgia. Kinderdine (2017) maintains that “This is the smallest number for any proposed land bridge between the EU and China that also avoids Russia” Moreover, this involves the least number of the countries giving the opportunity to decrease transit time by lessening border and customs controls. Since the independent countries have their own custom and border controls; consequently, it is preferable to avoid more of them for the shippers.

Physical barriers, such as low average speed, lack of harmonization and facilitation among the borders, certainly affect the choices of the shippers. From this view, the Northern route is long, time-consuming and also involves geopolitical issues due to Russia’s involvement. The same can be said for the Kazakhstan-Russia-Belarus route as well. The Kyrgyz route, on the other hand, involves five jurisdictions and requires two rail gauge changes: one from China to Kyrgyzstan, and another from Turkmenistan to Iran (Kenderdine ,2017). Figure 13, illustrates the comparison of three different transportation alternatives from China to the EU. As can be seen from the illustration, the Trans Caspian route is the shortest and fastest one among the others. Although it is newly established, conversely, its development speed demonstrates more reliable and harmonized transportation on the given routes in the near future.

TITR, Khorgos - Piraeus direction

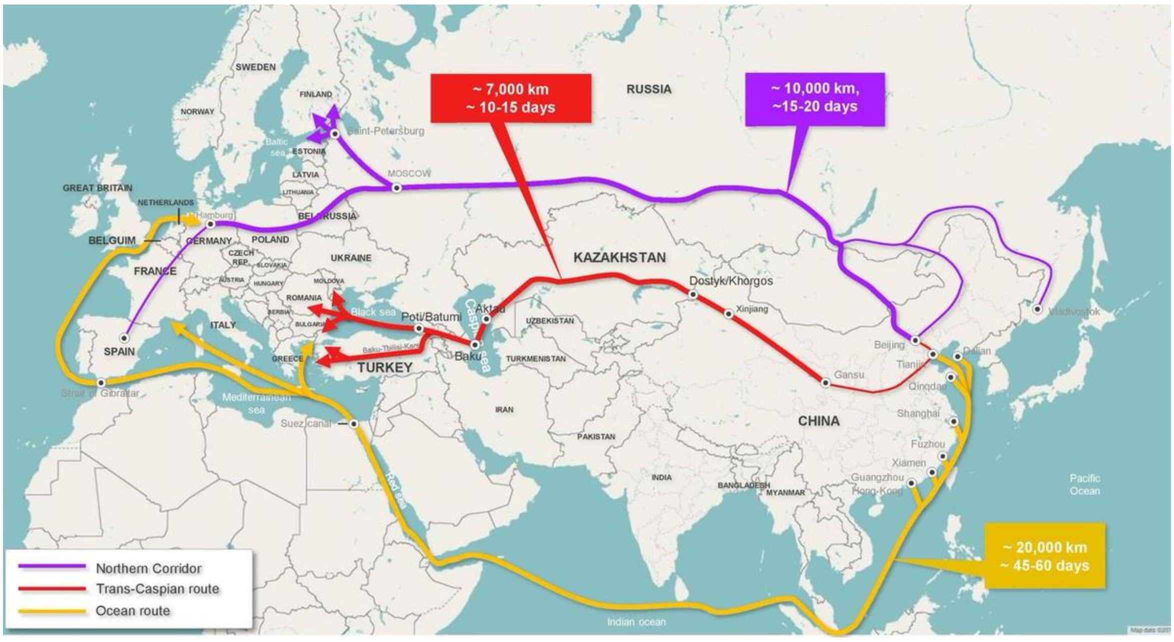


Figure 2: Source: Trans Caspian forum

Another main player in the TITR and TRACECA project is Turkey, which in recent developments regarding railway connections increased advantages of The Trans-Caspian route or the Middle Corridor. TITR comprises crossing several countries between China and Europe, thus requiring a comprehensive network of infrastructure, harmonized customs and cross-border procedures. Freshly added Baku-Tbilisi - Kars leg of the corridor, connecting the Caspian Sea to eastern Turkey is completed. In western Turkey, the newly built Yavuz Sultan Selim Bridge in Istanbul includes a railroad, targets to ensure a corridor for a seamless flow of freights and people between Asia and Europe (Reuters, 2017).

The Baku-Tbilisi-Kars (BTK) railway project, which has a price label of $1 billion, was initiated in 2005 and the construction started in 2007 (China Daily, 2017). The line will primarily be used to transport 1 million passengers and 6.5 million tons of freight a year. In the long run, its volume ability is aimed to reach up to 17 million tons annually (China Daily, 2017). The Baku-Tbilisi-Kars railway will also increase connectivity across Eurasia and reduce the transport time from China to Western Europe to 15 days from over a month. The BTK railway, totalling 826 kilometres in length is constructed on the base of a Georgian-

Azerbaijani-Turkish intergovernmental agreement. The railway starting in Baku stops in Tbilisi, passes through gauge-changing facilities in Akhalkalaki and terminates in north-east Turkey. President Erdogan declared that the BTK is “an important chain in the New Silk Road, which aims to connect Asia, Africa, and Europe” (Korybko, 2017)

After completing the last connecting chain of the corridors, participants of the projects increased attention for facilitating and harmonizing the process alongside the route. Moreover, having uniform tariffs can be highlighted as one of the improvements which just recently were accomplished by the member of the TITR consortium. The TITR International Association, an association of legal entities, signed the final protocol of tariffs for the transportation of coal and grain, which was approved under the protocol (Trend, 2018).

It is also possible to see different tariffs for the transportation of the containers or wagons between different destinations. Table 4 adopted from TITR website illustrates agreed tariffs for container transportation between Kazakhstan and Turke, or Georgia. The members of the TITR International Association signed the final protocol of the TITR General Meeting in Baku on May 8 where tariffs for transportation of coal and grain was approved under that protocol (Tsurkov, 2018).

Table 4: Container transportation tariffs, TITR

Rates on Container shipments	**Distance, km**	**Laden. $/20 ft.**	**Empty. $/20 ft.**	**Laden. $/40 ft.**	**Empty. $/40 ft.**
Altynkol st. - Istanbul st.	5714	2808	1167	3700	2062
Altynkol st. - Istanbul st. (BTK)	6409	1990	-	3029	-
Altynkol st. – Mersin (Kz-Tr)	5747	1900	-	2883	-
Altynkol st. - Slavkow st.	6893	2774	1619	4281	2608
Altynkol st. - Vadul Siret/Mastiska st.	6333	2600	1525	4089	2425
Altynkol st. - Chop st.	6569	2732	1553	4179	2474
Altynkol st. - Uzhgorod st.	6597	2646	1478	4093	2372
Batumi st. - Sary Agach st.	3509	1539	-	2487	-
Kokshetau st. Kars st	4878	1720	-	2635	-

Source: TITR website (Titr.kz)

3.5 Port of Baku (Azerbaijan)

The new Baku Port at Alat is a transportation hub linking the east to west (Turkey & EU), south (Iran & India) and north (Russia & Northern Europe). The strategical position of Baku Port upturns its connectivity as a competent hub port in the Caspian region, and so increases the volume of cargo being handled. In addition, the new port location is linked to prevailing highways and railways, connecting the port to the inland regions of the country. There are three international rail routes passing through Azerbaijan, which all intersect at Alat. The new port is proficient of serving 150 – 160-metre-long, 10,000-tonne capacity ferries and all other types of vessels serving in the Caspian Sea. The position of port enables a flexible expansion of all the facilities for different cargo segments (rail ferry, general cargo, container and bulk) once cargo turnover rises. Furthermore, development plans cover the creation of Free Zones and an International Logistics Center as well which will be introduced soon.

Phased development of the new port of Baku (Alat)

