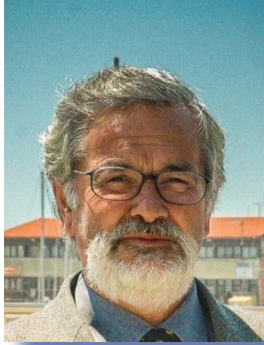


DOURO RIVER AND LEIXÕES PORT (PORTUGAL) – THE PAST, THE PRESENT AND THE FUTURE

by



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MOTS-CLES:

Port de Leixões, la rivière Douro, navigation, protection côtière, commerce commercial

THE DOURO RIVER

1. Commercial Trade

The Douro port was used for commercial trade for centuries as the only Portuguese port to the north of Lisbon. In the 14th century, Porto was considered an important trade port.

Throughout the 15th and 16th centuries, Portugal pursued an intensive maritime exploration that included the discovery and mapping of Africa, Asia and Brazil and during that period, Porto played an important role in the shipbuilding industry. During that time, important routes to Brazil and England were maintained and later on, in the 18th century with the creation of Alto Douro Wines Company (Companhia dos Vinhos do Alto Douro), Porto was the centre of Port Wine commerce (Figure 1).



Figure 1: River Douro – Cais de Gaia

2. River Limitations

The Douro River is one of the most important rivers in Portugal and the one with the highest flood flow rate, which is estimated at 26,000 m³/s (for a return period of 1,000 years). Furthermore, the configuration of the river channel, with steep rocky slopes, creates propitious conditions for high flow velocities near the river mouth (Figure 2).

These natural characteristics contribute to the severe navigation conditions in result of floods.

This fact led in the past to a high inoperativeness of the Douro port, especially in the autumn and winter seasons.



Figure 2: Flood river Douro in 1909

3. Navigation and River Mouth Entrance

The narrow navigation channel at the river mouth presented multiple obstacles, both stable, such as granitic rock formations, and dynamic, such as sand bars that migrated constantly due to currents and wave action. These obstacles complicated navigation in the river channel even for experienced sailors, and therefore, multiple accidents and shipwrecks were reported along the years (Figure 3).



Figure 3: Shipwreck at Douro River

These difficulties were aggravated by the increase of ships' cargo capacity which made them bigger and therefore more difficult to enter the river mouth and navigate upstream.

From the 18th century onwards, transatlantic vessels were not able to scale at Douro port, making Lisbon the only stop in Portugal on these important routes.

Despite some resistance from sceptics connected to the Douro port activities, a strong necessity to create a safer and feasibly alternative to Douro port emerged, in particular during the winter period.

Meanwhile, the Port wine commercial trade kept its traditional journey, from the Alto Douro region to Gaia, down the river, until the implementation of the Douro railway line.

During the second half of the 20th century, several studies were conducted in order to find a solution for the stabilisation of the Douro River entrance and protection of the Porto riverside and in 2007 the Douro Moles were inaugurated (Figure 4).

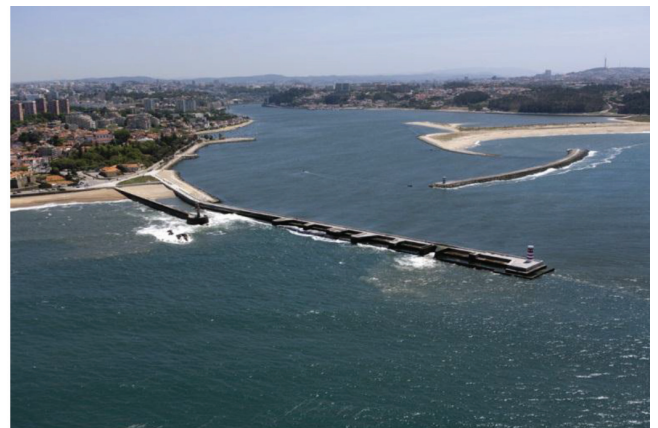


Figure 4: Douro moles at the entrance of Douro River

This coastal protection and stabilisation work also plays an important role on the cruise industry of the river Douro, which has been growing in the past decades (Figure 5).



Figure 5: Douro cruise terminal at Cais de Gaia

The Douro cruise industry moves more than 550,000 tourists per year, placing the Douro River in the top 3 of the Portuguese ranking.

