



**Universidad
Zaragoza**

Trabajo de Fin de Grado

Puertos secos. Análisis comparativo entre la TMZ y Duisport

*(Dry ports. Benchmarking analysis between TMZ and
Duisport)*

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RESUMEN

El creciente aumento del comercio global y, por consiguiente, marítimo en las últimas décadas ha generado un incremento de necesidades de recogida, almacenamiento y distribución de mercancías que ha desbordado a los puertos marítimos. Ante esta nueva situación, en este Trabajo de Fin de Grado se presenta cómo solucionar la congestión e ineficiencia en los mismos. El objetivo de este trabajo es presentar a los puertos secos como la opción más viable para solucionar de forma eficiente dicho problema y si la Terminal Marítima de Zaragoza tiene las características necesarias para ser y operar como un puerto seco competitivo a nivel europeo. Para lograrlo, se ha realizado un estudio comparativo entre la TMZ (Terminal Marítima de Zaragoza) y el puerto seco de Duisport, considerado actualmente el más importante y eficiente de Europa. Los datos obtenidos parecen indicar que, a pesar de los buenos resultados de la TMZ, la plataforma logística de Duisport es muy superior en cuanto a infraestructura y localización estratégica.

ABSTRACT

Recent growth in global trade and therefore maritime trade in the last decades has generated an increase regarding the needs of collection, storage and distribution of goods which has overwhelmed maritime ports. Facing this new situation, this Final Degree Project presents how to solve the congestion and inefficiencies of maritime ports. The aim of this project is to introduce dry ports as the most viable option for efficiently solving the aforementioned problem and whether or not *la Terminal Marítima de Zaragoza* has the required competencies to operate as a competitive European dry port. In order to attain this, it has been made a benchmarking analysis between the TMZ (Terminal Marítima de Zaragoza) and the dry port of Duisport, which is currently considered the most efficient and important in Europe. The data gathered seems to show that even though the results of the TMZ are quite good, the logistics platform of Duisport is much more superior when it comes to infrastructure and strategic location.

Key words: Dry ports, maritime ports, TMZ, Duisport, global trade, freight transport.

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1. Introduction

The massification of port facilities dedicated to the transport of imported and exported goods is coming to an end after several decades. Such exploitation has derived into great differences between the hinterland and the coast in addition to some inefficiencies due to the lack of capacity to respond to such a high demand.

Thus, the objective of this paper is to present the dry ports, which are one type of inland facilities, as a solution to solve the long dwell times, congestion and inefficiencies that take place in the maritime ports at the same time that they foster trade and the economy of inland regions. Moreover, as these inland facilities are becoming more popular, the other goal of the paper is to determine which features make dry ports more sustainable and competitive in the long-term. And once those factors or features are known, the study will conduct a benchmarking analysis between two dry ports in order to extract conclusions on what should be improved.

Therefore, the first part of the report will deal with the implementation of dry ports and its advantages that appear as both as substitute and as complement to maritime ports due to efficiency and productivity differences, intermodal freight transport availability, environmental reductions, lead times and bottlenecks and the opportunity to satisfy inland demand. Modern trends of distribution require from port operators the quickest and highest-quality transport service and high standard operations, all in compliance with rigorous environmental requirements.

To do so the study is going to focus and highlight the functioning, services and characteristics of the dry ports while the aim in the second part of the paper is to make a benchmarking analysis or compare two different dry ports, TMZ located in Zaragoza, Spain and Duisport located in Duisburg, Germany.

TMZ is particularly interesting dry port for the researchers of this paper due to the closeness to Zaragoza and how it could shape the future in the region. Since the idea is to increase TMZ's relevance, it has been chosen the most important and competitive dry port in Europe as the other facility to be benchmarked against.

In this scenario the chosen target is Duisport, a leader organization in the areas that this paper wants to study. Firstly, the standards which are going to be the measure of performance shall be selected, to do so several case studies from all over the world are going to be the base for

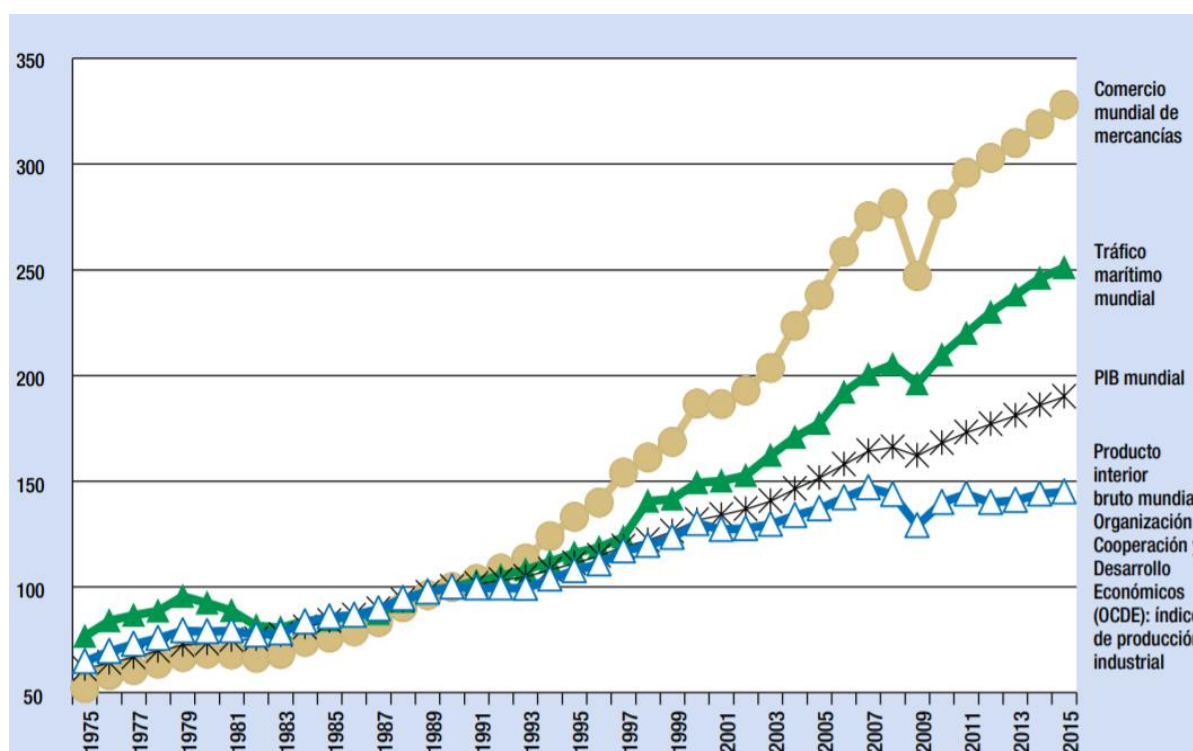
this report. Once the standards are selected it is convenient to measure and analyse them in each port separately and afterwards make a peer to peer comparison between the two terminals.

Finally, the case study will end with the conclusions to analyse the strengths, weaknesses and opportunities that TMZ should take into account to improve its efficiency and to stay as a relevant location regarding the trade of the Eurozone in the near future. The actions that aim to strengthen TMZ's position should be supported by the state and public institutions when required as certain factors can only be modified when both private and public institutions cooperate.

2. Introduction to dry ports

From the last two decades to nowadays global trade has experienced a huge increase; however, this paper is going to focus in maritime trade which represents 77% of world trade (UNCTAD and World Trade Organization, 2014-2016). The global trade as well as the maritime trade rise accounted from 1995 to 2015 has more than doubled (235 %), see *1.1*.

Figure 2.1: Indexes of world trade, maritime trade, global GDP and industrial production of the Organization of Cooperation and Economic Development, 1975-2015; in Spain.



Source: Cálculos de la secretaría de la UNCTAD, basados en Organización de Cooperación y Desarrollo Económicos, 2016; UNCTAD, Informe sobre el transporte marítimo, varios números; UNCTAD, 2016a; Organización Mundial del Comercio, 2014; y Organización Mundial del Comercio, 2016.

Since the trend of the growing containerised transport of maritime trade is so sharp, the facilities, installations and organizations of maritime ports that receive and send these goods are being overwhelmed by the number of orders affecting directly to their efficiency and reputation. The measures adopted by the corresponding authorities have not been proportional to the market demand resulting in the lack of capacity, loss of services quality, delay times and scarcity of operators as well as containers (Jeevan et., 2017).

Furthermore, the inability to remain competitive and perform well is added to spatial, operational and institutional issues regarding scarce capacity and no ability to manoeuvre with flexibility. These ports can no longer be able to maintain competitiveness as they can't keep the pace of demand growth, where diseconomies of scale begin to appear along with an increase in activity times leading to bottleneck problems and growing congestion on the access routes serving their terminals.

After a phase which focused on maritime shipping and ports terminals networks, inland distribution has become a very important part of globalization and a cornerstone in port competitiveness driven by transport development and the gradual shifting towards inland (Notteboom, 2010). In many places around the world with more intensity in Europe and EEU bimodal and trimodal facilities in the hinterland are essential in the supply chain, transport system and freight distribution. According to European Union Road Federation (2008), in the period of 1996–2006 European hinterland transport market share for road increased by about 5%; while for rail it decreased by 4%. Furthermore, road transport has the biggest market share of 76% (European Union Road Federation, 2008)

The transport distribution of freight along the supply chain is solved by the intermodal transport concept, which combines at least two transport modes to move a person or a load from its origin to its destination (Cardebring, 1985). The transfer initially begins in the intermodal terminal of the maritime port, which is afterwards transported by a combination of rail, truck, barge and ocean shipping. Hence, after covering a long distance by a chain of transport modes, the cargo reaches its consignee in the destination.

The transfer takes place in an intermodal terminal, usually being the maritime port, the origin of the containerized cargo transported by a combination of rail, truck, barge and ocean shipping dedicated to the international movement of goods. While the destination is the consignee of the container, the container is linked by this chain of transport modes and takes over long distances.

The change of the transport mode is done in these inland nodes or hubs that provide other services as well.

These inland facilities present some differences among themselves, but the common denominator is the relationship that most of them have with the seaports. As already stated, they have a close and tight dependence where the hubs located in the hinterland work as an extension of the port itself, being called extended gates. The freight distribution is then split so that the seaport orders and delivery times are eased, thus accomplishing the deadlines and orders expected.

2.1. Inland facilities

These relatively new facilities are not expected to be the same at all, we can classify them depending on several variables such as which activities they can carry out and to which legal bodies or authorities they are related to (Vasiliauskas & Jaržemskis, 2007), being the most relevant ones:

- *Inland Container Depot*: inland facility with public authority status, they are equipped with fixed installations and work as temporary deposits that handles and stores import/export goods and empty containers for a certain period.
- *Inland Clearance Depot*: inland facility, with public authority status, equipped with fixed installation, and offering services for handling and temporary storage of any kind of goods (including container) carried under customs transit by any applicable mode of inland surface transport, placed under customs control to clear goods for home use, warehousing, temporary admission, re-export, temporary storage for onward transit, and outright export.
- *Intermodal Freight Centre*: it is a concentration of independent companies working on freight transport which can be private or state-owned, these companies work in freight transport and have supplementary services. They work as a designed area where a change of transport units between transportation modes can take place.
- *Inland Freight terminal*: it is any facility other than seaport or an airport at which at which cargo in international trend is collected or dispatched. They work as nodes between bigger intermodal centres or even dry ports.
- *Dry Port*: According to Roso et al. (2009, 27(5), 338-345) a dry port: “*is an intermodal inland terminal directly connected to seaport(s) with high capacity transport means, where customers can leave or pick up their standardized as if directly to a seaport*”.

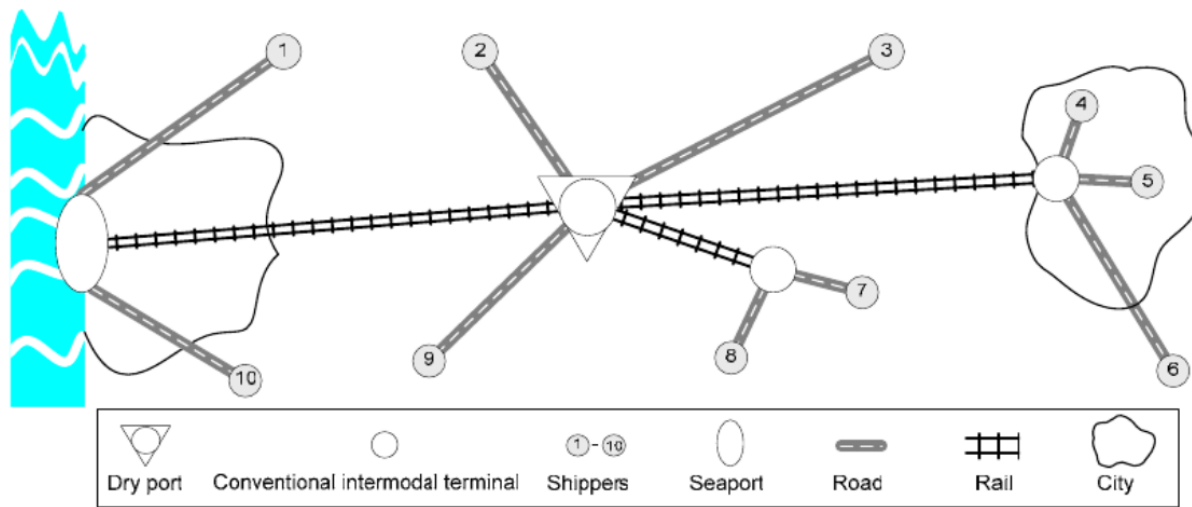
2.2. Dry ports in depth

Although the most used and acknowledged definition is the one provided by Roso et al. and like him, multiple authors consider the links and bonds between the maritime port and the dry port as an intrinsic part in the definition of the last one. Other authors such as Notteboom and Nguyen think that: *“in contrast to more advanced systems, where dry port development is often driven by seaport interests, inland terminal planning in developing countries seems to be triggered by land parties”*. Which means that the concept of dry port does not necessarily have to be fully dependent on a sea port, thus having its own governing bodies and initiatives (Notteboom and Nguyen, 2016). Despite the disagreements in certain topics, there are some common characteristics and attributes which always appear in the definitions of dry ports, such as intermodal transport terminals and customs services.