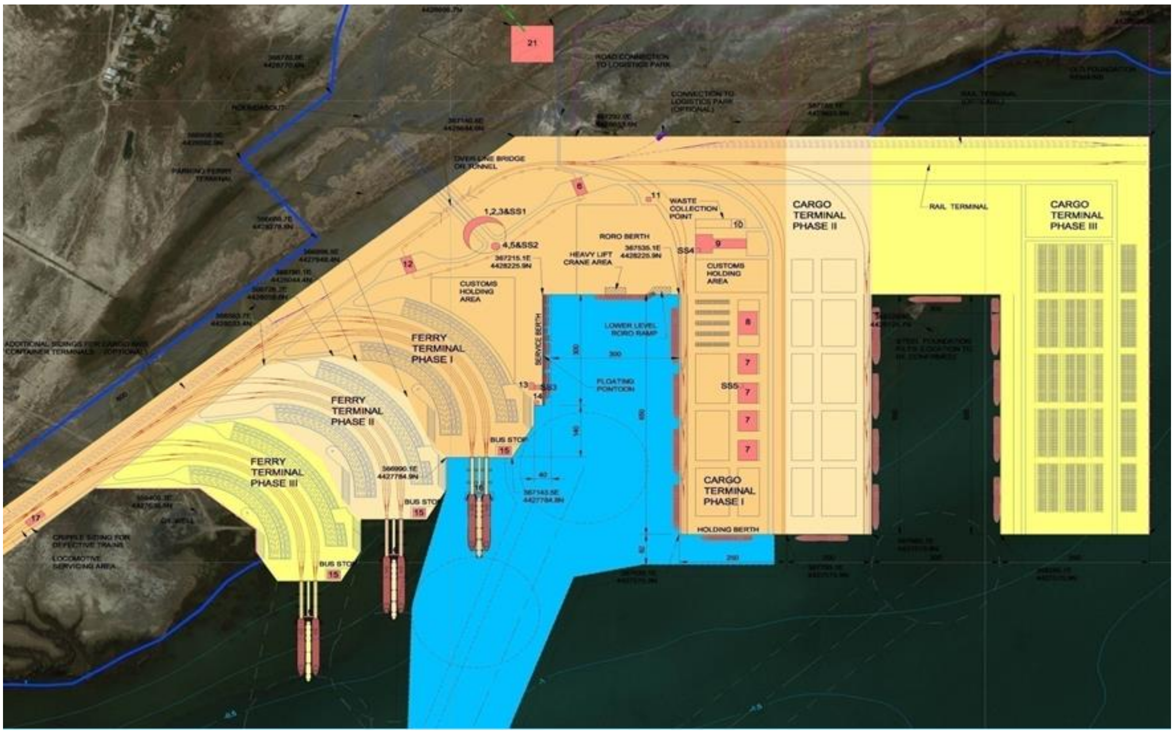


Figure 13: Source: Trans Caspian forum

By the end of the first phase of construction, the cargo processing capacity of the new port will increase around 10-11.5 million tons and 40,000 - 50,000 TEU annually. The decision regarding the commencement of the second and third phases of construction developments depends on the current cargo volumes. Moreover, public-private partnership (PPP) model or the “build-operate-transfer” BOT model are likely to be used for the next development phases as indicated by the Port Baku authority. By the end of the third stage of construction, the cargo capacity of the new port is intended to reach about 25 million tons and up to 1 million TEU per year. The forecasts for the three phases are illustrated as follows:

- Phase One: 10–11.5 million tons of general cargo + 40,000–50,000 TEU;
- Phase Two: 17 million tons of general cargo + 150,000 TEU;
- Phase Three: 21–25 million tons of general cargo + up to 1 million TEU.

3.6 Aktau Port (Kazakhstan)

Aktau Port is the sea-gate of modern Kazakhstan which has significant importance both for the west side of the transport corridor and the east side. The current condition of Aktau Port can be explained as a multi-purpose, intermodal terminal with many prospects and capabilities. The Infrastructure capability has been upgraded to handle all types of general and bulk cargo, containers and rolling cargo. Aktau Port consists of 6 oil berths, 3 general cargo berths, 1 grain terminal and 1 ferry terminal (DP world, Aktau Port, 2017). Additionally, the port includes three general cargo or dry bulk terminals. The capacity of storages are 2.5 million tons with a warehousing capacity of 80,000 m2 of open space.

Moreover, as stated in DP world, Aktau Port, (2017). “the port is ice-free, and available for year-round navigation, equipped with active ventilation, high-precision electronic scales and automated management of the entire process cycle, giving the port an ability to provide high-quality services”. Furthermore, port equipped with 6 quay cranes with a capacity changeable between 10 – 40 tons each, mobile cranes up to 80-ton capability. Additionally, as like Port of Baku, there is also a special economic zone at Aktau port where investors can establish their manufacturing and warehousing operations without the liability of corporate income, land, property taxes. Moreover, EEZ cover exclusion of VAT on imported goods, customs duties, and, others advantages as well (Shephard, 2017).

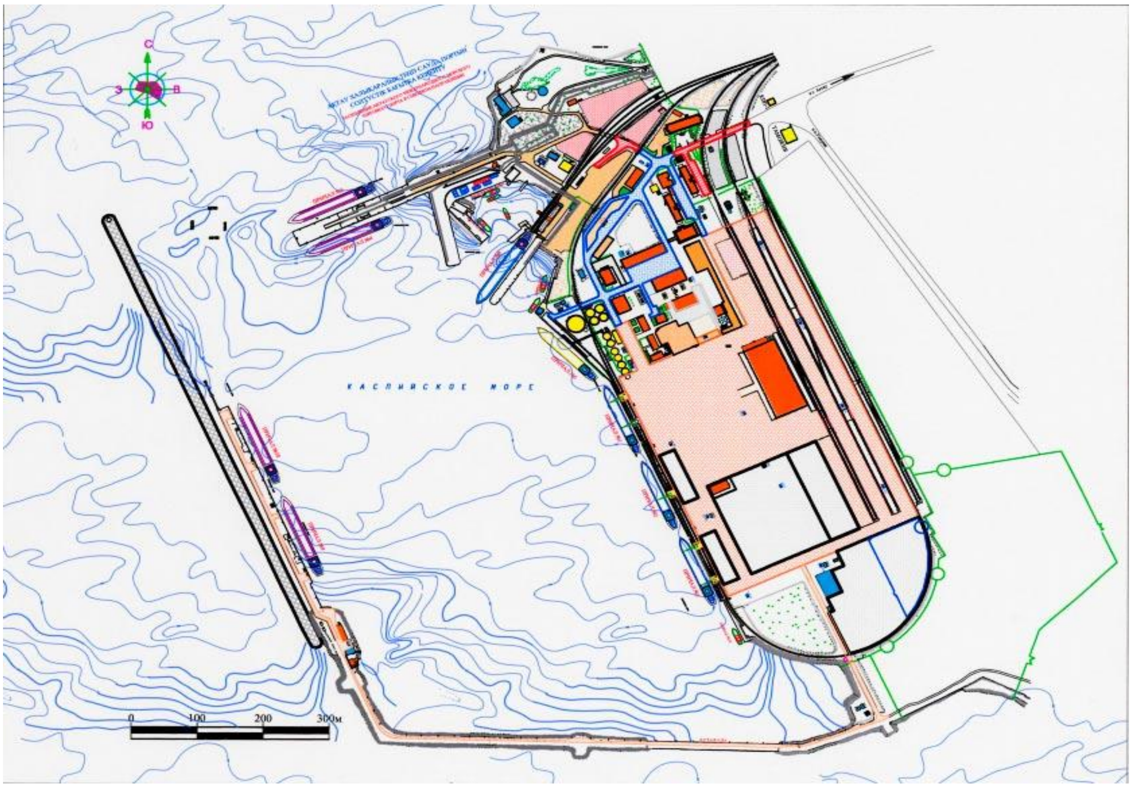


Figure 14: Source: Aktau Port, website

3.7 Barriers alongside TITR

To elaborate real potential of TITR as a transport corridor, the effectiveness of the various transport modes and transportation period should be analysed. The objective of the analytical study was to examine the factors that can be highlighted as a barrier to container transportation on selected routes. According to Sladkowski, and Ciesla (2015) time and cost factors are the basic factors to be taken into account when making optimum decisions regarding the carriage of freights by forwarders. Since TITR is a transport corridor involving several countries, it will face several challenges to become a smoothly operating corridor. As an outcome of related literature reviews, barriers to the development of the transport corridor are categorized as Physical Barriers and Non-Physical Barriers. Physical barriers include, the issue of insufficient railway systems, e.g., different gauge systems, low average speed coupled with inaccurate ferry transportation services decreased the competitiveness of the transport corridor. Figure 15 demonstrates identified barriers to the Trans Caspian International Transport Routes.

Barriers alongside TITR

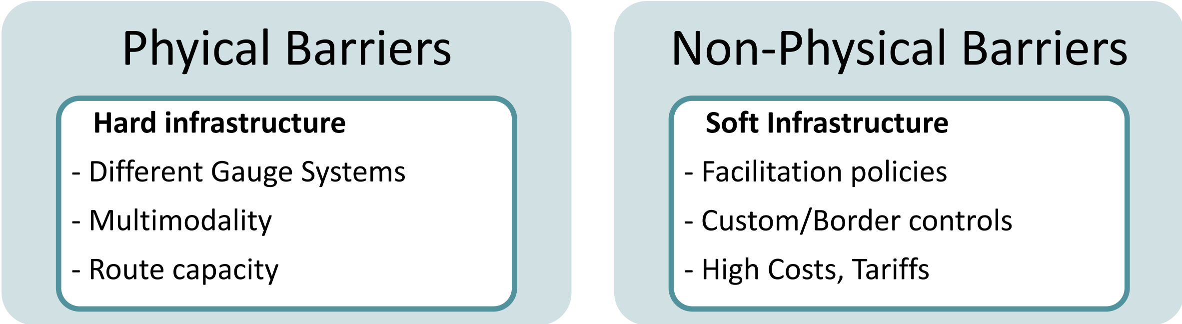


Figure 15

3.7.1 Physical barriers

Hard Infrastructure

Technical structures are a main underlying source for the issue of integration between trans-continental railway transport networks ("When Eurasia matters", 2018). Europe and China mostly have standard-gauge railways (1,435 mm; on the contrary, the former Soviet Union have broad-gauge railways systems (1,520 mm). This alteration on gauge systems results in delays of the transport services while encouraging the use of containers as well ("When Eurasia matters", 2018). However, only half of the route is in a double-track standard, and major parts of it remain non-electrified (Nazarko et al., 2016). The route's capacity is also limited by restrictions due to train weight on certain sections of the route. The average train speed on this route is estimated at 40 km/h. Wagons would be manually attached to the train. Along the Baku Tbilisi Kars line, the gauge is changed at Akhalkalaki in Georgia. However, China Railway Corporation (CRC) proposed adopting the world standard of 1.435mm in high-speed railways for the Tehran – Urumqi line via Central Asia (Inan & Yayloyan, 2018)

Multimodality

The transport of freights via this corridor is more complicated and involves complex intermodal solutions such as the need for a ferry crossing on the Caspian and the Black Seas. However, the reliability of the shipping leg of the transportation, especially within the limit of the Caspian Sea, is affected by several factors. The issues related irregular ferry schedules are due to weather conditions; on average 90 days in a year ferries are unable to operate due to big waves and significantly low cargo volume (Inan & Yayloyan, 2018). Moreover, the process of loading rail wagons and trucks to the ferries is inefficient according to Shepard (2017b).