THE LEIXÕES PORT

1. An Alternative for Douro Port

The natural geotechnical and topographic conditions in front of the mouth of river Leça, namely the presence of a series of massive rocks named 'Leixões', created a sheltered basin, located at 1.5 km from the coastline. This basin was used in the past when ships were not capable of entering the mouth of the Douro river and waited there for better navigation conditions.

The construction of the breakwater, the first artificial protection of the Leixões port, began in 1884, making use of the existent natural rocks named 'Leixões' (Figure 6). The port was considered by many experts as the Portuguese most important engineering construction of the 19th century [Souza, 2002].



Figure 6: Construction of the Leixões breakwater

The strong increase of the commercial trade in this new and safer port, despite the distance from the city of Porto, soon made clear that the future would pass by the Leixões Port.

During the 19th and 20th centuries, larger and heavier ships demanded the increase of port fa-

cilities and multiple interventions were performed towards that goal. The interior docks were excavated inland during the first half of the 20th century (Figure 7).

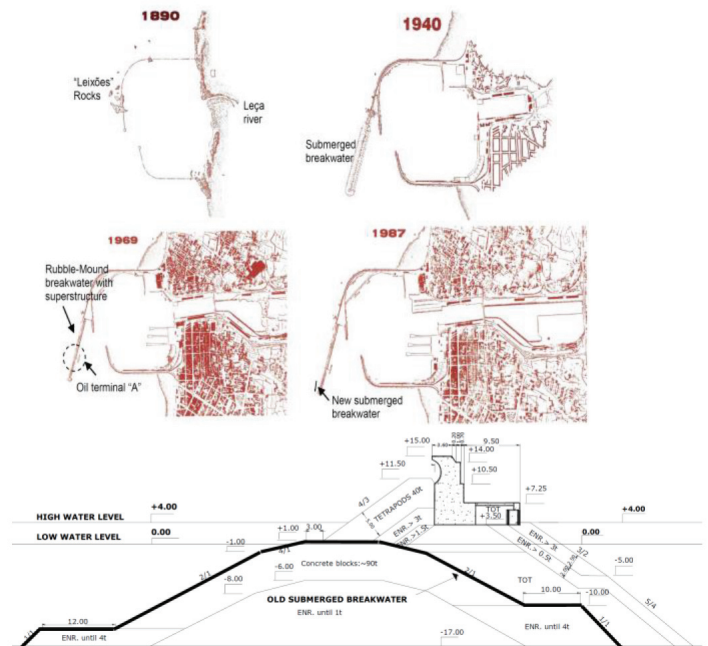


Figure 7: Leixões port evolution and layout of the north breakwater

2. The Port Growth

Along the years, the port grew larger and deeper, facing new challenging conditions in response to international demands and keeping the Leixões port in the forefront of Europe's ports (Figure 8).



1940



2004

Figure 8: Leixões port layouts in 1940 and 2004

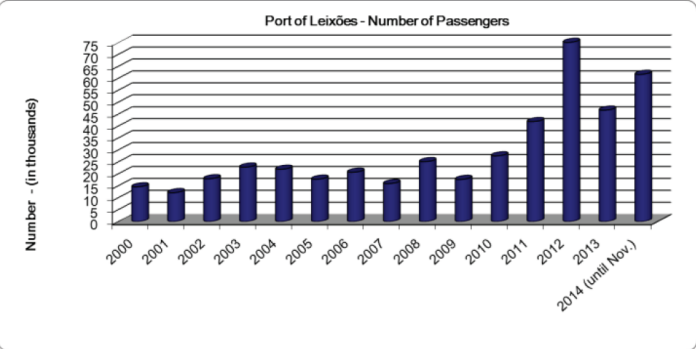
3. Today's Numbers

The port of Leixões is nowadays one of the most important ports in Portugal and the most important of the northern region (Figure 9).

In terms of total cargo handled, containers are rising significantly in the past decades, when compared with other types of cargo (Graph 1).

A detailed analysis on container handling results reveals that it has been growing consistently (Graph 2).

In terms of passengers, the results reveal an overall growing trend (Graph 3).



Graph 3: Number of passengers

The constantly growing requirements of maritime trade demand permanent adjustments from port authorities to meet exigent standards.