Even though the facilities described above have different governing bodies and provide different services, they are interconnected between themselves and work as complementary facilities. Each of them operates as a node and has a purpose in the supply chain where the dry port plays a central and major role.

In figure 2 we could see how the dry port is represented as a circle within a triangle, being the direct nexus between the seaport and any other facilities. While the intermodal freight terminals are connected to the dry port represented as a circle, they operate as stations where freight changes the mean of transport. Finally, the shippers could be any of the other three types of installations classified above, depending on the authority that governs them, and the type of cargo which they are allowed to process. The last ones are represented as smaller grey circles and are not differentiated among themselves.

Figure 2.2: Maritime port and dry port with their relative transport connections.



Source: The Dry Port Concept – Connecting Seaports with their Hinterland by Rail

JohanWoxenius*, Violeta Roso, Kenth Lumsden.

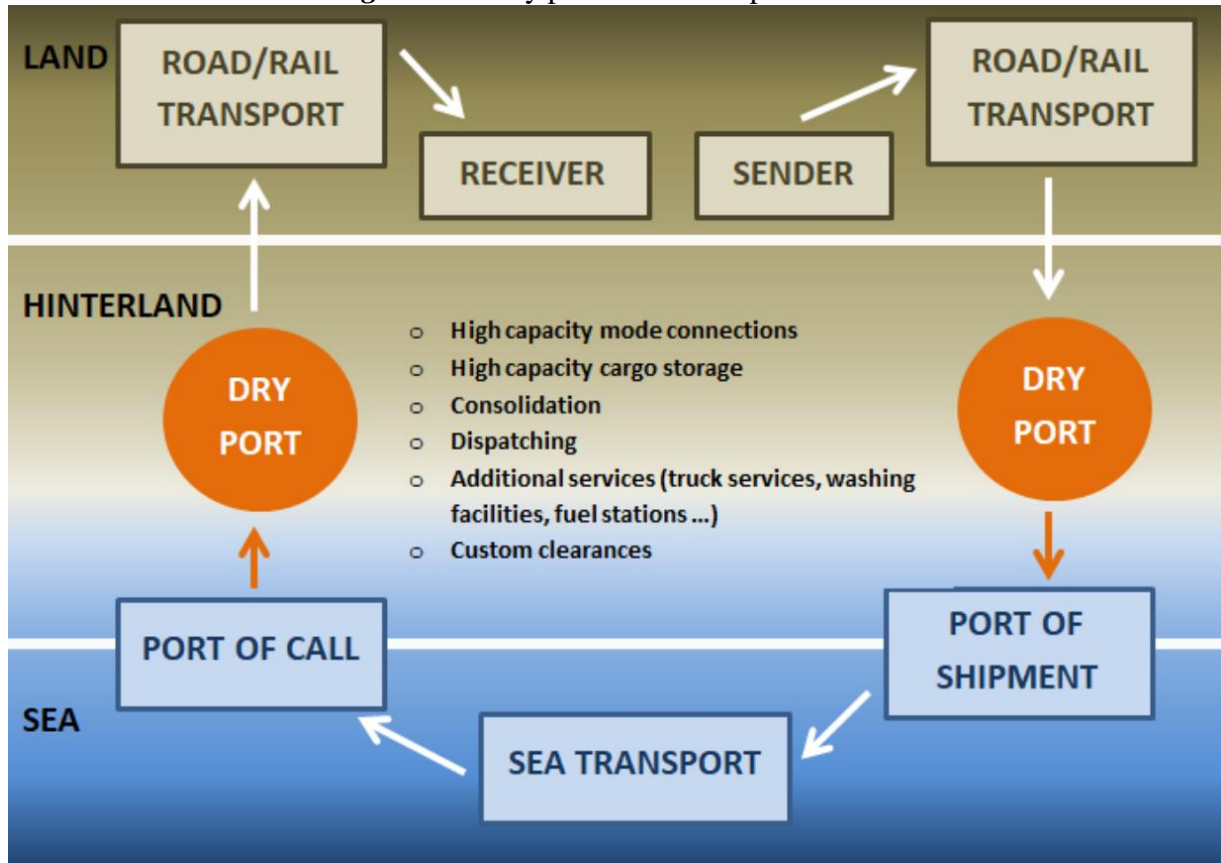
Dry ports are vertically integrated as an intermediate facility in the supply chain (Notteboom and Rodrigue, 2005), the flow of goods shown in the figure 2.2 represents the cycle followed by merchandise from its origin to its destination. Via intermodal transport the dry ports are equipped and operated to receive and send goods from and to the ports of shipment and call. In addition to the distribution and procurement activities, the dry ports are qualified to carry out and develop other complementary activities and services. These activities and services are focused in solving some of the most common weaknesses and issues of sea ports. Such as lead times and congestion addressed via diversification and flexibility offered by transport modes or capacity scarcity and diseconomies of scale solved by the warehouses and containers that flow directly to dry ports and are able to carry out customs clearance relieving the constraints and shortages of sea ports.

They are located inland and are conceived as intermodal terminals or as merging points for transport modes. The dry ports can be an extension of seaports called ‘extended gate’ that distributes imported/exported goods and merchandise coming from water ports, figure 2.2 demonstrates its layout (Lumsden, 2009). Or they can be an independent platform which does not necessarily have to be initiated, controlled, owned or operated by the port(s) which is linked. It is also important to highlight that the extra services provided within the facilities of the dry port are the main driving force and difference between dry ports and the other inland installations mentioned above.

Intermodality is the most important reason together with customs clearance service that supports the creation of dry ports since it allows these ports to be as competitive and efficient as the ports located in maritime regions.

It refers as a multi-modal chain of container -transportation services. They serve the customer with combined traffic, most of the distance is covered by rail or ship in order to take advantage from the economic advantages offered by these transport methods for long distances and high freight transportation capacity along with the low variable cost per unit. Pre and onward carriage by truck for final and small distributions is kept as short as possible to avoid pollution, traffic bottlenecks and higher transport costs per unit. However, it is still used a lot in the developed countries so we might see a slow paced changed towards rail in the future.

Figure 2.3: Dry port in the transport chain.



Source: Self made image.

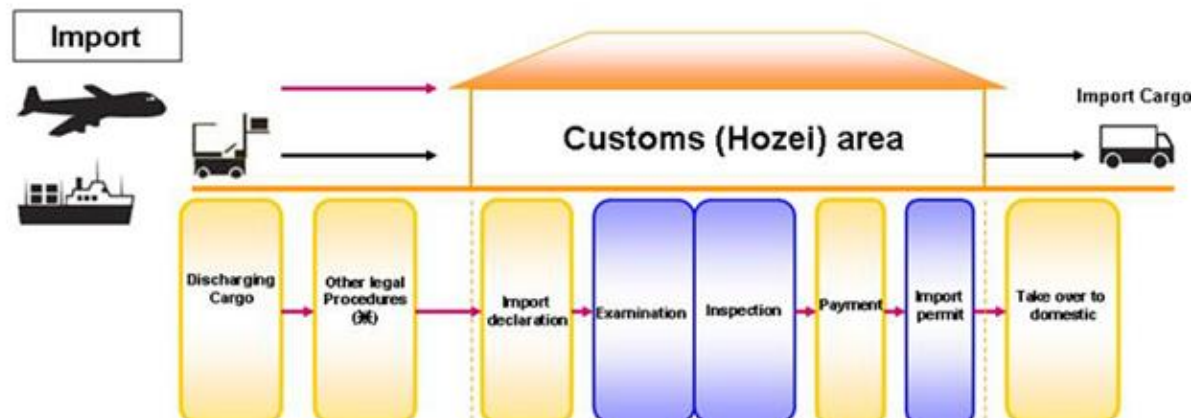
The reasons and viability of such inland facilities is not only encouraged by the poor performance of ports but also due to some opportunities and major advantages that should be fostered and exploited. Economies of scale and scope are both well implemented by clustering different logistics services, providers and distributors within dry ports, therefore attaining an improvement in efficiency that was no longer possible for the maritime areas.

Furthermore, the flow of freight into urban areas that must be distributed later causes huge traffic bottlenecks in the immediate roads of such cities. This turns into inefficient delivery times, delays and traffic congestion that slows the economic life of the area. If part of the total orders is redistributed to the hinterland, not only the traffic congestion is reduced but also there appears a new market to be exploited as the demand within interior locations will increase. For that reason, prior to establishing any dry port, a benchmarking analysis should be conducted in order to forecast the sustainability of the local demand (Nicoletta Gonzalez, 2016).

Along with the transport and connections with the seaport offered, customs clearance, it is the most distinguishable service that an inland installation could offer since a dry port that does not offer customs clearance is no longer a dry port. It is granted by the legal authorities so that the facilities can examine and inspect the imported goods and if everything is correct allow

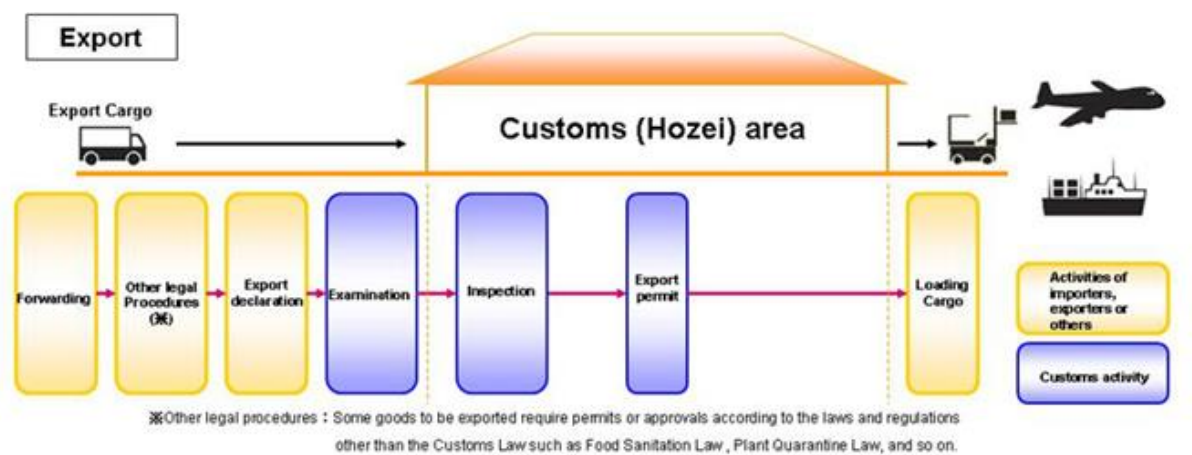
the cargo the import permit so that it can get to its destination. The same happens the other way around whenever the goods are exported, its inspection and examination determine if all the packaging and what it contains is in the right condition and whether they are legal goods to be exported to the country of destination.

Figure 2.4: Import regulation process.



Source: BCD Technology channel.

Figure 2.5: Export regulation processes.



Source: BCD Technology channel.

For such project, the maritime city needs to have good rail network connections to relieve road congestion by shifting a part of truck distribution to rail distribution. This shift of transport mode has other advantages besides avoiding traffic bottlenecks such as lower transport costs, lower delivery times and decrease in pollution. Experts keep increasing the belief that the rail transport is going to be the transport by excellence of the 21st century.

As already mentioned, the appearance of inland ports is not only encouraged by social or ecological reasons. The main drivers of such phenomenon are economic reasons pursued by governments and private companies. The increase of productivity is the result of increasing the

throughput without physical port expansion as well as better services to shippers and transport operators, less need for infrastructure investments and the possibility of securing a market niche in the hinterland.

Regarding the ecological and environmental consequences, the increase of industrial and trade activities in the maritime ports located near cities has come to some environmental problems that authorities and public opinion regard with disdain. Pollution and congestion are particularly the most damaging consequences that the local population faces (Roso, 2017).

The solution where some of the orders flow to dry ports located in the hinterland allows for a reduction in the emission of greenhouse effect gases as well as less congestion of transport that harms tourism and social life.