Route capacity

There are two main sources of the route capacity issue which limits the volume of the cargo that can be transferred alongside the route. There is the insufficient capacity of the railway system, especially in some parts of it where there are weight restrictions. The second limitation is regarding the current draft restriction of the sea leg of the corridors, which is maximum 7 meters. Although it is capital extensive to enhance the infrastructure capability, related countries and international organizations have already invested in the enhancement of the infrastructure capability not only in the proposed route but also at the regional level.

3.7.2 Soft Infrastructure

Facilitation policies

The main bottlenecks of global trade integration have been raised in the behind-the-border area where the issues contain the facilitation of all physical, procedural, and administrative steps involved in trade transactions, including in particular transport and cross-border operations. Since TITR involves several countries with different customs and border rules, having harmonized border procedures is getting harder. To overcome such an issue, TRACECA started its developments in 1993 and is still under the process to harmonize the trade alongside the corridors. In 2016, rail transportation fees applicable on a section of the corridor were reduced by 50%, and taxes and transit fees have also fallen as the outcome of these facilitation policies over the years. These actions are intended to lower the cost of China-EU carriages sent via this corridor to enable the creation of a genuinely competitive business alternative to the Trans-Siberian corridors (Jacobski, 2018).

Custom/Border controls

There are considerable interruptions caused by loading/unloading operations, border crossings, customs clearance, police checkpoints and queues along this route. The TITR contains a number of countries, and therefore a number of different border and customs checkpoints. Hence, there is a series of dependency in terms of timing alongside the logistics corridor. This problem requires an approach from a wider perspective e.g. of the supply chain, network, from China to the EU, bypassing through the Trans Caspian part of the Eurasian Transport Corridor networks.

High Costs/Tariffs

According to Inan and Yayloyan (2018), the most frequently cited issue is the high costs of the Caspian crossing between Aktau Port in Kazakhstan and Baku Port in Azerbaijan. Inan and Yayoyan (2018) claimed that “As of 2015, it costs USD 1,200 one way to cross from Baku to Aktau route and USD 1,100 from Baku to Turkmenbashi amounting to USD 4 and USD 6.5 per nautical mile, respectively” On the other hand, Ro-Ro shipment from Mersin in Southern Turkey to Italy’s Trieste costs USD 1 per nautical mile (Kurguzova & Sahbaz, 2016). This is mainly due to the low volume of cargo, and a short distance together with limited economy of scales. The draft restrictions limit the economy of scale which was provided by the ferries, or container vessels. This can be explained due to the low volume of cargo transhipment on the given routes. Especially, in the case of the shipping leg of the corridor, several factors affect the advantage of the routes. Firstly, low cargo volume and the short distance between the ports, either port services, or shipping operators, increase the charges for transportation services, which in the end result in higher transportation cost within the given corridor compared to other Eurasian transport corridors.

3.7.3 Future of the corridor

The EU remains critical of the Trans-Caspian corridor as well as individual countries in the South Caucasus and Turkey.As stated by Inan and Yayloyan (2018), “While continuing with soft infrastructure reforms, removing barriers across borders along the corridor, expectations from the EU are largely financial in the form of financing infrastructure development and investment”. Conversely, the future use of the Trans-Caspian corridors for China-EU trade is uncertain due to Beijing’s unclear stance on this matter (Jacobski, 2018). Although they mentioned TITR as a potential route for goods transported from western China, at present China’s involvement in the expansion of this corridor has been insignificant.

IV. Case Study: Establishment of container feeder services in the Caspian Sea

4.1 Transportation in the Caspian Sea

Transportation of cargos between Caspian Sea ports is done by fleets from each of the five littoral states (Ziyadov, 2011). Several types of merchant's vessels can be found such as general cargo vessels, tankers and ferries and Ro-Ro, Ro-Pax vessels. However, no type of container vessel has been deployed in the Caspian Sea. On the other hand, Caspian ferries connect Kazakhstan and Turkmenistan, to Azerbaijan, for further transportation of freights by rail or road through Azerbaijan, Georgia, and Turkey to Europe, which overlaps with the proposed project.

Especially, the Azerbaijan Caspian Shipping CJS (ACSC) Company plays a connecting role in the TRACECA program by providing marine transportation of goods and passengers along the Caspian Sea. Particularly, the ACSC is one of the key role players in the TITR project where their ferries deployed on the route from Baku to Aktau and in an adverse way. The fleet of the company consists of 51 vessels: 20 tankers, 13 ferries, 15 universal dry-cargo, 2 Ro-Ro ships, while the Offshore fleet is made of 210 Vessels (ACSC website). Annual transportation capacity of Caspian ferries equals 95,000 railway wagons or 4,5 million tons of cargo (Tarimanashvili, 2017). Currently, seven out of those 13 ferries are dedicated for the TITR project as the voyage is based on the Baku (Alat) - Aktau - Baku (Alat) route.

The proposed case study is based on the Baku-Aktau-Baku (Azerbaijan, Kazakhstan) route which corresponds with the TRACECA and TITR project, where the countries' interest is to facilitate the trade by providing a shorter, reliable and economical logistics solution. It started in 2015 when the first containerised cargo was being sent by the railways which pass through central Asia and cross the Caspian Sea by ferries or feeder vessels to continue on their journey. The Head of Kazakhstan's national railway company stated during a ceremony welcoming the Nomad Express that “considering the expected commodity turnover between the countries in the region, the potential of container shipping of the Trans-Caspian route is estimated at 300,000 TEU by 2020” (Jakóbowski, 2018) The above mentioned information with regard to the containerization process, indicates favourable potential for deployment of the feeder container vessels between the mentioned ports in the near future, as it highlighted by TITR member companies.

4.1.1 Structure of proposed Voyage route

The proposed container services between the mentioned ports are based on two parts: loading containers in Baku Port for Aktau Port, which is the first, beginning stage. Once, the containers have been loaded onto the vessel; it will continue to the next phase of the voyage to call at Aktau Port, where the second stage of the voyage starts. The arrived ship should discharge cargo in Aktau Port and load new containers for Baku port. Finally, when the vessel discharges her cargo in the Baku Port, the voyage will be completed. Figures 15 and 16 illustrate one sample scenario for the voyage.

Proposed Voyage structure

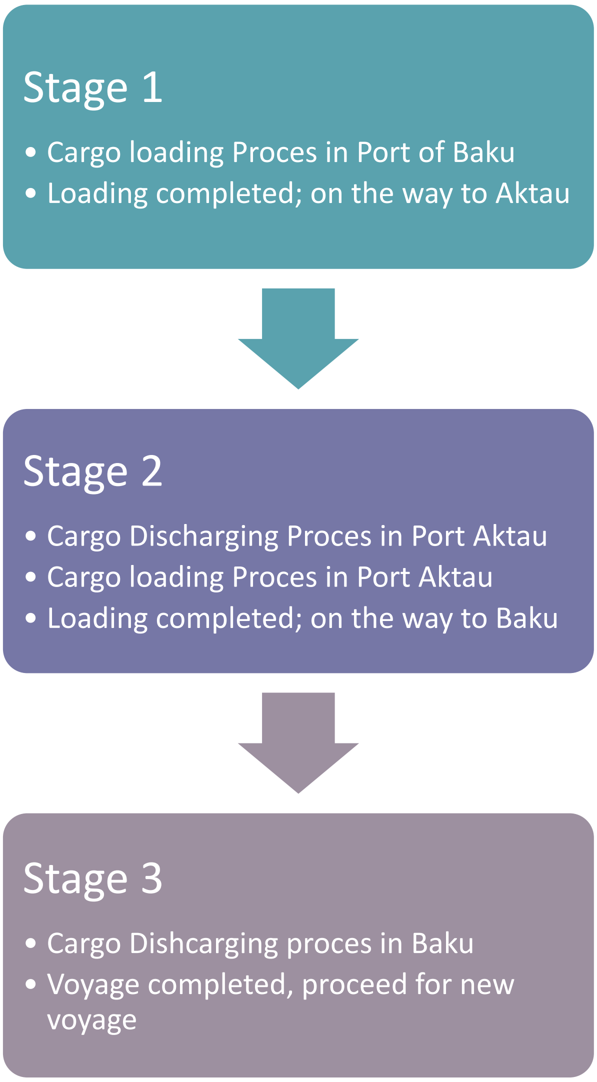


Figure 15

Outline of Voyage sample

Distance between ports: 260 miles; total of 520 miles

Speed of Vessel: 15 Knot

Total time spend on sea leg: 0,7 days on each route; total of 1,4 days

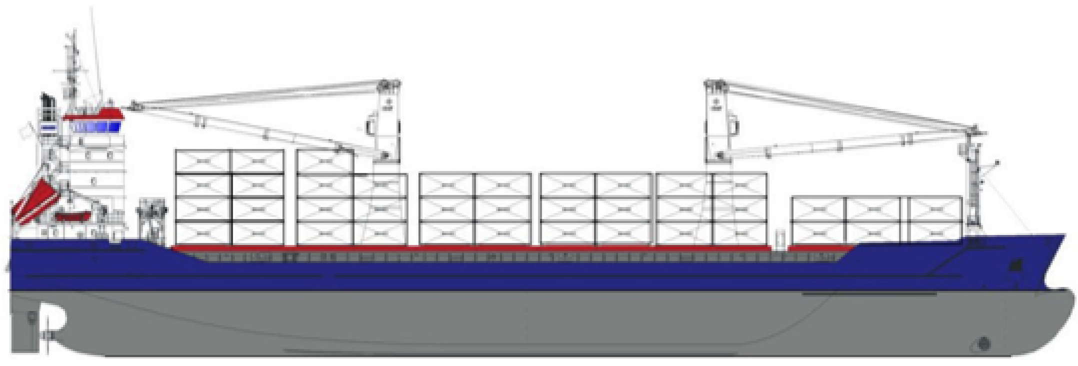
Total time spend on ports: 1,2 days in each loading/discharging process; **Total of 2,5 days in each ports**

Approximate total voyage duration: 6,4 days

Figure 16:

4.1.2 Vessels specification

It is a well known practice to employ small container vessels with its own gear in order to quicken or provide the loading and discharging process where the ports lack infrastructure. Any time loss in ports equals the loss of voyage and eventually loss of revenue. On the other hand, waste of time in ports is one of the main barriers which affects the whole supply chain process which based upon these trade corridors. Consequently, by considering draft restrictions and infrastructure capability, the proposed type of container vessel should be supplied with two cranes. Figure 17, illustrates the proposed type of container vessel.



Deadweight	GRT	NRT	Draft	Cargo Capacity
8600 MT	7350 GT	4000 MT	7.2 M	703 Nominal TEU
LoA	Beam	Speed	Consuption	14 tons/ 432 TEU
122 M	20 M	15 Knot	22 MT IFO 380	110 Reefer Plug

Figure 17, Proposed type of container vessel

4.2 Shipping cost assessment: Fixed and Variable costs

The cost of maritime transport can be classified as fixed costs and variable costs where some of them are the cost which appears from the natural necessity to employ the vessel such a seaworthy and cargo worthy. OPEX and CAPEX remain constant unless any changes appear in the specification of those fixed costs; i.e. due to inflation, policy changes and others. The voyage costs or variable costs are a function of the activity which only occurs when the vessel is in voyage service. Different from fixed costs, variable costs depend on every specific voyage and, especially, on the ports of call, distance and cargo handling operations. It should be mentioned that for the case study purposes some costs adjusted more than the usual value, in order to achieve more robust simulations outcomes.

Table 5: Shipping cost structure

Fixed Cost		Variable Cost	
Operating Cost (OPEX)	Capital Cost (CAPEX)	Port-Based Cost	Voyage based cost
Wages Insurance, Stores, Maintenance Administration	Capital Brokerage	Cargo Handling Port fees	Fuel Cost Canal Fees

4.2.1 Fixed Cost

Operating cost (OPEX)

As illustrated in the breakdown of the cost assessments (see Table, 6) operating cost is based on the cost which occurs due to the day-to-day running of the vessel excluding fuel, which is included in voyage costs. However, since the case study is based on regional waters, it requires regional information to calculate real operating expenses. Nevertheless, OPEX for the given case study will be taken as the average cost for similar vessels in the Caspian Sea, which was concluded as 4000$ per day.

Capital Cost (CAPEX)

Stopford (2009) maintains that “Once a ship is built, its capital costs are obligations which have no direct effect on its physical operation”. Capital Cost is based on the capital value of the vessels, the depreciation period (years) and Interest rate. As it has been analysed through Clarkson Intelligence, the assumed price of a 700 TEU containership would be 13 million USD. On the other hand, the expected loan amount would cover 54 % of the project with 8% Interest Margin 3% LIBOR rate. Calculating CAPEX involves initial purchase capital and the periodic cash payments to banks or equity investors who put up the capital to purchase the vessel. and thirdly, cash received from the sale of the vessel. Moreover, the depreciation deduction will be defined by a straight line approach for the 20 years. As a result of the calculation, the daily capital cost of a vessel is assumed to be 5000 USD per day.

Depreciation

Figure 18 illustrates the depreciation slope, which reflects the loss of performance due to age, higher maintenance expenses, a level of technical obsolescence and expectations about the economic life of the vessel. In general, as illustrated by Stopford (2009), instead of recording the cost of the ship in the balance sheet, it is possible to add a percentage of its value (e.g. 5%) as a cost in the profit and loss account to reflect the loss of value during the accounting period in each year. The so-called depreciation is not a cash charge. This is, therefore, the amount the vessel was paid in cash when the project started. It is just bookkeeping, so profit will be lower than cash flow by that amount.

Value depreciation of the vessels within 20 year

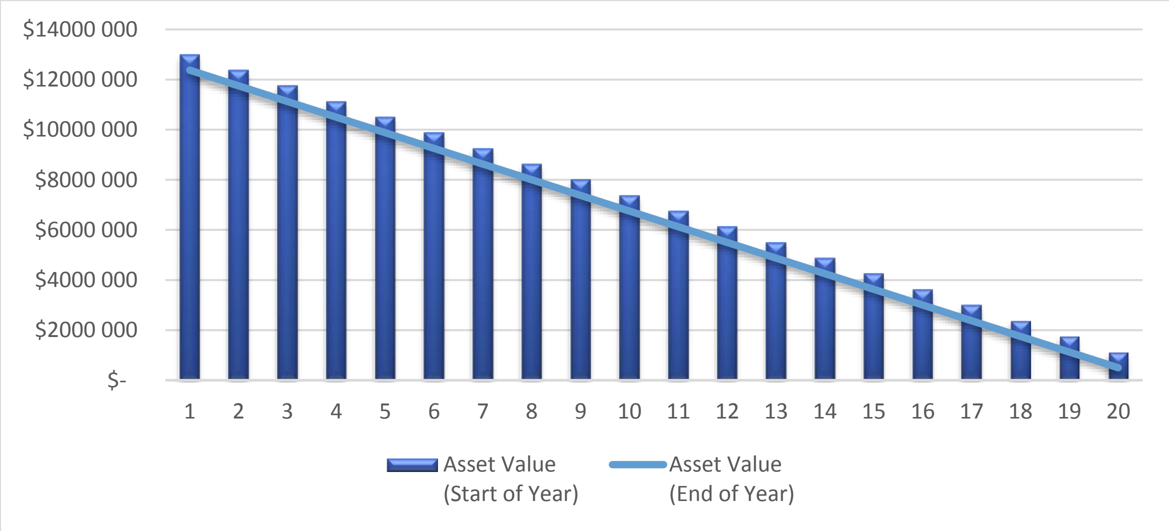


Figure 18

Cost of Debt

Financial management fundamentals suggest that to reduce riskiness in a project, it is advisable to uphold more debt than equity. This is due to the fact that reducing equity increases the leverage ratio. The value of a firm is defined to be the sum of the value of the firm's debt and the firm's equity. In the proposed case Debt is 54% and Equity is 46% with the Shipowner as the sole owner of title. The WACC of the project is 11%.

Principal Repayment Calculation:

$$PPMT = Rate \times Per \times Nper \times Pv \times Fv \times Type$$

Interest repayment calculation:

$$IMPT = Rate \times Per \times Nper \times Pv \times Fv \times Type$$

- Total capital = 13 000 000
- Total Debt = 7 000 000 = 54%
- Total Equity = 6 000 000 = 46%
- Leverage ratio = D/E = 1,16

Table 6 illustrates the financial structure of the project based on the above-given assumptions.

Table 6: Financing Structure

Project Cost	$13 000 000
Financing	54%
Loan	$7 000 000
Interest Margin	8%
LIBOR (annual)	3%
Period (years)	10
Period (quarters)	40
Annuity Payment	($1 162 882,40)
Total Principal Repayment	$ 7,000,000
Total Interest repayment	$ 4,628,824
Quarterly Rate	3%

4.2.2 Variable Cost

Fuel Consumption

The ship's fuel consumption is contingent with its hull design and the speed at which it is under operation. Consequently, the operation of the vessel at lower speeds results in fuel savings because of the reduced water resistance, which, according to the 'cube rule', will be approximately proportional to the cube of the proportional reduction in speed:

$$F = F * (\frac{S}{S'})^{a}$$

As Stopford claimed (2009), "Where F is the actual fuel consumption (tons/day), S the actual speed, F* the design fuel consumption and S* the design speed. The exponent a has a value of about 3 for diesel engines and about 2 for steam turbines". Moreover, since the distance between the port is not so long that gives another advantage to being able to operate the vessels under economic speed, which is changeable due design factors. Furthermore, due to the energy supply on board, it requires burning diesel oil as well. Hence, a similar type of vessels' daily fuel consumption was analysed, and for the assumption purposes, it has been concluded that at a speed of 15 knots, it consumes 25 tons of bunker oil and 1,5 tons of diesel oil in a day.