3. Case Study

The Zaragoza Maritime Terminal (TMZ: “terminal marítima de Zaragoza) is an inland dry port located in a competitive hinterland which was fostered and strategically initiated by the Port of Barcelona. The partnership between the Port of Barcelona and the Logistics Activities Area of Mercazaragoza set up this project and the TMZ started to work as a extended gate of the maritime port.

The aim of this paper is to seek and find methods and systems in to locate areas for improvement. To attain such objective, it has been decided to perform a benchmarking analysis with Duisport, the dry port of Duisburg. Duisport has been chosen as the one to be compared with since it represents the biggest inland facility in Europe with an outstanding located and a desirable efficiency level with cutting-edge networks and services provided. Benchmarking is an important tool for improving quality in an organization. According to Heizer and Render (2013): *“it is the tool that involves selecting a demonstrated standard of products, services, costs, or practices that represent the very best performance for processes or activities very similar to your own”*.

In this scenario the chosen target is Duisport, a leader organization in the areas that this paper wants to study; therefore, the TMZ is going to be benchmarked against Duisport.

Firstly, the standards which are going to be the measure of performance shall be selected, to do so several case studies from all over the world are going to be the base for this paper. Once the standards are selected it is convenient to measure and analyse them in each port separately and therefore assign numerical values to them and explain how those values have been assessed. Finally, the case study will conclude with the conclusions to analyse the strengths,

weaknesses and opportunities that TMZ should take into account to improve its efficiency and to stay as a relevant location regarding the trade of the Eurozone in the near future.

3.1. Factors to benchmark

In order to determine the factor to benchmark, it has been considered several worldwide studies and research from recognized authors. The studies consulted are: Location of mid-range dry ports in multimodal logistic network written by Ambrosio et al., 2014, Jeevan et al., 2015, Esmer et al., 2016 and by Notteboom and Nguyen, 2016.

- **Location:** Proximity to other platform logistics and proximity to the production base (Notteboom and Nguyen, 2016): The production base refers to the access and distance between the dry port and the target industrial zones, the testing is provided by experts as well as industrial or logistics cluster reviews. In addition to it, Nuñez also refers as the other logistics platform placed nearby since such proximity enhances the whole logistics system of the country and will guarantee the success of the dry port up to a certain degree (Núñez et al., 2013). It should also be added how much room for expansion is available for the port to expand in the future.
- **Logistics services in the supply chain:** Dry ports provide a wide range of services depending on their location and purpose, the services include the ones listed in the previous chapter of this paper. However, the most appreciated and outstanding services are the cargo receipt and dispatch; packing and unpacking of LCL (Less than container load) export containers; container storage; container repair; railhead operation; customs clearance; provision of offices for commercial activities; provision of cargo handling equipment; appropriate security; communication facility. The list of services has been referred in Notteboom and Nguyen (2016) who added the contribution made by (Beresford and Dubey, 1990). The rating and assessment criteria are based on the activities and services available at each port and region as well as the performance level. Tongzon (2007), Clark et al. (2001), NG (2006), Featherstone (1979)
- **Co-operation agreements (mergers and alliances):** The relationship between the dry ports and its usually related maritime port is an alliance itself. The market needs, investment requirements (entry barriers) and technical issues make it almost compulsory for the dry ports to co-operate with other institutions in the form of agreements. Both dry ports will be examined as well as their past current and future agreements and how they have helped its development considering the reputation of the other involved entities as well as how interdependent they are among themselves.

Heaver et al. (2010), Heaver (2002), Parola and Musso (2007), Yap and Notteboom (2007)

- Policy regulation and operational climate: Operational climate focusses in the banking environment innovation culture, government policies and existing competition. The authors suggest using the PCI index (Provincial Competitiveness Index)/(Ease of doing business) as a reliable tool to rate these criteria, the results indicate the ease of doing business, legal restrictions and how operators/investors interact with the government. Finally (De Schepper et al., 2015) argue that the platform or dry port might not generate positive value by itself, however, the value added to the region and the local trade greatly overwhelms that deficit and the public services may be interesting in financing the project with subsidies.
- Reduction of transport cost and transport time: As related by Notteboom and Nguyen (2016), assuming that the cargo handling costs are the same or very similar between different distributors, the transport cost and transport time are based on the modes used in the intermodal service of the dry port. The more area is covered by train the more cost-effective are the dry ports since truck costs are rather high.
- Mode of container distribution (Accessibility to road infrastructure, Accessibility to railway infrastructure and Accessibility to waterway infrastructure): This criterion relates to how easily the dry port has access to the different inland transport infrastructures. For rail and barge integration it is going to be considered the distance to the nearest system, daily capacity, frequency and reliability of the connection. Finally, concerning road transport (Núñez et al., 2013) suggests as reliable measures, the distance to the nearest highway, average daily traffic and level of service.

Eventually there are other factors that are not related either to the competitiveness or the efficiency such as social and ecological ones. Within the ecological group it can be seen how reducing congestion reduces the emission of greenhouse effect gases up to a 25%, pollution and noise are cut down as well in urban areas. The social factor benefits from new business opportunities that were not available in the hinterland and boosts inland demand and value-added activities.

3.2. Benchmarking standards

In order to compare both terminals and their strategic competencies, there are several standards that are going to be used for the purpose of obtaining specific data so the comparisons can be

as objective as possible. As for the location the GDP, population and logistics centres available at a certain range have been the parameters used.

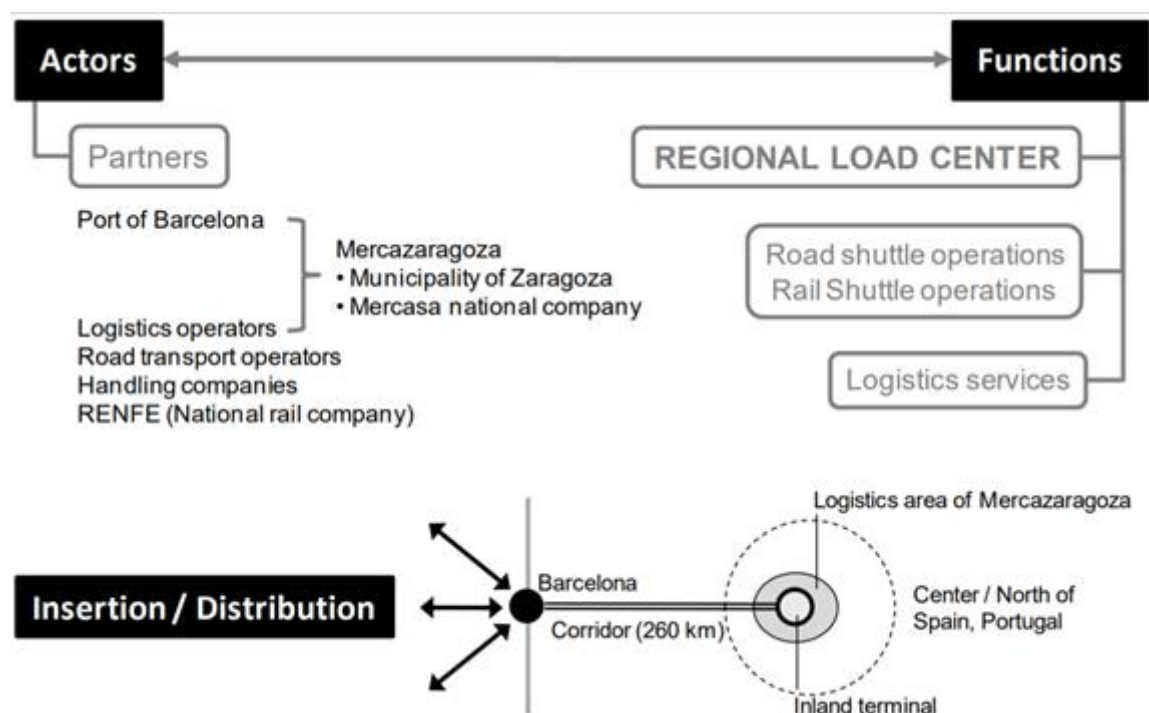
Within terminal's activity its range of services and tariffs has been divided, so the costs and complexity of operations can be measured. Being the intermodal concept a key stone in the dry port concept, the accessibility and the cost of transport of both countries and terminals have been investigated, it has been obtained the direct access to rail, road and waterway network from both terminals and the average cost per km per tonne of freight for all the transport modes.

At last the fiscal policy and the customs clearance rights that each terminal must comply with were to follow with their respective countries' regulations. So, Duisport follows Germans policy and TMZ follows Spanish policy.

3.3. Measuring standards at TMZ in Zaragoza

3.3.1. TMZ location:

Figure 2.1: TMZ position, function and partners layout.



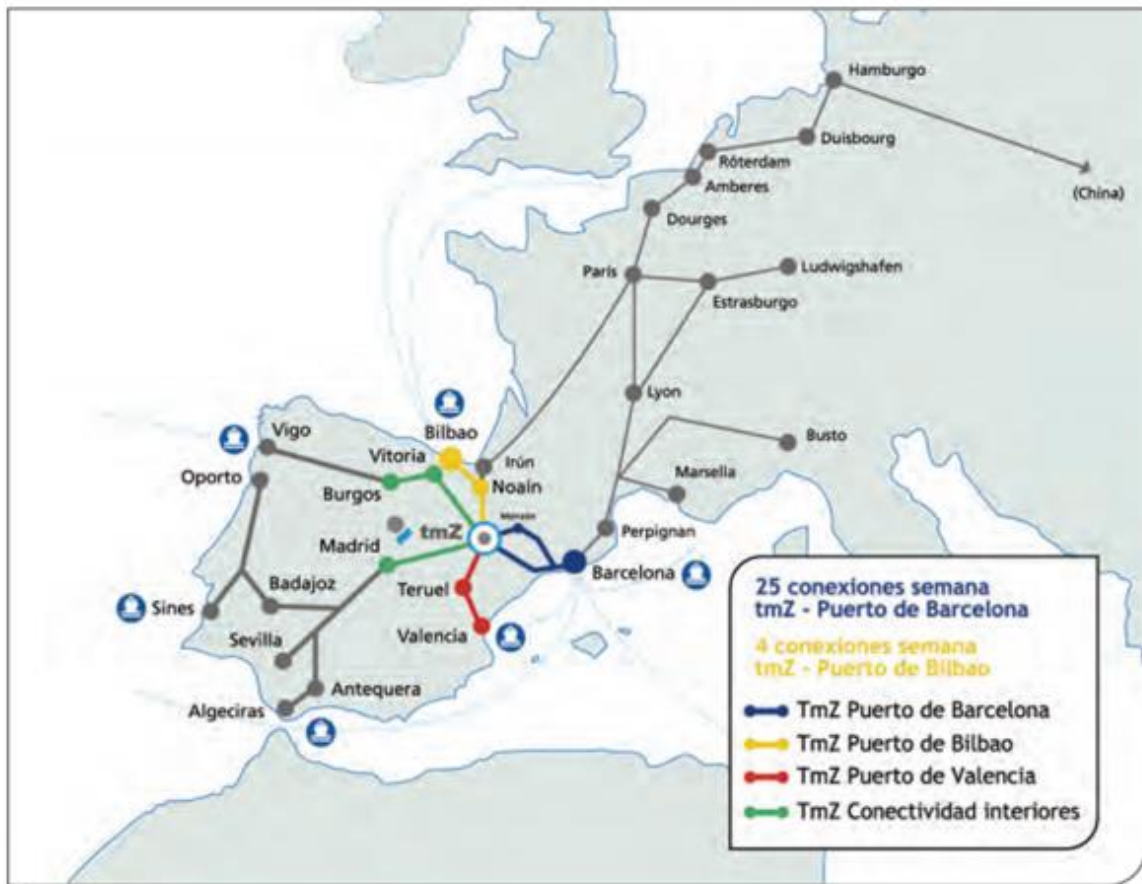
Source: Functions and Actors of Inland ports, 2010

The TMZ (Zaragoza Maritime Terminal) is an inland port located in a competitive hinterland, the project was a strategic initiative promoted by the Port of Barcelona. It was set up in 2001 as part of the port's development plan which aimed at expanding the port hinterland via a partnership between the port of Barcelona and the Logistics Activities Area of Mercazaragoza. Though the terminal is not new, the implementation of the label "Port of Barcelona" on existing

infrastructure pursued a strategical promotion and organization of inland freight distribution (TMZ, 2019). Where Mercazaragoza assumed the role of operator that carries out logistics activities while the Port of Barcelona undertook the role of promoter. Therefore, there was no need of significant investment since there already existed road shuttle services, freight handling, consolidation and deconsolidation, warehousing and other value-added logistics services. The Port of Barcelona participated mainly in the funding of a new rail terminal in partnership with the national rail infrastructure manager (RENFE) and the company Acciona Logística, allowing rail shuttle services between the port and the inland port.