Table 7: Daily bunker Consumption

Daily Bunker Consumption			
At Sea		**In Port**	
FO	DO	Idle (DO)	Work (DO)
25 Ton	1,5 Ton	1,0 Ton	2,0 Ton
Speed	**15 Knot**	**Daily Miles**	**360 Miles**

Fuel Cost

The price of IFO and HFO are based on the up to date prices which were provided by one of the bunker supplying companies in the Caspian Sea. As a result, Fuel Oil at $350 per ton, Diesel Oil, $370 per ton have been noted for the case study (see Table 7 and 8). Bunker price is one the main costs which affect the profitability of the company; nevertheless, less fluctuating and lower bunker prices in the Caspian Region give the advantage to reduce the variable cost compared to the global average.

Table 8: Bunker Expenses breakdown

Voyage Leg (15 Knot)	Days	FO	DO
Port Baku - Port Aktau (250)	0,69	18,1	1,1
Port Aktau- Port Baku (250)	0,69	18,1	1,1
Port Time	Days	FO	DO
Baku Port	2,5		5
Port Aktau	2,5		5
Totals	Days	FO	DO
Baku-Aktau-Baku	6,4	36,1	12,2

Voyage Expenses			
Bunkers		Price	Expenses
FO	36,1	$ 350,00	$ 12 638,89
DO	12,2	$ 370,00	$ 4 501,67
Total Bunker Expenses		**Per Voyage:**	**$ 17 140,56**

Port Expenses

Since port charges are generally based on the ship's tonnage, this introduces an additional element of economies of scale, where costs per TEU might be reduced as the ship gets a bigger size. However, draft restriction limits benefit of bigger vessels. On the other hand, since the information is not available from Baku Port and Aktau Port, handling costs per TEU have been assumed as $40 per container (including all related costs) TEU based on the similar DWT vessels port expenses.

Table 9: Port expenses breakdown

Port Expenses	Loading Disbursement Baku (400 TEU)	$ 16 000,00
	Discharging Disbursement Aktau (400 TEU)	$ 16 000,00
	Loading Disbursement Aktau (400 TEU)	$ 16 000,00
	Discharging Disbursement Baku (400 TEU)	$ 16 000,00
	Total Port Expenses (1600 TEU)	**$ 64 000,00**

Table 10: Total cost breakdown sample

Fixed Cost Per Day		
OPEX	$	4 000,00
CAPEX	$	5 000,00
Total Fixed Cost Per/Day	$	9 000,00
Fixed Cost Annual	$	3 285 000
Variable Cost (400 TEU each port – loading/discharging)		
Port expences	$	64 000,00
Bunker cost Per Voyage	$	17 000,00
Variable cost Per Voyage	$	81 000,00
Bunker Cost Idle annual	$	15 000,00
Variable Cost Annual	$	4 833 600
Total Cost Annual (50 voyage annual)	$	7 187 700

Table 10, illustrates the type of cost breakdown sample which is based on the assumption that the vessel loaded 400 TEU in each port, (total 800 TEU for one voyage) and that the vessel had 50 round trips in the given year with same loading factor. Independent from the mentioned ones, there are costs of sales, which are usually proportional to the earnings or commissions on the sales, but these are often considered a reduction of revenue. Moreover, to achieve a more realistic outcome, the study included financial methods to analyse the viability of the given project by including tax reductions as well.

4.3 Revenue

The revenue for the container shipping company is able to be earned by conveying the container from one port to other ports either door to door services or port to port. However, the price to be charged to these services may vary depending on several factors. Especially, for the liner operator, it is tradition to include bunker the adjustment factor and port handling cost variance to the freight rates. However, for the case study purposes, fixed freight rate has been concluded by involving several scenarios. In each of these scenarios, each cost has been simulated between the given range to achieve an average range of unit cost and to define the final freight rate per TEU.

There are several methodologies to calculate the unit cost by involving various factors, e.g. the sum of operating costs, voyage costs, cargo-handling costs and capital costs incurred in a year divided by the deadweight of the ship (Stopford, 2009). However, to define the freight rate for the transportation of containers on the proposed route requires to involve numerous factors such as real market demand of the region, more precise cost calculations and others. Therefore, the main goal of the assumption for the freight rate was to achieve a price which will result in cutting cost as much as possible for the shippers and, on the other, hand making the satisfactory level of earning based on the projected study. The proposed freight rate per container for the assumption purposes was concluded as $300 per TEU container (See table 11)

Table 11: Revenue Sample for 800 TEU

Total TEU loaded	Rate	Gross Freight	Com. %	Total Cost
800	$ 300	$ 240 000	0,00	$ 126 140
Gross Surplus	**TCE**	**OP/Capex**	**Net Daily**	**NVE**
$ 158 859	$ 24 651	$ 9000	$ 15 651	$ 100 859

Taxation

For the case study purposes, it has been assumed that the corporate income tax rate will be 19 %, which will be deducted from net profit based on the regional average. Its amount is based on the net income companies obtain while exercising their business activity, normally during one business year. However, if there is negative cash flow in the first year, there will be a tax-free exclusion in that given year.

4.3 Project Viability Analyses

Net Present Value (NPV)

Decision making with regard to investment is usually made through the standard discounted cash flow techniques. The ordinary methods of the decision-making process involve Net Present Value (NPV), Simulation, or Decision Tree Analysis DTA (Farissia et al., 2008). The method of net present value is the sum of expected future cash flows minus the primary investments (Sahutb & Mondher Bellalahc, 2008). The calculation of NPV (net present value) contains three essential components such as time of the cash flow, discount rate and the net cash flow. The formula of calculation is shown as follows:

$$NPV = \sum_{T=1}^{T} \frac{C_t}{(1+r)^t} - I$$

- t = the time of the cash flow
- T = the total time of the project
- r = the discount rate
- C_t = the net cash flow at time t
- I = the (single initial) investment outlay

Key challenges for its reliability is first, how to forecast the future cash flows, the second issue is how to treat inflation and finally how to determine the discount rate.

Internal Return on Investment (IRR)

The IRR can be defined as the discount rate which, when applied to the cash flows of a project, produces a net present value (NPV) of 0. This discount rate can be assumed as the forecast return for the project. If the IRR is greater than a pre-set percentage target, the project is accepted. If the IRR is less than the target, the project is rejected. The main drivers of IRR are projected financial performance, purchase price, and financing structure, as well as exit multiple and year. Usually, private equity investors seek an IRR in excess of 20%, as this reflects the increased risk that they take on when compared to the public stock markets according to the CAPM model.

$$NPV = \sum_{T=1}^{T} \frac{C_t}{(1+IRR)^t} - CF_0 = 0$$

Table 12 shows how the investment period, IRR and cash multiple are interconnected.

Table 12: Multiple and the year of the investment derived IRR table sample

Multiple	1.25x	1.50x	1.75x	2.00x	2.50x	3.00x	3.50x	4.00x	5.00x	6.00x	8.00x	10.00x
Year 2	12%	22%	32%	41%	58%	73%	87%	100%	124%	145%	183%	216%
3	8%	14%	21%	26%	36%	44%	52%	59%	71%	82%	100%	115%
4	6%	11%	15%	19%	26%	32%	37%	41%	50%	57%	68%	78%
5	5%	8%	12%	15%	20%	25%	28%	32%	38%	43%	52%	58%
6	4%	7%	10%	12%	16%	20%	23%	26%	31%	35%	41%	47%
7	3%	6%	8%	10%	14%	17%	20%	22%	26%	29%	35%	39%
8	3%	5%	7%	9%	12%	15%	17%	19%	22%	25%	30%	33%
9	3%	5%	6%	8%	11%	13%	15%	17%	20%	22%	26%	29%
10	2%	4%	6%	7%	10%	12%	13%	15%	17%	20%	23%	26%

Source: Demaria, 2010, p.56

The modified internal rate of return MIRR

According to the IRR method, it is assumed that any previously received cash flows are reinvested at the same internal rate of return. However, in practice, this occurs quite rarely, and the internal reinvestment rates fluctuate. In such circumstances, the method of the modified internal rate of return (MIRR) is both more reliable and realistic. The MIRR method, interim cash flows which are generated by the project are reinvested at the capital cost rate. The modified internal rate of return is a discount rate which makes the future value of the cash flows generated by the project equal to the present value of investments, with the interim cash flows reinvested at the set limit rate.

$$MIRR = \sqrt[T]{\frac{FV^{+}}{FV^{-}}} - 1$$

MIRR is the modified internal rate of return, where FV+ is the future value of positive cash flows (in the last income earning period), FV– is the present value of negative cash flows (at start of project), and t is the period between the first investment and the last income earning period. MIRR is the profitability of investments when the cash flow reinvestment rate is clearly defined.

4.3.2 Scenarios

For the case study purposes, it has been assumed that there are container cargos to be transported in each port; Baku and Aktau Ports. However, the number of containers to be transported is defined by the market condition, which is unknown and difficult to measure. Therefore, the minimum and maximum range for the number of containers have been created to simulate the numbers and achieve an average outcome for the different scenarios. As a floor level, it has been assumed that 60% of the utilization level for the whole voyage is the utilization threshold. Less volume of cargo is of no value to proceed for the voyage. 60% of utilization level by numbers is equal to the total of 510 TEU to be loaded during the round voyage process. Consequently, three main scenarios have been created that are based on the assumptions in accordance to a possible number of containers to be transported, which also reflect utilization level:

- **The Best Case Scenario** reflects perfect market condition – Total TEU number for each voyage vary between 710- 830 TEU; **85-95% Utilization level**
- **The Base Case Scenario** reflects calm and promising market condition – Total TEU number for each voyage vary between 630 - 710 TEU; **75-85% Utilization level**
- **The Worst Case scenario** reflects bad market condition – Total TEU number for each voyage vary between 510 - 630 TEU; **60-75% Utilization level.**
- "**All Case" scenario** reflects the market condition where Total TEU number for each voyage vary between 510 - 830 TEU; **60-95% Utilization level.**

Table 13: Assumptions specifications

Variable assumptions	The Best Case	The Base Case	The Worst Case	All Case
TEU per trip – Range	710-830 TEU	630-710 TEU	510 - 630 TEU	510 - 830 TEU
Duration of the voyage	6-7 Days	7 days	8 days	7 days
Number of Voyage annual	55 round trip	48 round trip	44 round trip	50 round trip
Fixed assumptions				**Range**
Freight Rate per TEU				300 $ per TEU
Number of port Calls				2 port calls
OPEX per day				4000 $
CAPEX per day				5000 $
Taxation annual				19%
Port Cost: Vary accordingly with a number of TEU				
Voyage Cost: ± 1500 $ per voyage				

4.4 The results from Oracle, Crystal Ball (Monte Carlo Simulation)

Tables 13 and 14 illustrate the cash flow structure of the project, which corresponds to all developed simulation forecasts. To clarify, any change in the main assumptions, such as "TEU per voyage", unit price, or a number of annual voyages will result in a different cash flow structure. Port expenses correlated with the number of TEU, the fuel cost variation including voyage and idle position have been considered during the calculation. Moreover, the duration of the voyage varies between 6-8 days, which affects the possible number of voyages in the year, has been considered as well, in order to achieve more realistic results.

Table 13: Assumption table for cash flow structure

Teu per voyage		800,00
$ per TEU	$	300
Duration of the voyage (days)		7
Number of Voyages (Annual)		48
Utilization percent		94%
Revenue Per Voyage	$	240 000
Total Voyage Cost	$	144 000
Net Voyage Earning	$	96 000
Daily net earning P/V	$	13 714
Ship value		$ 13 000 000
First-year expense		$ 6 500 000
WACC		11%

Table 14: Cash Flow structure for 10 years (Sample)

Year	0	1	2	3	4	5	6	7	8	9	10
			3%	3%	3%	3%	2%	2%	2%	2%	2%
Revenue Annual	$ 11 520 000	$11 520 000	$ 11 865 600	$12 221 568	$12 588 215	$12 965 861	$13 225 179	$13 489 682	$13 759 476	$14 034 665	$14 315 359
OPEX	$ 4 000,00										
CAPEX	$ 5 000,00										
Total Fixed Cost P/D	$ 9 000,00		2%	2%	2%	2%	2%	2%	2%	2%	2%
FC Annual	$ 3 285 000	$ -3 285 000	$ -3 350 700	$ -3 417 714	$ -3 486 068	$ -3 555 790	$ -3 626 905	$ -3 699 444	$ -3 773 432	$ -3 848 901	$ -3 925 879
Variable Cost											
Port expences	$ 64 000,00										
Bunker cost Per Voyage	$ 17 000,00										
Bunker Cost Idle annual	$ 14 700,00										
Variable cost P/V	$ 81 000,00		2%	2%	2%	2%	2%	2%	2%	2%	2%
VC Annual	$ 3 902 700	$ -3 902 700	$ -3 980 754	$ -4 060 369	$ -4 141 576	$ -4 224 408	$ -4 308 896	$ -4 395 074	$ -4 482 976	$ -4 572 635	$ -4 664 088
Total Cost Annual	$ 7 187 700	$ 7 187 700	$ 7 331 454	$ 7 478 083	$ 7 627 645	$ 7 780 198	$ 7 935 802	$ 8 094 518	$ 8 256 408	$ 8 421 536	$ 8 589 967
Annual net profit		$ 4 332 300	$ 4 534 146	$ 4 743 485	$ 4 960 570	$ 5 185 664	$ 5 289 377	$ 5 395 165	$ 5 503 068	$ 5 613 129	$ 5 725 392
Tax Payable	19%		$ 861 488	$ 901 262	$ 942 508	$ 985 276	$ 1 004 982	$ 1 025 081	$ 1 045 583	$ 1 066 495	$ 1 087 824
Profit after tax	$ -6 000 000	$ 4 332 300	$ 3 672 658	$ 3 842 223	$ 4 018 062	$ 4 200 388	$ 4 284 395	$ 4 370 083	$ 4 457 485	$ 4 546 635	$ 4 637 567
Cumillative Cash flow	$ -13 600 000	$ -1 667 700	$ 2 004 958	$ 5 847 181	$ 9 865 243	$14 065 631	$18 350 026	$22 720 110	$27 177 595	$31 724 229	$36 361 797
NPV	$ 19 448 574	$ -1 854 047	$ 1 001 523	$ 3 748 566	$ 6 390 186	$ 8 929 484	$11 311 171	$13 545 029	$15 640 234	$17 605 392	$19 448 574
IRR	67%	-27,80%	22,27%	44,93%	55,69%	61,19%	64,10%	65,70%	66,62%	67,15%	67,46%
MIRR	26,47%	-27,80%	18,21%	29,27%	31,81%	31,84%	30,96%	29,82%	28,65%	27,52%	26,47%

The results are automatically displayed as in the frequency chart that includes the vertical probability statistics. Values that are separated in bins are displayed on the horizontal axis (see Figure 19). The values displayed in the chart in different colours reflect case scenarios and their possible outcomes from the simulations. One of the main question to be asked is what the likelihood of getting a negative return from the investment is by analyzing key financial factors which are answered in Tables 15 - 18 and Figures 19 - 22.

Annual Net Profit

Estimated forecasts for annual net profit

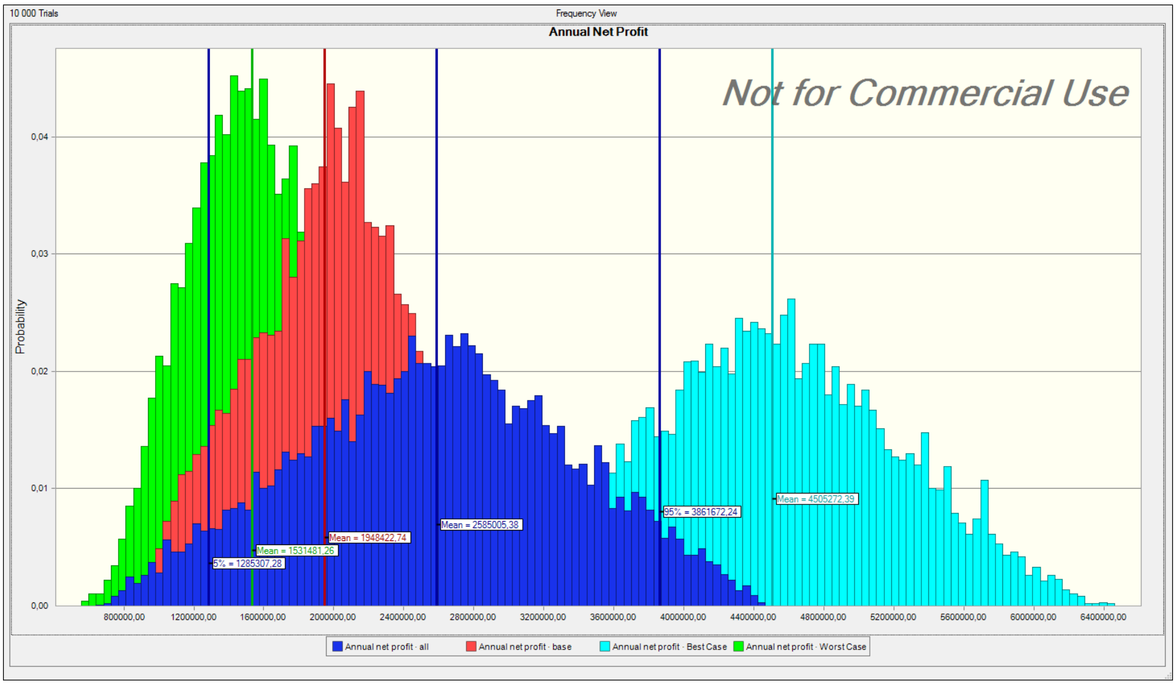


Figure 19

Table 15: Annual net profit simulation breakdown

Percentile	All		Base Case		Best Case		Worst Case	
0%	$	741 997	$	796 045	$	2 676 018	$	567 139
10%	$	1 624 226	$	1 354 442	$	3 581 531	$	1 061 987
20%	$	1 999 125	$	1 573 268	$	3 866 875	$	1 212 262
30%	$	2 266 714	$	1 735 223	$	4 104 553	$	1 324 528
40%	$	2 492 448	$	1 866 388	$	4 295 562	$	1 420 095
50%	$	2 711 783	$	1 979 696	$	4 479 750	$	1 513 391
60%	$	2 909 970	$	2 080 552	$	4 663 805	$	1 614 953
70%	$	3 131 582	$	2 186 071	$	4 876 578	$	1 730 245
80%	$	3 391 292	$	2 315 834	$	5 119 925	$	1 864 271
90%	$	3 737 813	$	2 490 282	$	5 465 764	$	2 039 927
100%	$	4 592 419	$	2 932 397	$	6 576 152	$	2 549 751