It is situated in Zaragoza (Aragón), the 5th largest city in Spain, geographically speaking it possess an enviable strategic location. Considering a range of 300 km there is access to the main industrial cities and economic core of Spain such as Madrid, Barcelona, Valencia and Bilbao. The direct market access amounts to 800,000 inhabitants with a regional GDP of 36.054 M euros, within a radius of 300 km kilometres 60% (27M) of the Spanish population resides and around 70% (215,220 M euros) of the country's Gross Domestic Product (GDP) is produced (Datos macro, 2019). These features together with outstanding communication and logistics infrastructures have turned Aragón into the entrance door to Europe and one of the logistics drivers of Spain and Southern Europe, therefore, the northern industry and commercial expeditions are usually interested in Zaragoza as a distributor hub (Aragon Plataforma Logistic, 2017). The TMZ is a nodal point in the centre of two strategic corridors: the Ebro Corridor (Barcelona-Zaragoza-North of Spain) and the transversal Iberian corridor (Barcelona-Zaragoza-Madrid-Lisbon). The competitiveness of the region is directly correlated with the performance of the unemployment rate, which currently is about 10.5%, one of the lowest considering the national context.

Figure 3.2: Map of the strategic railway connections of the TMZ.



Source: Moviendo la economía para mover el mundo, 2018

Not only Zaragoza has one of the best locations within Spain if not the best, but it also has a key position regarding western Europe influence area as well as the northern African regions such as Morocco and Algeria.

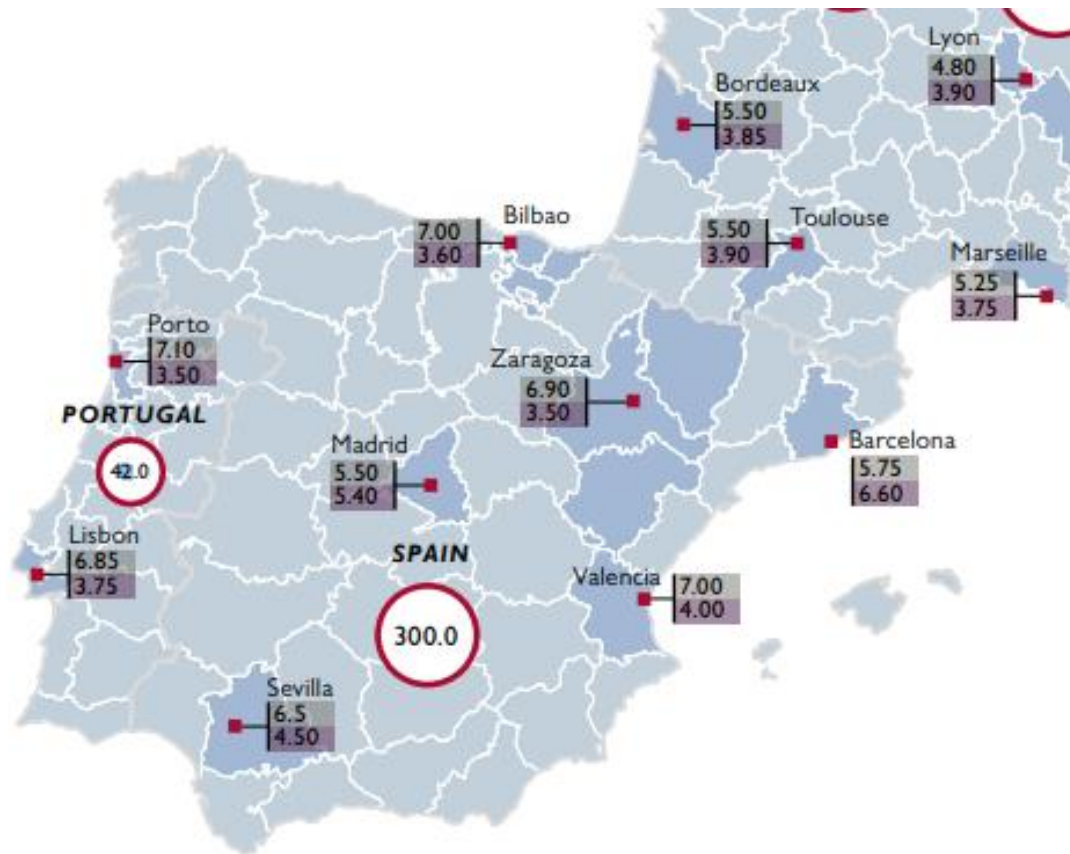
Figure 3.3: Available European market within Aragón range.



Source: Online portal Eurosmes, 2013.

Moreover, as stated by Catella group, Spain is matched with Netherlands and Poland with a total of 6 logistics clusters per country, surpassed by France (7), United Kingdom (8) and finally Germany with the highest density (25). The same report indicates the logistics prime yield net and the logistics prime rent of Zaragoza which respectively amount for 6.9% and 3.5€/sq./month, in addition to the total logistics transaction volume of Spain which accounted for 300 Million € (Catella, 2018). Meanwhile by the year 2012 the Spanish government released an in-depth paper regarding logistics issues about the country, the region of Aragón was mentioned as a developing region with intrinsic connection and potential for future expansion, there were already 2 “Centros de Logística y Transporte” (CTL), and 4 more where being built up. The expansion possibilities for future logistics clusters or hubs are quite attainable since the planned and forecasted space for logistics in Aragón adds up to 5,794,319 sq. (Observatorio de la logística en España).

Figure 2.4: Logistics prime yield and prime rent in Spain.



Source: Catella group, 2018.

3.3.2. TMZ logistics services and facilities:

Relative to the TMZ, the company offers a wide range of services which aim to complement and facilitate the logistics services that work as the core of the operations of the company. Therefore, there is a list of both types of services, the list of services offered as well as the governing competencies has been obtained from their official webpage (TMZ) and it is as follows:

TMZ Functions:

- Operating Partnership, (Depot.tmZ.Services.S.L):
 - Management and movement of stocks
 - Monitoring of internal operations
 - Load/unload operations to/from trucks and trains
 - Container handling
 - Bureaucracy and legal procedures
 - Customs clearance processes

- Promoting Partnership, (tmZ.S.L):
 - Railway operations management
 - Infrastructure development
 - Railway and intermodal transport promotion
 - Project development
- TmZ Services:
 - Handling movements
 - Empty and full container storage
 - Container weighting VGM (Verified Gross Mass)
 - Cleaning and repairs
 - Customs services (ADT, DA)
 - Consolidation/deconsolidation, classification and palletize
 - Cold connections, storage and temperature control of *reefer* containers
 - Truck parking lot

TMZ Facilities:

- More than 6000 railroad metres.
- Up to 10 railways: a technical area with 5 electrified tracks and an operative area with 5 load and unload tracks.
- An operational area of a surface of more than 100,000 m² with the possibility of expansion
- Of which, 65.000 m² are committed to container storage, with capacity for more than 4,000 containers.
- Cold channel: space intended to connect the reefer container to perishable merchandise.
- Available logistics land in the nearby area of the railway installations.
- Dry and cold warehouses next to TMZ designed to the consolidation of containers.
- More than 20,000 m² of available logistics land, extendable to 90,000 m²
- Plug in for 60 reefer containers (cooling containers) which allow the transport of goods under temperature control.

3.3.3. Policy regulation:

As a continuation of the TMZ services and facilities, the terminal is subject to the regulations and tariffs applied within the EU, the terminal already has the ADT (Almacén de Depósito Temporal) and DA (Depósito Aduanero) certifications and it is in process of obtaining the

certification of an OEA (Operador Económico Autorizado) which has a global and wider recognition. While the free flow of goods within European member states has very few restrictions (agricultural products special tariffs), non-European countries must comply with tariffs and import taxes. The standard VAT for importing products in Spain is 21%, however specific products have a reduced VAT rate of 10% or 4% (Agencia Tributaria Española).

Table 3.1: Minimum thresholds for paying import duties and taxes.

	Price of shipment including transport	Duties	General porcentaje - General applied [1]
	Less than 22 €	Nontaxable	0% duties- 0% VAT
Internet purchases (when sender is a company)	Greater than 22€ - less or equal to 150€	Should pay duty but not taxes	0% duties- 21%VAT
	Greater than 150€	Should pay duty and taxes	2,5% duties - 21% VAT
Shipments between individuals [2]	Less or equal to 45€	Nontaxable	0% duties- 0% VAT
	Greater than 45€	Should pay duty and taxes	2,5% duties - 21% VAT

[1]: These percentages will be applied if it's not indicated the classification that applies to the goods.

[2]: Not applicable to shipments constituting commercial expeditions.

Source: Self-made image with data obtained from Agencia Tributaria Española.

3.3.4. Transport cost and accessibility to Spanish transport infrastructure:

Simultaneously, the transport modes have been analysed as well, the most significant and interesting characteristics to discuss efficiency are the cost per kilometre, dwell times and the accessibility that each terminal has to the different transport modes available.

Beginning with a look of the TMZ connections to the different transport modes, it can be observed in figure 3.5 how well connected the terminal is, the periphery of the city is surrounded by the highway A2 which joins Madrid and Barcelona where most of the truck transport flow converges, added to the direct connection with the A23 and the A68, thus allowing for a straightforward and swift access to road infrastructure. The daily traffic of trucks that transport freight from and to the terminal is estimated to be between 400 and 500, (Jornadas Pilot, 2017).

Another observable advantage is the closeness to the airport of Zaragoza, it usually takes between 15-20 minutes to reach the airport within the terminal. Besides, there are more than 20 weekly freight flights towards Europe, Southeast Asia and Mexico.

Figure 3.5: Strategic map of Zaragoza and its surrounding connections.



Source: Zaragoza Atlas 2009

When it comes to railway accessibility, the terminal has outstanding national connections, with weekly connections with the port of Barcelona, Bilbao and Valencia. However, Aragón and Spain altogether face one of the greatest connectivity issues, the railway width is slightly wider in the Iberian Peninsula (1,668) than in the rest of Europe (1,435). This inconvenience does not allow the Spanish freight trains to have an easy transition into the French rail system, therefore the process of changing the railway width or swapping the cargo from one train to another takes a lot of time, effort and resources (Revista 80 días-Ministerio del Fomento, 2018). A great opportunity which could be implemented to solve this major drawback is the re-opening of the Canfranc station which will kill two birds with one stone by strengthening the direct trade between Aragón and France and at the same time developing a modern system where the laborious task of the freight switch between trains would be solved.

Finally, it should be mentioned as well that the river Ebro is not navigable even though several drain projects were designed to make the river deeper. Thus, waterway infrastructure is non-

existing which is a shame because the natural course of the river ends near the port of Barcelona.

Figure 3.6: European transport network: Railway corridors in the Iberian Peninsula.



Source: El País, 2011

The trade by rail is in an expansive phase with the recent inclusion of Zaragoza in the new Silk Road, where the logistics company DSV has already shuttle more than 40 trains with China as its destination. Moreover, the terminal had already 28 weekly connections with Barcelona, 3 to 4 weekly connections with Bilbao and some sporadic connections with the port of Valencia, all the trade is forecasted to grow with the implementation of the reefer containers, a total number of 2,450 trains ran in 2017, (Jornadas Pilot, 2017). The performance of the terminal is complemented by the intermodal terminal in Zaragoza with a total surface of 60,000 sqm.

Once the accessibility and the infrastructures for each transport mode have been assessed, the benchmark analysis continues with the estimated prices per each transport mode per kilometre. As stated, by el Ministerio de Fomento in their latest report, the price of tonne per kilometre for companies not associated with Renfe is 0,16€/km, while the price for the public company amounts to 0,28€/km. On the other hand, the same report concludes that the road transport, which is the most common in Spain, has a price of 0,986€/km, with 13,156 Km of available

interurban highways network (Revista 80 días-Ministerio del Fomento, 2017), of which only 2,814 km of those highways are tolled sections.

3.3.5. Operational climate:

Other factors which had not been considered in the final assessment but regardless are influential in the future of the logistic paradigm of Aragon would be: the Ease of Doing Business, Spain was ranked 28th with a total score of 77.2 out of 86.55 while Germany's was 79.00 getting the 20th place, (World Bank, 2018), labour cost (98.4 - index points) and the average wage of Spain (2039.01 - EUR/Month) were much lower in comparison with Germany's labour cost (115.62 - index points) and average wage (3899.00 - EUR/Month), (Trading Economies, 2018). It could be reached to the conclusion where one of the greatest strengths for Spain is their relatively low labour cost compared to the rest of Europe even though the easy of doing business remains very similar in comparison with its European partners.

3.4. Measuring standards at Duisport in Duisburg

3.4.1. Duisport location:

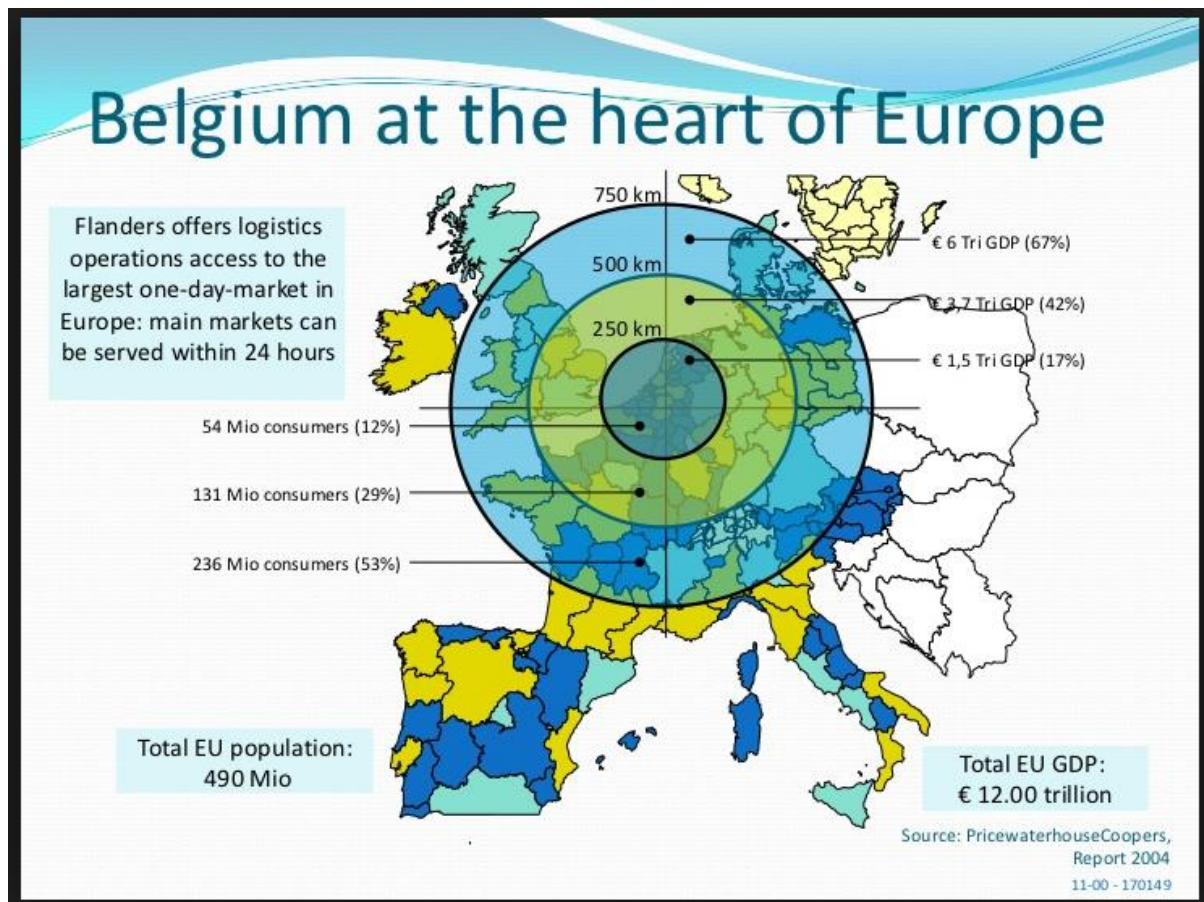
Duisport, the inland port of Duisburg is in the German region of North-Rhine Westfalia, the region is adjacent to Belgium and Netherlands while enjoying a privileged location in the centre of Europe and being part of the so-called: Blue Banana. The figures of the region speak by themselves, NRW generates 20.8% of the German GDP or 4.5% of the EU-28 GDP which makes it one of the most important economic regions, (World Bank, 2018). All of this is accompanied by highly develop infrastructure and suprastructure as well as top-level multimodal networking.

The region has a direct market access of 17.9 million people, where the most important metropolitan areas are the Ruhr Metropolis with 5.1 million inhabitants and the Rhineland with more than 3.0 million inhabitants. Within 150 km the port can supply 30 million consumers with a GDP of 705 billion € and assist up to 300,000 companies with their logistics services, (IT.NRW, 2019).

If we consider a larger radius (500 km), around 160 million people live around the state capital Düsseldorf- this represents 31% of total EU population and 50% of EU purchasing power. From no other location in Europe can so many people with such high purchasing power be reached within such a short distance from NRW. The figure x offers a clear perspective of the situation and reach that Belgium Netherlands and NRW benefit from, (NRW. Invest, 2017).

Note: Although the data of the graph might look a bit obsolete, the population of EU has been checked and it is 513 million, so the deviation is not that big, (Eurostat, 2018).

Figure 3.7: Available population and GDP within different distances.



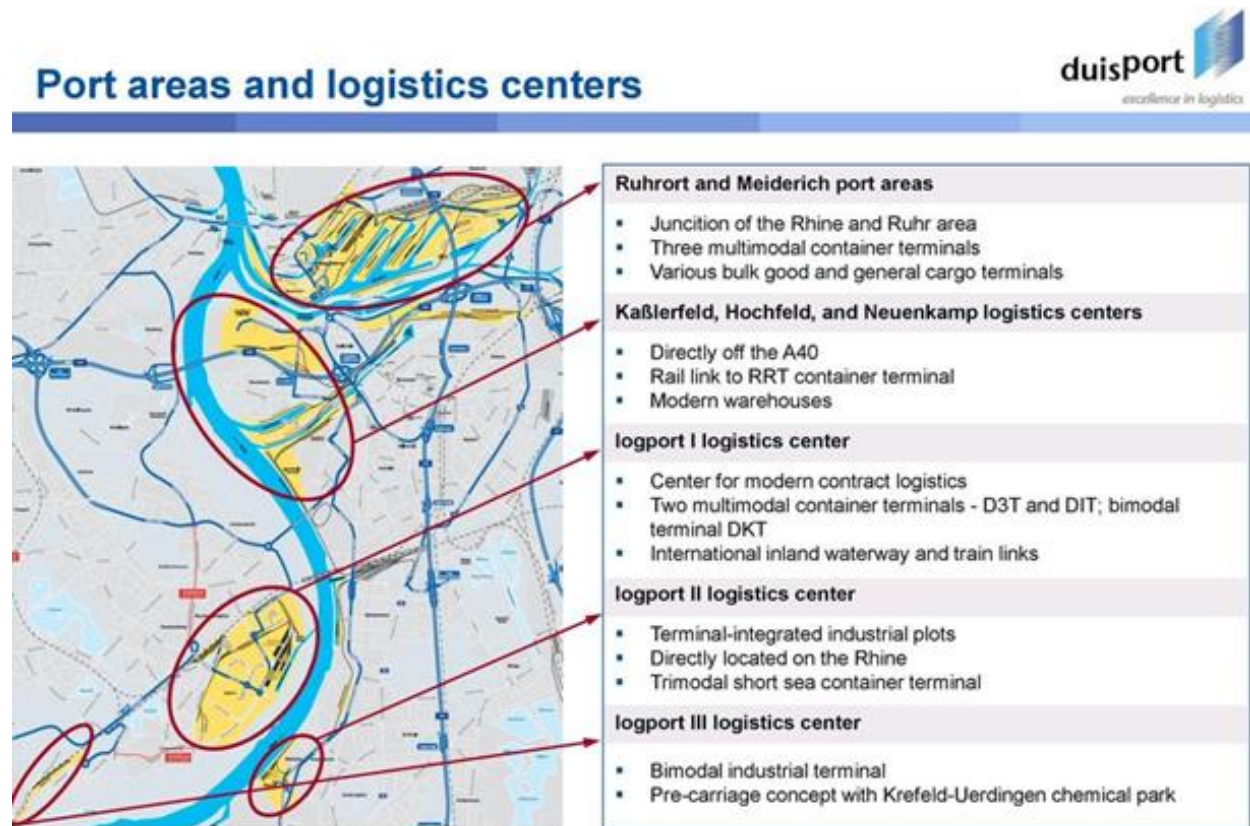
Source: PriceWaterhouseCoopers, 2004.

Once again by obtaining information from the Catella Group paper, the report shows how Germany overwhelms any other European country in terms of logistics clusters, this massive display of strength is translated into 3060 million € from logistics transaction during the year 2018. The country is home for 25 logistics clusters, however the massification of this market impacts on the logistics prime yield and primer rent, thus they are less profitable, and the logistics space is more expensive. Specifically, in Duisburg where Duisport is located, the prime yield is 5.00% and the prime rent is 4.30 €/sqm/month, (Catella Group, 2018).

After the analysis of the port's location, it is time to begin with the benchmarking factors relative to the port itself. Services are distributed among the different providers for each department that the group has. The range of services and facilities that the port offers are huge, and the group is currently undergoing through and expansion in which they are building Logport V and Logport VI. Each logistics centre is specialized in certain activities, for example

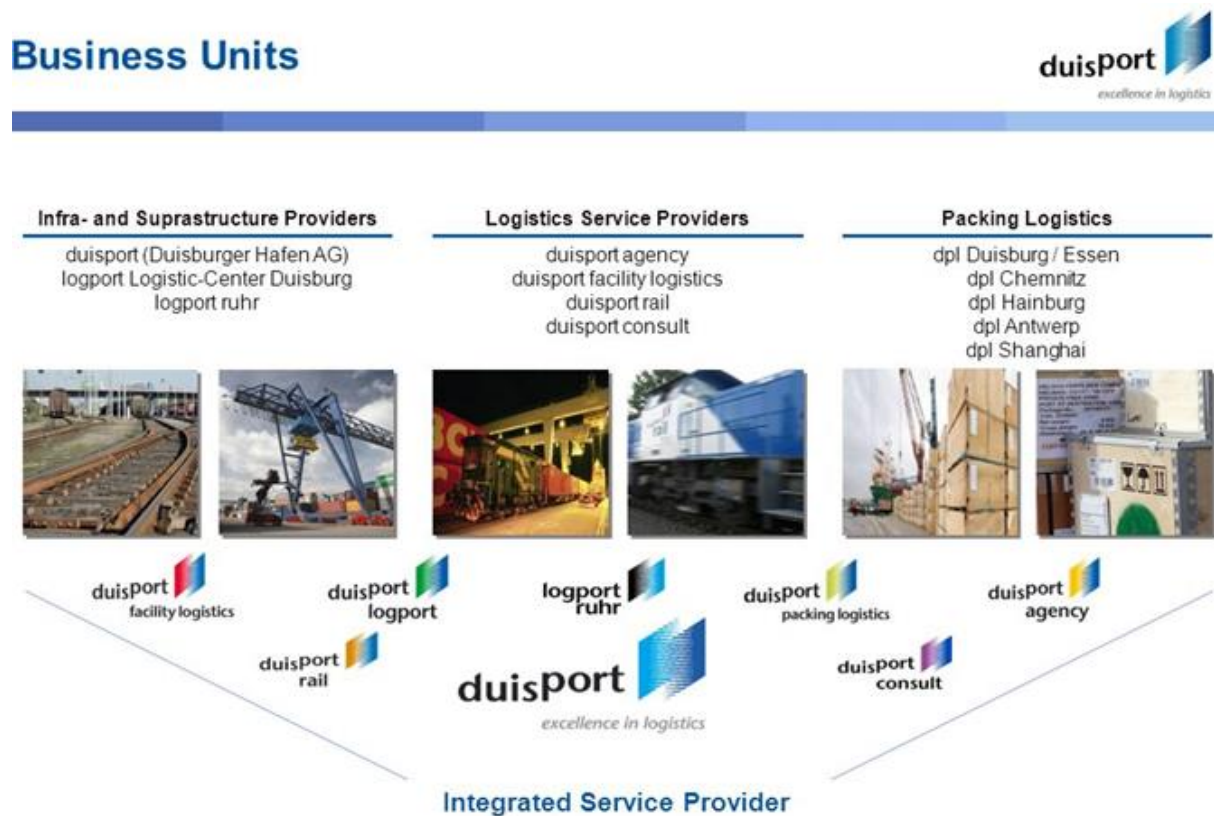
Logport III is focussed on chemicals. The next figure attached depicts an easy reading of the main strengths and functions for each terminal, (Duisport, 2015):

Figure 3.8: Different logistics centres of the group with their functions.



Source: Duisport online portal.

Figure 3.9: Duisport business units.



Source: Duisport online portal.

3.4.2. Duisport services and facilities:

Duisport figures speak by themselves; it currently handles a cargo volume of 131 million tons and 4.1 million TEUs per year. 15,000 containers are stowed per year on average. It can be attained due to the following services and facilities, (Duisport.de, 2019);

- Warehouse:
 - Storage capacity of 2.2 million sqm. of covered space
 - 6500 square metres covered transshipment building with direct rail connection
 - 2000 square metres storage building for material that can be handled by forklifts
 - 10000 metres external warehouse (for container storage, among other things)
- Logport I and II facilities:
 - 1550 ha.
 - 21 port basins
 - 200 km railway track (duisport rail) own rail company
 - 8 container terminals with 21 gantry cranes
 - 5 import coal terminals

- 19 facilities for handling liquid goods
- 130 cranes with up to 500 tones capacity
- 2 Ro-Ro facilities
- Services:
 - Procurement/distribution logistics
 - Pre-packaging
 - Customs clearance
 - Sea freight
 - Intermediate storage
 - Container stuffing/stripping
 - Export packaging
 - Pre and onward carriage (road/train/waterway)
 - Tracking and security solutions
 - Container consolidation
 - Customized transport solutions
 - Goods handling
 - Forwarding services

3.4.3 Duisport tariffs and policy regulation:

The import tariffs and the fiscal policies that the port of Duisburg must comply with, are those imposed by Germany which are very similar to the Spanish ones. The minimum threshold from which tariffs are required is 150€, the duties for countries outside of the EU which do not benefit from the free trade is on average 4.2% excluding agricultural products. Regarding the import taxes the standard Import Turnover tax is 19% except a 7% on agricultural products and exceptions.