Net Present Value

Estimated forecasts for NPV

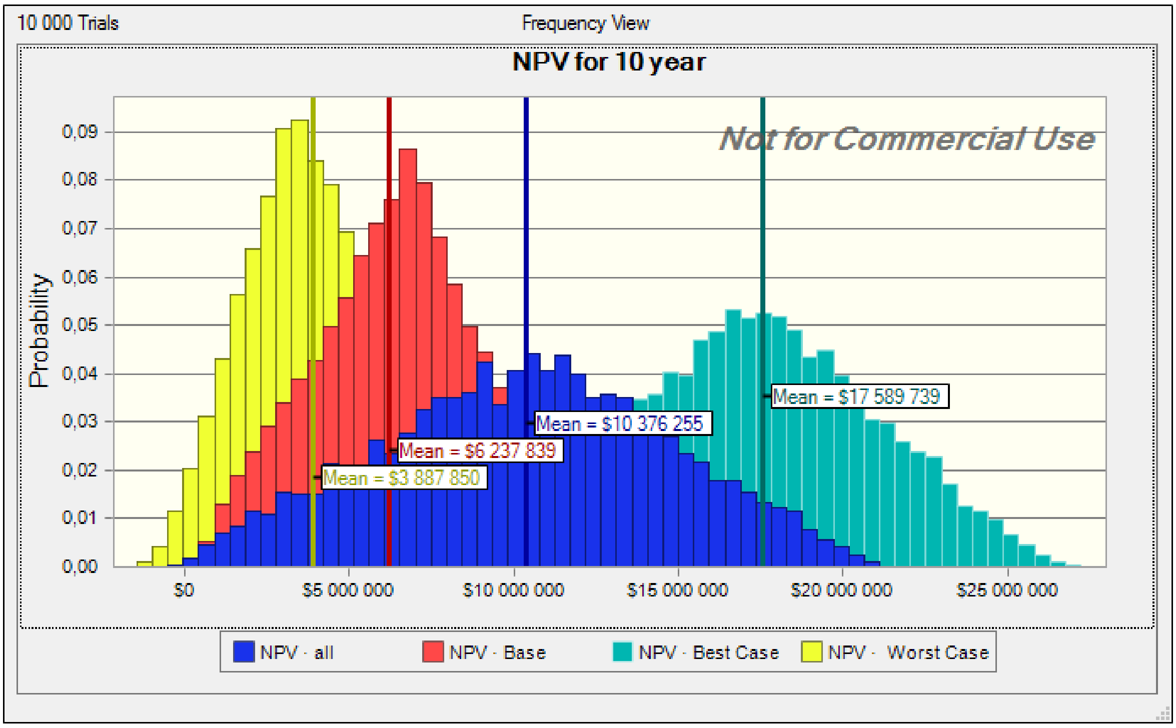


Figure 20

Table 16: NPV simulation breakdown

Percentile	NPV · all	NPV · Base	NPV · Best	NPV · Worst
0%	'-$465 417	'-$168 025	$8 685 940	'-$1 427 673
10%	$4 427 214	$2 923 174	$13 095 398	$1 281 075
20%	$6 508 381	$4 151 181	$14 497 535	$2 110 196
30%	$7 992 815	$5 053 130	$15 656 817	$2 728 999
40%	$9 249 645	$5 785 685	$16 594 200	$3 257 296
50%	$10 473 442	$6 413 672	$17 496 653	$3 771 876
60%	$11 568 441	$6 976 097	$18 392 778	$4 331 341
70%	$12 802 088	$7 566 639	$19 438 945	$4 964 712
80%	$14 237 880	$8 285 522	$20 625 531	$5 707 039
90%	$16 166 411	$9 268 527	$22 327 638	$6 676 859
100%	$20 894 638	$11 698 639	$27 717 274	$9 473 666

Internal Return on Investment (IRR)

Estimated forecasts for IRR

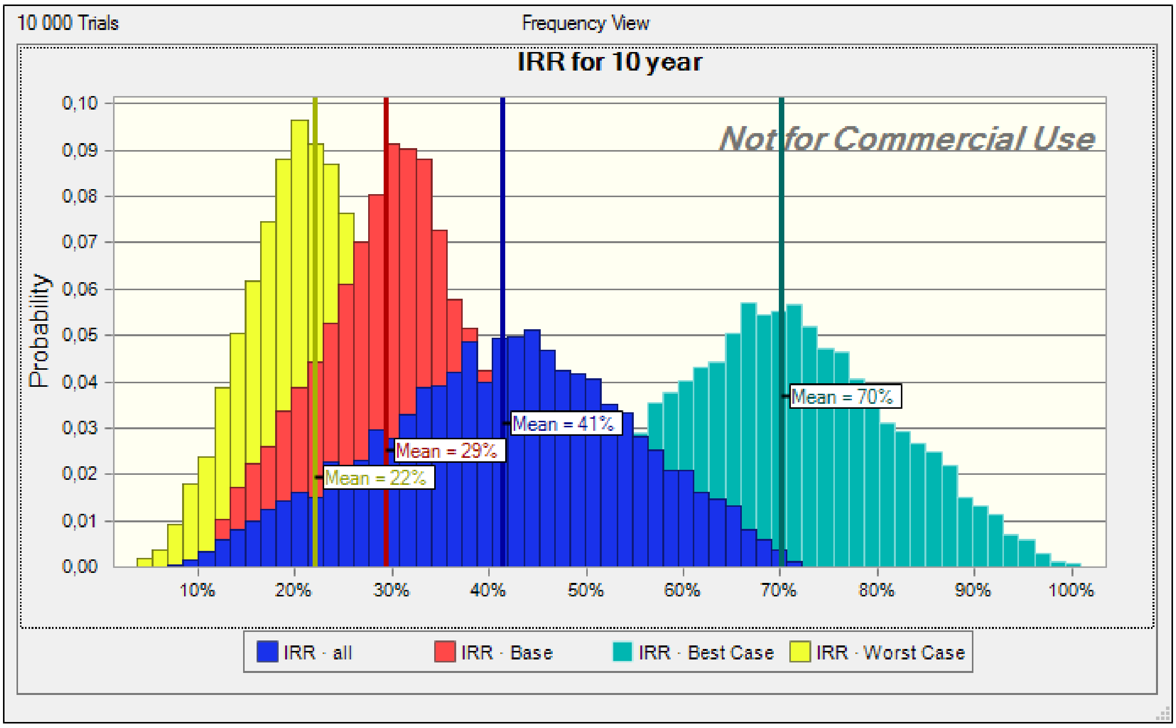


Figure 21

Table 17: IRR simulation breakdown

Percentile	IRR · all	IRR · Base	IRR · Best	IRR · Worst
0%	7%	8%	42%	3%
10%	24%	19%	56%	13%
20%	30%	23%	60%	16%
30%	35%	26%	64%	18%
40%	38%	28%	67%	20%
50%	42%	30%	70%	22%
60%	45%	32%	73%	24%
70%	49%	33%	76%	26%
80%	53%	36%	80%	28%
90%	58%	38%	85%	31%
100%	72%	45%	103%	39%

Modified internal rate of return

Estimated forecasts for MIRR

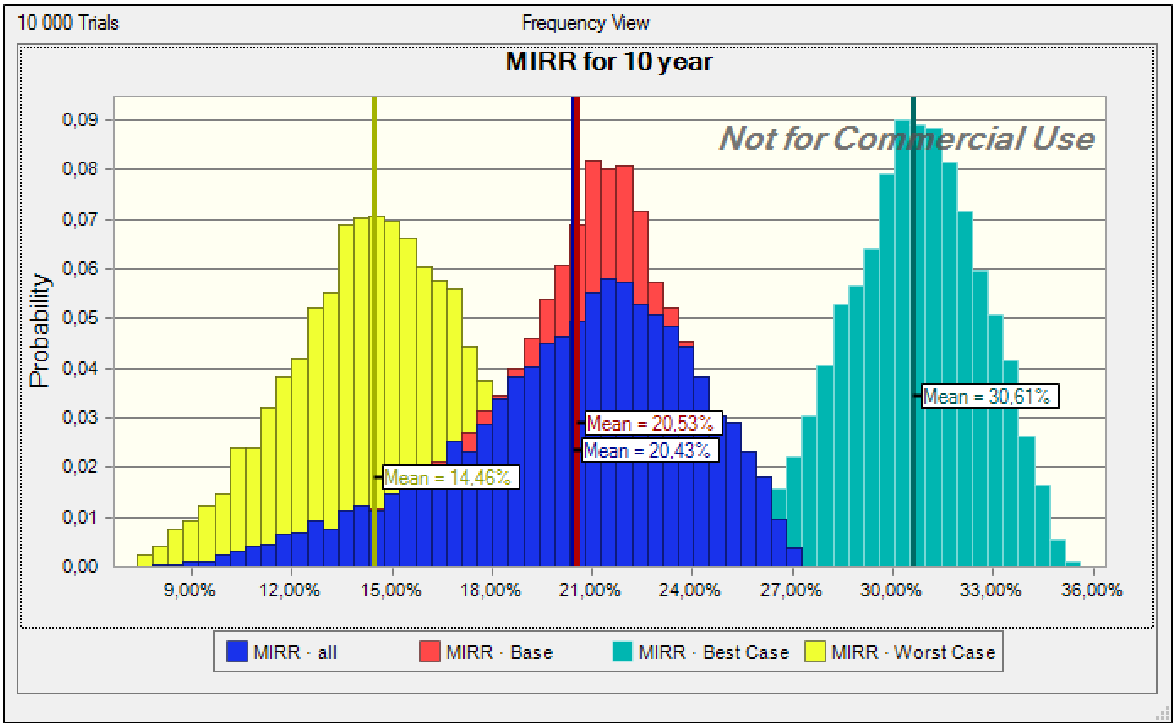


Figure 22

Table 18: MIRR simulation breakdown

Percentile	MIRR · all	MIRR · Base	MIRR · Best Case	MIRR · Worst Case
0%	8%	12%	24%	6%
10%	15%	17%	28%	11%
20%	18%	18%	29%	12%
30%	19%	19%	30%	13%
40%	20%	20%	30%	14%
50%	21%	21%	31%	15%
60%	22%	22%	31%	15%
70%	23%	22%	32%	16%
80%	24%	23%	32%	17%
90%	25%	24%	33%	18%
100%	27%	25%	36%	20%