Altogether with the tariffs and import duties, the port has its own prices for different activities and procedures, (Duisport tariffs, 2013):

Table 3.2: Duisport tariffs.

RAILWAY TARIFFS DUISPORT		ADDITIONAL SERVICES		
Standard cargo	29.85€/container	Weighting of containers	between 1 and 3	17.70€/container
Steel, iron and scrap	17.80€/container		more than 4	13.80€/container
Coal, coke	12.90€/container	Storage container		11€/24 h
Empty	5.10€/container	Labor cost per worker (Sunday and holidays 150%)	First hour	32.66€
Vehicles-cranes	29.85€/piece		After first hour	29.06€
Self container transport	12€/container	Fuel price		(Market price + 0.04) x 1.025

Source: Self-made with the information from Duisport online portal.

3.4.4. Transport cost and accessibility to the German's transport network:

On top of that the trimodal connections and transport infrastructure and accessibility are outstanding. To begin with rail transport, Duisport connects with 30 national and international railway service providers, during the last year they operated up to 25,000 trains which departed to more than 100 destinations all over Europe as well as transcontinental destinations, such as Chongqing in China thanks to the new Silk Road. At the port itself and in combined transport Duisport benefits from its own trains, for example the port has a daily connection with Antwerp, and since the beginning of last year a weekly train is shuttled directed to the JadeWeserPort. With a freight transport cost of 0,17€/km it stands in a very competitive position, (Railway Market Analysis, Dec 2017). In addition to that it is important to highlight that North-Rhine Westfalia has the highest rail network density in Germany whose track length amounts up to more 6000 km, thus the state is an important hub in the high-speed rail network. It is also worth mentioning that the port is 25 minutes away from the airport of Dusseldorf.

Figure 3.10: Duisport direct and indirect rail connections.



Source: Duisport online portal.

Although the state of NRW has no coastline, it lies at a privileged position for European waterways. It allows the port to have connections with the major European seaports since 226 km of the Rhine, one of the busiest waterways in the world flows through NRW, (IT.NRW,2017). Duisport uses the Rhine to transport goods to the port of Antwerp mainly, whose average costs for freight vessels per waterway in the Amsterdam-Rhine Channel (NL)

are between 1,14€ and 1,15€ per km per ton, (Charging and pricing in the area of inland waterways, 2005). Last year more than 20,000 ships were processed by the port itself, the optimal conditional such as water depth allows for river-sea ships with loads up to 6000 tons.

Figure 3.11: Duisport direct and indirect waterway and sea connections.



Source: Duisport online portal

At last but not least the road network of NRW is around 2,200 km. of expressways that link every important city in the state and have a quick access to the European expressway system. There are also 4,500 km of federal highways, 13,100 km of country roads and 9,800 km of local district roads. The port has as well direct connection with the country's road infrastructure, it is located at the intersection of international freeway routes (A2, A3, A40,

A57). As for the truck operating costs for Germany the average between short-distance and long-distance amount to 1,1€/km which is rather expensive.

3.5. Benchmarking analysis

After gathering all the data, the table 3.3 contains the relevant information available, on the right side it can be observed the peer to peer comparison of both dry ports. This method consists in giving a 1 to the terminal that is superior in that factor and 0 to the other or giving 1 to both terminals when the results for a given factor are the same or very similar.

Table 3.3: Results from the case study

Factor Name	Analytic tool	Modifier agent (State/Enterprise)	Results		TMZ	Duisport
			TMZ	Duisport		
Location	Proximity to the production base	State	- 27M population (300km) - 190,000M €GDP (300km)	- 54M population (250km) - 1,500,000M €GDP(250km)	0	1
	Proximity to other logistics platforms	State	6 logistics centres in Spain	27 logistics centres in Germany	0	1
Operating costs	Labour costs & handling costs	Governing enterprise	N/A	See table 2.2	1	0
Logistics services in the supply chain	Range of available services	Governing enterprise	All services provided	All services provided	1	1
Co-operation agreements	Nº of alliances and logistics hubs	Both	- Port of Barcelona - Port of Valencia	- Port of Antwerp - Port of Trieste - Chinese institutions...	0	1
Policy regulation	Duty and import taxes	State	- 21% import tax - 2.5% duty (+150€) - Free trade EU	- 19% import tax - 4.2% average duty (+150€) - Free trade EU	1	1
Transport cost	Transport cost/km & transport mode	Both	- Trucks: 0.986€/km - Train: 0.016€/km (Not Renfe) - Barge: n/a	- Trucks: 1.1€/km - Train: 0.17€/km - Barge: 1.15€/km	1	0
Transport time	Operating time of containers & dwell time	Governing enterprise	Maximum of 48 hours	N/A	1	0
Mode of container distribution	Accessibility to road infrastructure	Both	- Direct access to A2, A23, A68 - 13,156 km highways (Spain) - 757 km highways (Aragón)	- Direct access to A2, A4, A5, A57 - 2,200 km expressways (NRW) - 4,500 km highways (NRW)	0	1
	Accessibility to railway infrastructure	Both	- Mainly national destinations - Direct access to the North-East railway spanish network	- More than 100 worldwide destinies - Direct access to the European railway network	0	1
	Accessibility to waterway infrastructure	Both	N/A	Direct access to the Rhin	0	1

Source: Self-made table

4. Conclusions

TMZ score over all is significantly revealing, the terminal has several strong points that make it competitive and attractive enough for companies to entrust the handling and transport of their goods. One of the main reasons that fosters such confidence is the range of logistics services that the terminal offers which are on par with those offered in Duisport, and there are even some innovative services where the TMZ is ahead such as *reefer* containers. In the economic and operative field TMZ benefits from the systematic lower prices of Spain in terms of labour

costs, handling and storage tariffs as well as the price for the different transport modes that remains much lower than the prices of Germany. Both the TMZ and Duisport benefit from the free trade within European borders and have similar import taxes and duties for the movement and handling of freight. Another competitive advantage that the TMZ enjoys is the much shorter dwell times and operating time of containers when compared to its associate partner, the Port of Barcelona, the handling time of the TMZ goes between a few hours and no more than 48 hours per container while the port of Barcelona needs on average 5 days per container. Although it has not been possible to obtain this data for Duisport, the study finds it very relevant and is one of the key factors of comparison and efficiency for both ports.

However, there are certain points where the TMZ lacks the conditions to match the privileged position of Duisport. The greatest handicap is the geographic location, Duisport has at its disposal a larger number of consumers and GDP while TMZ periphery is reduced to national consumers, Portugal and the South of France. A good approach to solve this problem would be to widen the range of their operations and increase the trade with North African countries such as Morocco and Tunisia through the port of Algeciras. The other disadvantage for the TMZ and the Spanish paradigm is the low number of logistics centres and the synergies that come with them when several logistics hubs cooperate or compete, government policies and subsidies that aimed towards innovation and efficiency would solve this scarcity in the long-run.

On top of that Duisport is quite ahead when it comes to transport networks and national infrastructure, it has direct access to the most navigated river in Europe, the Rhin, while the Ebro is not navigable. Although both terminals have good direct connections to their respective road and railway networks, German's road and railway density is much higher, and the kilometres of available highways is substantially higher too. Spanish public institutions could once again boost the national infrastructure with long-term programs to improve the current state and enlarge highways and national roads. On the other hand, Germany has good railway links with all its European neighbours, however Spain must go through an expensive and laborious process each time that a train enters France due to the difference in the railroad track width, Aragón and the TMZ would benefit a lot if those problem were solved since France is 200 km away from the TMZ and the business opportunities would come along with it.

To sum it up the TMZ presents the required characteristics of a dry port and has a relevant position in the national context, its future and viability will be determined by its efficiency regarding the time it needs to handle each container and if it can widen the range of available

consumers as well as more strategic alliances. In the European and global context and despite some deficiencies when compared to Duisport it can become a relevant terminal if it solves certain accessibility issues (low highway density and railroad track width) and manages to make strategic agreements with France and some North-African countries.

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6.APPENDIX I: GLOSSARY

Blue Banana: The Blue Banana is a sporadic urbanization corridor that is expanding over central and Western Europe and has a population of nearly 111 million. The corridor begins from Northwest England, stretches to greater London, Southern Germany, German Rhineland, Alsace- France, Switzerland, and ends in Northern Italy.(World Atlas (2018) What is the blue banana?)

Customs Clearance: service or activity provided by the customs clearance agent that is the natural person or the legal entity authorised by the Customs Clearance Directive to certify and manage consignments between countries. The service consists in processing the documents regarding the export and import of goods as well as to carry out the payments of the tariffs, taxes, licenses, certificates to the customs authorities made by the user, exporter or importer. (El lenguaje del transporte intermodal. Ministerio de Fomento)

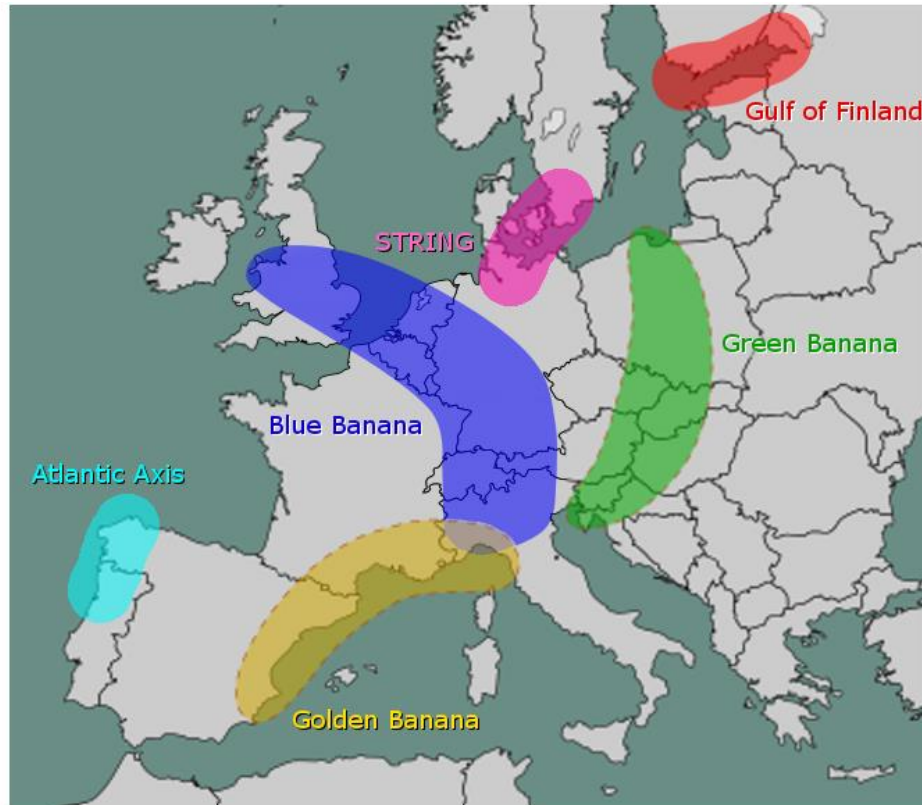
Consignee agent: The party listed as the consignee on the Bill of Landing is the agent who does all the necessary management regarding the legal documents to be reported to the legal authorities, pays attention to the shippers and carriers as well as any supplies. The consignee is in charge of the freight since he receives the shipment and usually becomes the owner of the goods. He negotiates, manages and completes any freight charge or shipping cost related to the goods, he signs the knowledge agreements of those goods to be exported and is informed as well of the goods imported into the country. If needed, he could work as an intermediary of the stevedore companies in order to negotiate the tariffs corresponding to the handling of goods and the load or unload of the cargo within the port. (<https://www.icontainers.com/help/difference-between-shipper-consignee-notify-party/>)

Consolidation: Combining two or more shipments in order to realize lower transportation rates. Inbound consolidation from vendors is called make-bulk consolidation; outbound consolidation to customers is called break-bulk consolidation. (Inbound logistics, Glossary of transportation)

Golden Banana: The Golden Banana is an analogous region on the Mediterranean coast between Valencia and Genoa. Commonly called the "European Sunbelt," this urbanized area developed out of an environment warm in climate but cold to trade unions, leading

to the establishment of countless new industries. (Marcus Mitanis (2017) The Blue and Golden bananas of Europe)

Figure 1.1: Names of European corridors.



Source: The Blue and Golden bananas of Europe

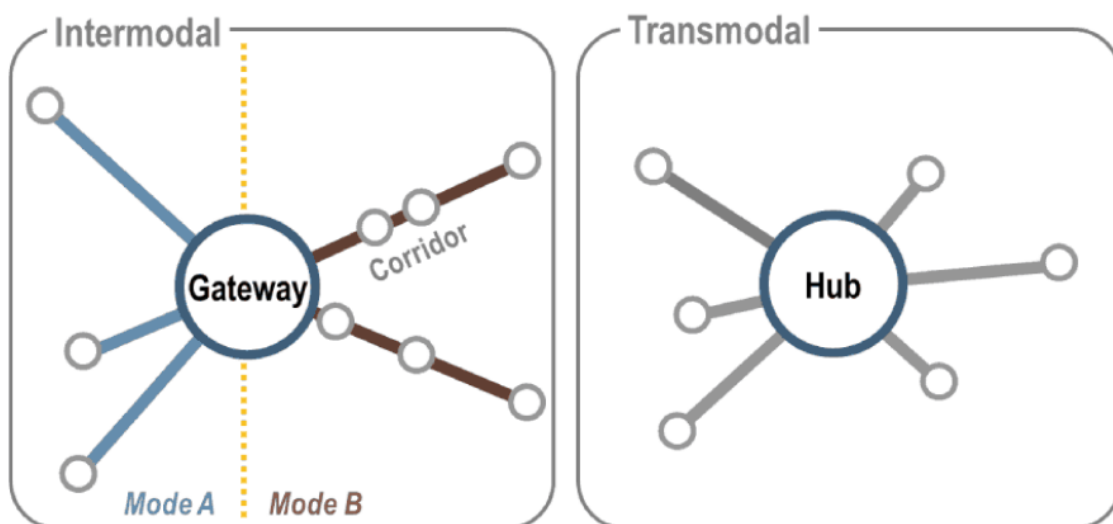
Gateway: Gateways and hubs are locations where flows converge and the foremost expression of global connectivity. However, they differ in terms of the nature of their connectivity. While a hub is a central location in a transport system with many inbound and outbound connections of the **same mode**, a gateway commonly implies a **shift from one mode to the other** (such as maritime / land). A gateway is performing an intermodal function (between modes) while a hub is mostly transmodal (within a mode). Transport corridors are commonly linking gateways to their hinterland. Gateways tend to have a temporal stability as they often have emerged at the convergence of inland transport systems and through the long term accumulation of infrastructure and investments. (Jean-Paul Rodrigue (2017), Fourth edition of The Geography of Transport Systems)

HUB: Logistics hubs are intermediate points between the origin and the final destination of commodity flows. They provide the possibility to adjust flows both temporally and spatially. Logistics hubs represent the locations that determine the free flow of freight

(Raimbault et al. 2011). Logistics hubs can be defined as locations where goods are stored in warehouses or transhipped between different transport modes and vehicles. In the following, we will distinguish between transport logistics hubs and distribution logistics hubs. Transport logistics hubs mainly possess transshipment function as well as a buffer function as a time offset. In this context, transport logistics hubs are, for example, airports, seaports, terminals for intermodal transport as well as handling facilities of freight forwarders and courier, express and parcel service providers (cep service providers). In contrast, distribution logistics hubs are oriented towards storing goods for a longer time period. Examples for distribution logistics hubs can be found in central or regional warehouses. (Integration of transport logistics hubs in freight transport demand modelling, Huber, Luft & Klauenberg)

It is also worth mentioning the use of the term HUB as: A reference for a transportation network as in "hub and spoke" which is common in the airline and trucking industry. For example, a hub airport serves as the focal point for the origin and termination of long-distance flights where flights from outlying areas are fed into the hub airport for connecting flights.(Vitasek K (2013) Supply Chain Management Terms and Glossary. Council of Supply Chain Management)

Figure I.2: Gateways and hubs.



Source: The Geography of Transport Systems, 2017

Intermodal transport: is the use of two or more modes, or carriers, to transport goods (freight) from shipper to consignee. Special standardized containers are used for intermodal

transport of cargo on trucks, freight trains, and ships. These containers are large rectangular boxes, capable of being secured to special trailers. These durable, steel containers are built so they can be transferred between different modes of transportation easily. This eliminates the risks of directly handling shipments. (Shipag group (2017) What is Intermodal Transportation and When is it the Best Choice?)

Other important services provided by dry ports:

In order to remain sustainable and competitive dry ports need to carry out certain services, some are offered by private companies, other by public institutions and some may even require especial permission granted by the legal authorities which is the case of customs clearance. The most required and intrinsic services that a dry port has or should have are procurement/distribution logistics, pre-packaging, intermediate storage, container stuffing/stripping, export packaging, pre/post carriage to sea ports, information systems, fuel stations, washing facilities and consolidation of individual container flows:

Procurement/distribution logistics: The act of obtaining or buying goods and services. The process includes preparation and processing of a demand as well as the end receipt and approval of payment. It often includes price negotiation, purchase planning, financing, supplier research and reputation, standard determination disposal and specifications development among others. All of them combined make up for a great information assessment and planning for the customers as they will now exactly what they are purchasing with which characteristics and how and when it is going to be delivered.

Pre-packaging: The port offers a packing service that adjusts to each good depending on their needs such as size, delicacy and fragility, number of spare parts, expiry date and climate conditions. The customized packaging improves the durability of the product as well as the quality and safety, the most cutting-edge packages are related to the food and beverages sector as well as electronic equipment where temperature regulated chambers are being used to preserve delicate and expensive products such as fish, meat, fungus or shellfish.

Intermediate storage: The port offers the possibility to store the containers temporarily in the case that the container must be delivered later or needs reallocation due to market flows or cancelled orders.

Container stuffing/stripping: This consists in the stuffing of the containers made by the workforce of the port. Once the goods arrive to the port depending on the size of the container,

quantity of orders and quality of products the port offers different fees for the load/unload of the freight

Export packaging: Designed to protect the freight during overseas transit. Some examples of export packaging are wooden crates or boxes, metal drums and plastic wrapping.

Pre/post carriage to sea ports: Most ports work as 'extended gates' of sea ports which means that the goods can be carried to the seaport from the dry port and vice versa, this is done via the intermodal transport mainly by rail or truck. However, waterways or air transport can be used as well if a route is available.

Information systems: The port is equipped with ERP system assistance, these systems are programmes such as SAP, Oracle or People-soft that has been developed in the last three decades to facilitate the track and organization of orders, inventories, delivery times, costs and so on. Therefore, each order has a cost, time, size and any type of observation attached to the order. All the flows of goods that take place within the port can be followed and tracked down by customers and see whether they will arrive on time or if there is any delay or problem. The implementation of systems like this are extremely effective to fight corruption, thief or any kind of mismatch.

Fuel stations: Where trucks and cars can fill their deposits at a reasonable price, sometimes the freight fee includes the price of the fuel.

Washing facilities: Especially useful for trucks which operate in cold or muddy regions where dirt and dust adheres to the wheels and body of the truck or vehicle.

Consolidation of individual container flows: It consists on the action of combining cargo of many consignees into a single lot and then preparing it for shipping. Clients benefit from the freight consolidation since shipment costs are significantly reduced by moving smaller goods together and then sharing the total costs between several orders.

Prime yield: The yield for a property of the highest quality specification in a prime location within the area. The property should be 100% let at the market rent at the time, to blue-chip tenants, with leasing term typical for prime property within that market. The yield should reflect net income received by an investor, expressed as a percentage of total capital value plus expected acquisition costs. (Catella group (2018))

Prime rent: Prime rent represents the top open-market rent that can be achieved for a notional office unit (sq m.) per month. The unit itself has to feature highest quality and is to be situated in the best location of the local market. (Catella group (2018))

Reefer Container: It is a refrigerated container used to transport freight that requires certain controlled conditions such as perishable items, fruits, vegetables, dairy products and meat. It are equipped with a refrigerating unit which is connected to the electrical network of the ship, truck or port terminals. It has a controlling disc for the temperature that displays the container's temperature from the loading time to its destination. (DSV, Global transport and logistics)

Silk road: The Silk Route was a series of ancient trade networks that connected China and the Far East with countries in Europe and the Middle East. The route included a group of trading posts and markets that were used to help in the storage, transport, and exchange of goods. It was also known as the Silk Road. In 2013, China began to officially restore the historic Silk Route under president Xi Jinping with a \$900 billion strategy called "One Belt, One Road" (OBOR). The project was a way to improve China's interconnectivity with more than 60 other countries in Asia, Europe, and East Africa.

Also known as the Belt and Road Initiative (BRI), it traverses numerous land and sea routes. The Silk Road Economic Belt is primarily land-based to connect China with Central Asia, Eastern Europe, and Western Europe, while the 21st Century Maritime Silk Road is sea-based, connecting China's southern coast to the Mediterranean, Africa, South-East Asia, and Central Asia. (Willy Kneton (2019), Silk Road definition - Investopedia)

Figure I.3: Silk Road.



Source: (Andrew Williams (2016) China-Europe rail: The road less travelled)

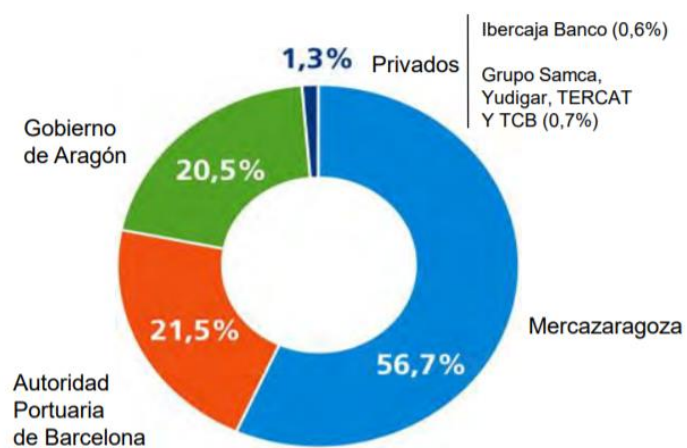
TEU: TEU stands for Twenty-Foot Equivalent Unit which can be used to measure a ship's cargo carrying capacity. The dimensions of one TEU are equal to that of a standard 20' shipping container. 20 feet long, 8 feet tall. Usually 9-11 pallets are able to fit in one TEU. Two TEUs are equal to one FEU (forty-foot-equivalent unit). (Dedola global logistics (2011) Supply Chain dictionary)

Transportation Mode: The method of transportation: land, sea, or air shipment. (Inbound logistics, Glossary of transportation)

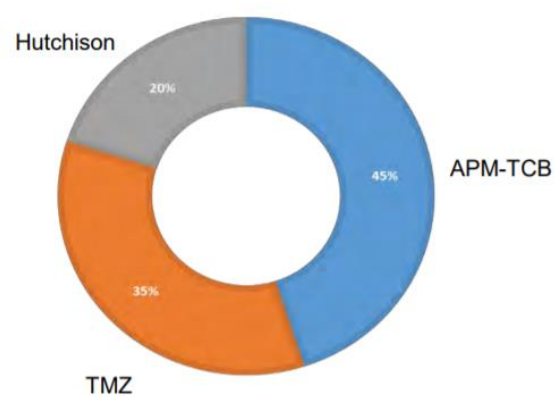
7.APPENDIX II: IMAGES, CHARTS AND TABLES

Chart II.1: Ownership and share distribution of TMZ.

**Sociedad Promotora:
Terminal Marítima de Zaragoza SL**

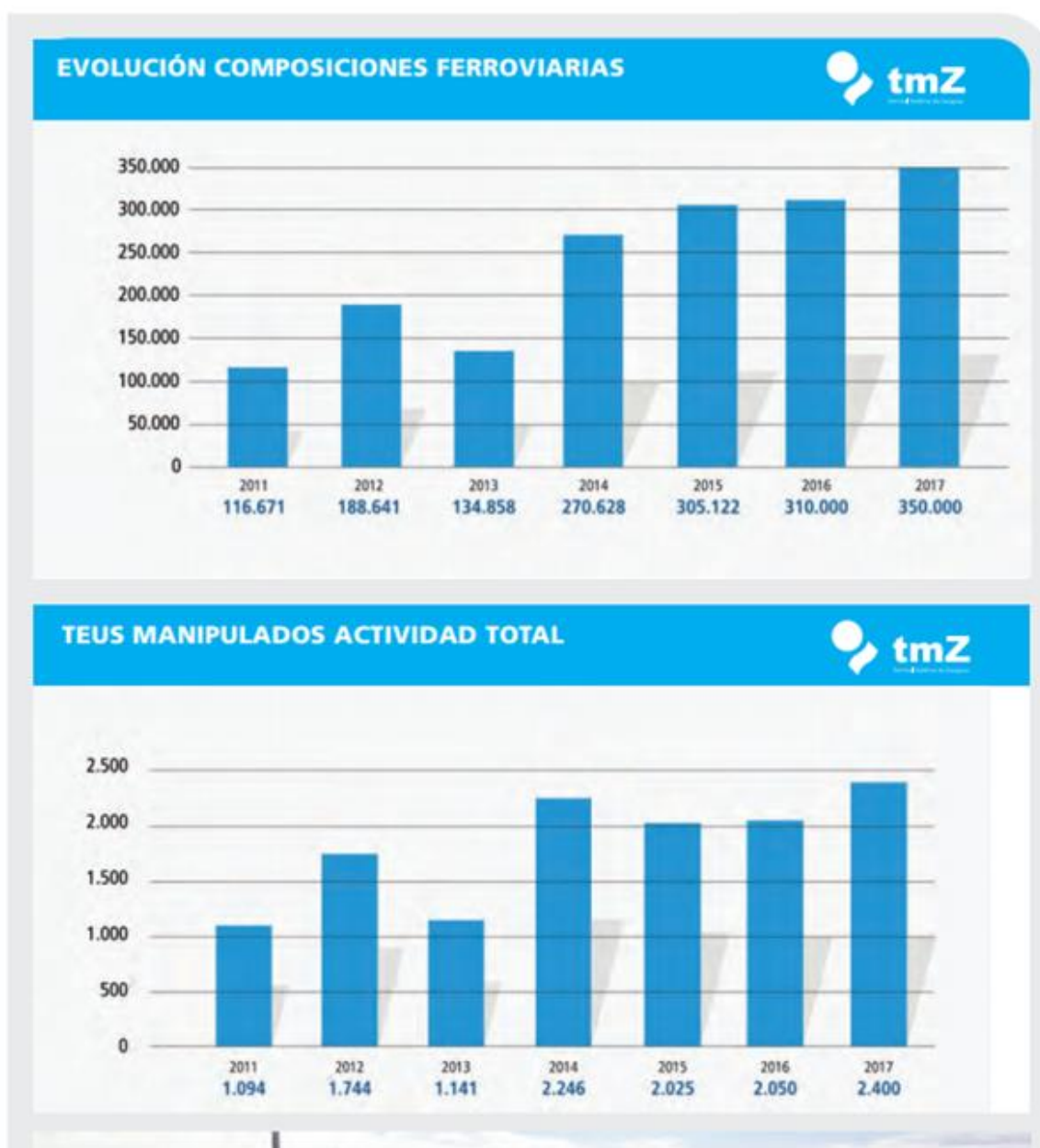


**Sociedad Operadora:
Depot tmZ.Services SL**



Source: TMZ.