4.5 Finding from the case study

As the main outcome of this case study, it has been acknowledged that only 30.000 TEU container transportation in one year is enough volume to make a profit, which can make the project viable for the investor within this assumption border. The numbers which stand for the “Annual TEU” label, illustrates averagely weighted (14 Ton) TEU containers that are loaded during the year for round voyages and its possible financial outcomes. These numbers do not include empty container transportation which is most likely to occur in Baku Port due to unbalanced trade conditions between Asia and the EU. However, results demonstrate that if one feeder vessel with 700 TEU capacity (430 TEU, at 14 Ton homogenously) carries around 30 000 TEU in the year on the round trip of Baku-Aktau-Baku, the owner of the vessel may end up with a 2 million USD net profit yearly. Table 18, illustrates different financial outcomes, which correspond to fluctuating cargo volume during the year. (TCE- stands for time charter equivalent which calculated by including the variance of voyage duration)

Table 18: Summary of all case scenario simulation

Mean of	Annual TEU	Net Profit $	TCE	IRR	MIRR	NPV
Base Case	**29 583**	$ 1 946 518	$15 634	0,29	0,2052	$6 230 577
Best Case	**39 946**	$ 4 508 434	$20 271	0,70	0,3064	$17 633 398
Worst Case	**26 638**	$ 1 532 814	$14 671	0,22	0,1445	$3 877 648
All Case	**32 338**	$ 2 722 614	$17 866	0,42	0,2056	$10 527 783

However, having negative results is a matter of low cargo volume; therefore, to avoid this issue a minimum threshold of cargo volume has been highlighted, which is worth proceeding for a voyage. As previously stated, since the assumption only includes 60% and 95% utilization interval, the mean of all case scenarios resulted in having some positive percentage. However, as separately shown in Tables which shown in under result chapter each variable has its minimum and maximum threshold, which includes negative results as well (See example, Figure 20).

The sensitivity analyzes acknowledged that the number of containers to be transported and the port costs along with bunker costs affect the whole acceptability of the project. As regards the revenue generator, it is understandable that in the case of a low volume of the cargo will result in negative cash flow and loss of money eventually. Besides, the port costs correlated with the amount of TEU handled will lead to higher voyage costs in case of a higher utilization level. Consequently, port handling cost has been highlighted as the main barrier to the profitability of the project. On the other hand, the lower bunker cost in the Caspian region compared to Europe and the short distance between the ports decrease the vulnerability to the higher bunker costs.

To finalize, it is known that shipping is a derived demand and its profitability is directly linked to trade condition and economic factors. Increasing development in the region shows that feeder vessels will soon be deployed on the Caspian Sea and the possible scenarios for the market conditions in the region illustrate promising future for investors. From a commercial perspective, it is rational to work on the development of the containerization process in the region, which might eventually lead to having profitable investments by deploying feeder container vessels on the proposed route.

Therefore, the main objective of the case study was to analyze possible scenarios which might happen due to the changing number of containers in both ports. As previously illustrated, the container cargo which is passing through the Caspian Sea to continue their journey started from China to the EU is just a new development in the region. The government's initiatives have increased, especially increased in past years, to upsurge transportation of containerized freight via the proposed trade corridor. Current freight volume is not satisfactory to deploy even one feeder vessel on the proposed route; however, promising potential and past activities have illustrated that soon the demand for container vessels will increase and will be one of the key trade facilitators for the Caspian Sea.

V. Conclusion, Discussion

The literature review illustrated that global container shipping is the backbone of modern trade among the continents. Since its introduction, the containerization process has fundamentally changed several factors within the shipping industry. Especially, solving break bulk cargo related issues and the establishment of standardization resulting in significant improvement at global levels. Today almost all proportions of trade between the EU and China are happening via ocean carriage, which is mostly containerized cargo. Moreover, in addition to it is carriage in the world ocean, container transportation also occurs within the limit of short sea shipping. The second part of the literature review illustrated that the concept of the Short Sea Shipping is not static but changes by adapting to the regional factors. Consequently, each region may develop its own respective concepts which will tackle their existing issues and harmonize the trade. Thus, there are several short sea concepts, which involve container carriage within the range of short distances as well.

The third chapter of the research illustrated possible transport corridors within the Eurasian mass, which are available for cargo transportation from China to the EU. This research has demonstrated that the Caspian Sea region will soon be part of the global container transportation chain as increased trade between China and the EU, conveyed through the Eurasian continent. The advantage of these transport corridors demonstrates that in case of more development, it will attract further interest as it has been never being done before. Especially, China, the EU, and regional countries own investments illustrate that all the countries involved see significant opportunities in the future based on these transport corridors. Especially, in the case of the Trans Caspian International Transportation Route, the findings from qualitative analyses show that there is a high level of containerization perspectives in the Trans-Caspian route. Specifically, within 3-5-year container transportation volume on the TITR is very likely to achieve 50 000 – 100 000 TEU annually.

The findings from the research by the support of the statistical tools applied have clarified that deployment of feeder vessels on the given route can be feasible if the annual volume is more than 30 000 TEU annually. However, naturally, the feasibility of the project is mainly relying on the demand side of the market. Rationally, if there is enough volume of cargo, it can be viable to deploy the vessel on the given route. However, the parties involved started to carry the containers by general cargo vessels because the capacity limit and factors related to the condition of the vessels create more cost for a shipping company, which increases transportation cost for shippers as well. Consequently, the issue creates a both sided dilemma, where the shipping company is exposed to low cargo volume but at the same time higher freights. Furthermore, expensive transportation in its turn decreases the number of shippers who would like to choose that transportation route. Therefore, the decrease in shipping freight within the Caspian Sea may significantly increase transhipment together with Trans Caspian Routes.

However, today transport cost in the Caspian Sea is high due to the mentioned factors; on the other hand, if the containerization process speeds up and reaches a satisfactory level in the region, it can lead to significant reductions in the transportation cost within the shipping leg of the logistic chain. In the given case study, identified freight rate for TEU container was chosen as 300 USD per TEU which is 40 % less than current transportation cost per TEU between Aktau Port and Baku Port. Today, it costs $500 to transport containers by general cargo vessels that can only carry 70/100 TEU.

On the other hand, the case study demonstrated that if the vessel capacity reaches up to 300/400 TEU per trip, it may result in 40 % fewer freight rates with new feeder container vessels. That decrease in the shipping leg of the transport chain might result in up to 10-15 % less transportation cost from China to the EU, which can result in a significant increase on the route. All in all, the next decade might witness noteworthy changes on the region by achieving more cargo transhipment through the Trans Caspian corridors which will result in a significant advantage for the shippers and specifically, noteworthy benefits for the landlocked countries involved.

5.1 Recommendations

As an outcome of presented research the following recommendations identified as possible actions which might increase the competitive advantage of Trans Caspian route (TITR) and result in considerable growth on the economy of the involving countries. Since the corridor is involving different transport modes alongside in different countries boundaries, consequently, enhancement of logistics corridor relies on both governments and other involving parties' collaborative actions.

1. In the first place, to achieve harmonized logistic corridors require harmonized custom and border controls. Although, there are existing policies towards this matter, however, the level of implementation of those policies is not satisfactory to increase the competitiveness of the transport corridor among the others. Consequently, simplified border processes, such as digitalization, "single window" system and etc. can help to increase the advantage of the proposed route. Such example can be shown in light of establishment Eurasian Economic Union (EAEU) customs union together with investments in physical infrastructural resulted in a reduction of transportation period from 18 days in 2014 to 11-12 days in 2017 alongside with significant cost reductions (See example, Inan & Yayloyan, 2018).

2. Although different gauge issue is challenging to tackle, on the other hand, enhancement of existing infrastructure can be a crucial step toward development. Specifically, the increase in average speed of railway systems alongside the corridor may sharply decrease whole transportation duration. Moreover, time in ports is another fundamental matter which plays crucial roles for shipper's choices. Consequently, effective port handling capability is a crucial factor which can increase the competitiveness of the corridor.

3. Integration level between different actors along the transport chain needs to be improved in order to achieve synchronized transportation of freights. These require optimization of collective performance in the transportation, distribution, and support with any related services alongside the transport corridor, including sea and land-based transport leg of the chain.

4. Lastly, a decrease of the tariffs on the route may considerably generate higher trade activity that passes through this corridor. Particularly, the reduction in the freight rates for transportation of cargos on proposed corridors can result in specific advantages.

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