Figure II.1: Evolution and data of TMZ activity.



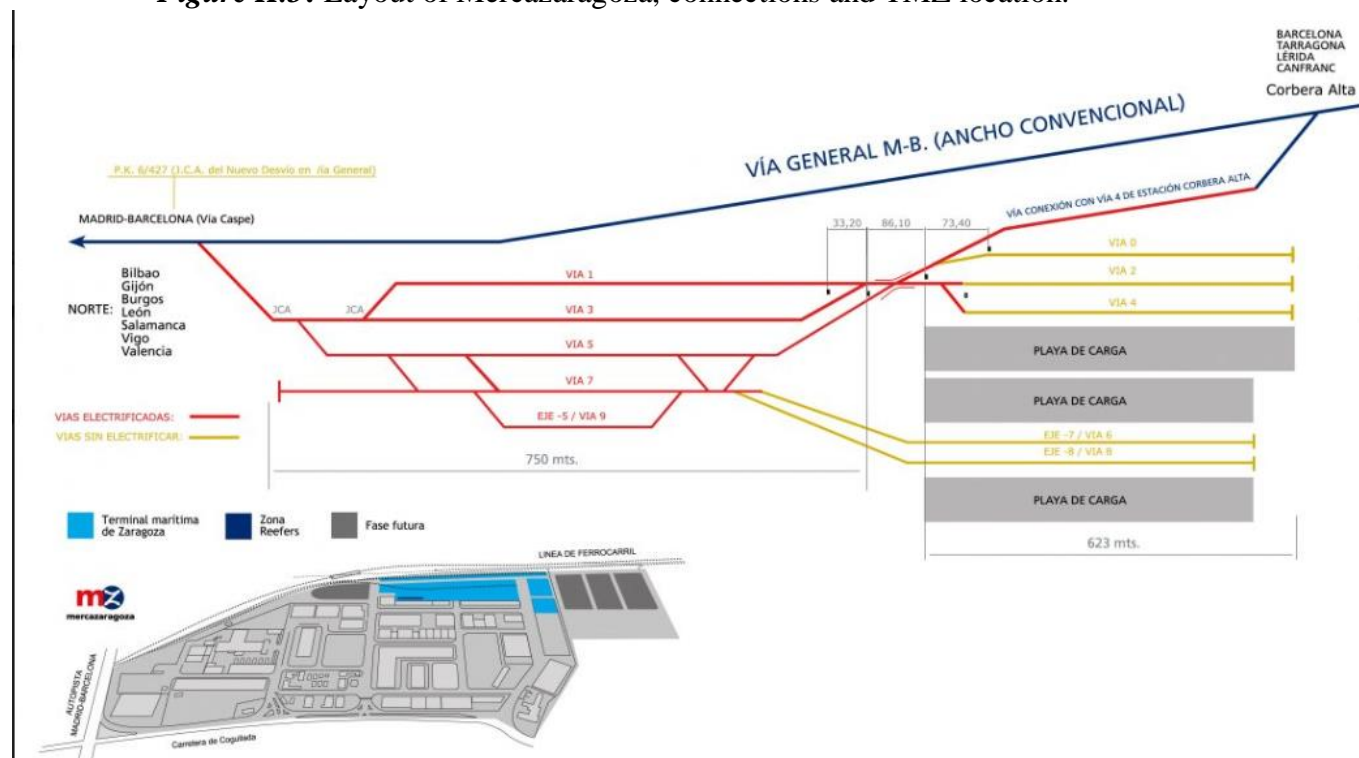
Source: Moviendo la economía para mover el mundo, TMZ.

Figure II.2: Goods distribution of TMZ.



Source: TMZ online portal

Figure II.3: Layout of Mercazaragoza, connections and TMZ location.



Source: Moviendo la economía para mover el mundo, TMZ

Table II.1: Duisport total cargo and containers handled.

	2017	2016
Total cargo handled by all Duisburg ports including the private ports	130,6 Mio. t	133 Mio. t
Total cargo handled by the duisport Group	68,3 Mio. t	67 Mio. t
Containers handled	4,1 Mio. TEU	3,7 Mio. TEU

Source: Duisport annual report

Table II.2: Truck operating costs for Germany.

Cost Component	Trucks, long distance	Trucks, short distance	Average costs, HDV
	Share of total costs (in %)	Share of total costs (in %)	(in EUR/vkm)
Personnel (wages, social costs)	38.7%	49.6%	0.486
Depreciation	9.3%	11.4%	0.114
Interests	1.1%	1.3%	0.013
Fuel	21.4%	12.7%	0.188
Maintenance and repair	8.0%	6.7%	0.081
Washing	0.5%	0.6%	0.006
Tyres	1.9%	2.5%	0.024
Taxes & charges	2.2%	1.2%	0.019
Insurance	4.6%	5.2%	0.054
Additional expenses	12.4%	8.8%	0.117
Total	100%	100%	1.100

Source: BGL (2005). BGL (2006), RHENUS (2005).

Table II.3: Truck operating costs for Spain.

Cost Component	Costs HDV per year (in EUR/year)	Average costs HDV per vkm (in EUR/vkm)
Depreciation	17'647	0.19
Interests	846	0.01
Wages	25'580	0.27
Insurance	4'996	0.05
Taxes	815	0.01
Fuel	23'218	0.24
Tyres	3'059	0.03
Maintenance	1'434	0.02
Repair	1'948	0.02
Total	79'543	0.84

Source: Ministerio de Fomento (2006).

Table II.4: Pierage fees 2006 in Duisburg, Germany

Load	Fee	Unit
Full Container	6,60	€/TEU
Empty Container	0,90	€/TEU
Freight class 1+2	0,40	€/ton
Freight class 3+4	0,29	€/ton
Freight class 5	0,20	€/ton
Freight class 6	0,17	€/ton

Source: Duisport.de online portal

Table II.5: Number of existing and in development CTL's

Comunidad Autónoma	Número de CTL existentes	Número de CTL en desarrollo o planificados
Andalucía	6	14
Aragón	2	4
Asturias	1	1
C. Madrid	2	10
C. Valenciana	0	10
Cantabria	0	1
Castilla La Mancha	6	6
Castilla y Leon	5	6
Cataluña	8	5
Extremadura	0	1
Galicia	0	3
Murcia	0	2
Navarra	0	1
País Vasco	4	0
Rioja	1	0

Source: Observatorio de la logística en España, 2010

Table II.6: Existing and in development logistics space

Comunidad Autónoma	Superficie planificada o en desarrollo (m ₂)	Superficie existente (m ₂)	Factor de crecimiento (%)
Andalucía	21.938.154	1.190.693	1842,47
Aragón	5.794.319	13.431.898	43,14
Asturias	4.130.000	150.000	2753,33
C. Madrid	36.640.000	1.438.500	2547,10
C. Valenciana	5.460.426	0	Nuevos CTL
Cantabria	N.D.	0	N.D.
Castilla La Mancha	3.831.900	10.360.000	36,99
Castilla y Leon	12.523.700	1.393.880	898,48
Cataluña	7.187.000	4.386.833	163,83
Extremadura	2.000.000	0	Nuevos CTL
Galicia	7.660.000	0	Nuevos CTL
Murcia	2.320.000	0	Nuevos CTL
Navarra	1.029.483	0	Nuevos CTL
País Vasco	550.000	2.780.701	19,78
Rioja	1.500.000	0	Nuevos CTL

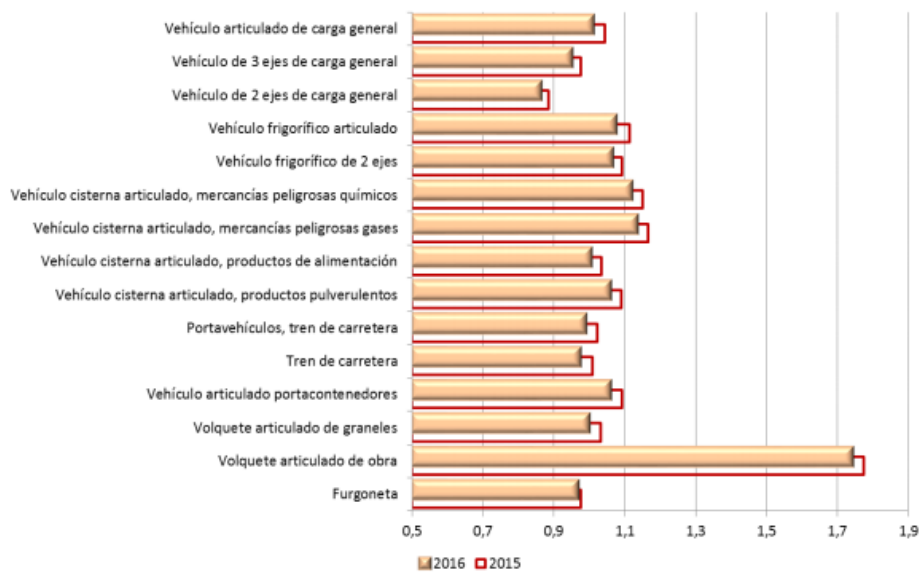
Source: Observatorio de la logística en España, 2010

Table II.7: Average renting costs depending on activity

Tipo de superficie	Alquiler Superficie (€/m ²)	Venta Superficie (€/m ²)	Servicios comunes (€/m ²)
Descubierta	0,86	106	0,25
Cubierta sin especialización (naves)	3,6	592,05	0,29
Contenedores	N.D.	N.D.	N.D.
Frigorífica	N.D.	N.D.	N.D.
Mercancías peligrosas	2,75	625	N.D.
Intermodal/Modos conectados	1	147	0,325
Oficinas y servicios generales	10	N.D.	36
Aparcamiento	71	N.D.	N.D.
Otros	2,6	N.D.	0,18

Source: Encuestas opinometre, 2011

Figure II.4: Total unitary cost (€/vehicle-km) for spanish road transport



Fuente: Elaboración propia con datos del Observatorio de costes del transporte de mercancías por carretera. Dirección General de Transporte Terrestre. Ministerio de Fomento

Source: Informe OTLE 2017, pp-157

Figure II.5: Ownership of Duisport and its competencies

Owner of duisport:

2/3 of share capital: State of NRW, 1/3 of share capital: City of Duisburg



Source: Duisport.de online portal

Table II.7: What doing business measures

Indicator set	What is measured
Starting a business	Procedures, time, cost and paid-in minimum capital to start a limited liability company
Dealing with construction permits	Procedures, time and cost to complete all formalities to build a warehouse and the quality control and safety mechanisms in the construction permitting system
Getting electricity	Procedures, time and cost to get connected to the electrical grid, the reliability of the electricity supply and the transparency of tariffs
Registering property	Procedures, time and cost to transfer a property and the quality of the land administration system
Getting credit	Movable collateral laws and credit information systems
Protecting minority investors	Minority shareholders' rights in related-party transactions and in corporate governance
Paying taxes	Payments, time and total tax and contribution rate for a firm to comply with all tax regulations as well as post-filing processes
Trading across borders	Time and cost to export the product of comparative advantage and import auto parts
Enforcing contracts	Time and cost to resolve a commercial dispute and the quality of judicial processes
Resolving insolvency	Time, cost, outcome and recovery rate for a commercial insolvency and the strength of the legal framework for insolvency
Labor market regulation	Flexibility in employment regulation and aspects of job quality

Source: The World Bank (2018)