The port of Leixões has been making important investments in the past decades and others are foreseen for the near future.

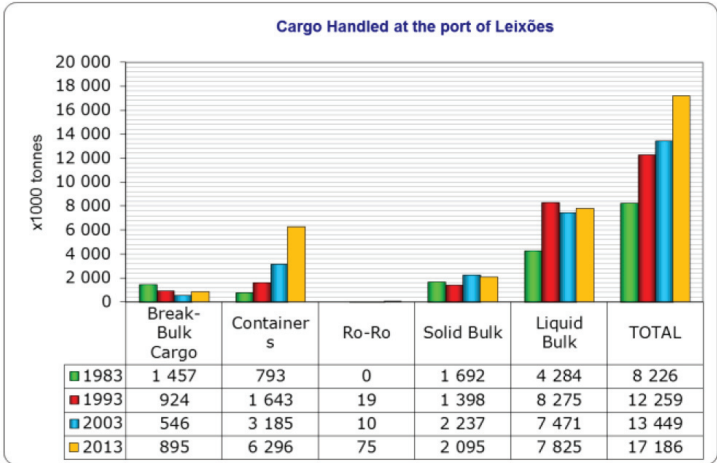
In 2014, and despite the economic crisis in Portugal, the Port of Leixões achieved a new record in container handling by exceeding the 650,000 TEU.

In 2014 more than 17.5 million tonnes of cargo were handled at the port of Leixões.

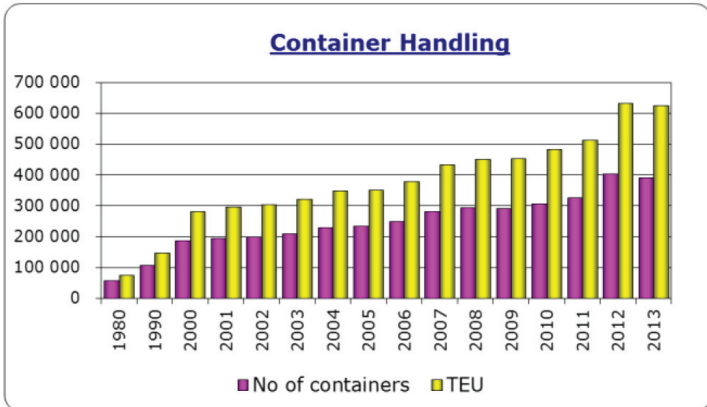
The main facilities of the port include:

NEW MAIN GATEWAY AND VILP

To reduce the time of entrance/exit of trucks in the port of Leixões, a new main gateway was constructed equipped with the most recent technology, including X-ray scanning and registration plates recognition (Figure 10). Along with the gateway, a new direct access to the main regional highways was built, the VILP, removing more than 2,000 trucks a day from the surrounding urban area.



Graph 1: Cargo handled at the port



Graph 2: Containers handled in the port of Leixões



Figure 9: Leixões port layout

Along with the new Gateway, a new system named **JUP II (Unique port Window)**, started to work in 2013. It's a one-stop-shop system where all entities that operate in the port deliver all information in electronic form. Thus, there are no documents in paper form, leading to a faster and more efficient exchange of documents between stakeholders, with total security and confidentiality.



Figure 10: Leixões main gateway

CRUISE SHIP TERMINALS

South Terminal

The new cruise terminal, with a berthing quay of 330 m, and a depth of -10.0 m (C.D.) is capable of receiving cruise ships of up to 300 m (Figure 11). It also includes a marina for 170 vessels.

North Terminal – Dock 1

The north cruise terminal has a berthing quay of 300 m with a depth of -10.0 m (C.D.), being capable of receiving ships with a maximum length of 250 m and a draught of 8.0 m (at high tide, 9.0 m).



Figure 11: Leixões port layout

OIL TERMINAL: A, B, C

The port of Leixões has an oil terminal composed by three piers, A, B and C, in the inner side of the north breakwater (Figure 12).

Pier A, with a water depth of -14.0 m (C.D.) is capable of receiving vessels of up to 100,000 DWT (Deadweight tonnes), carrying crude oil and various refined products. Pier B, with a water depth of -10.0 m (C.D.) is capable of receiving vessels of up to 27,000 DWT, carrying crude oil and various refined products, liquefied gases and aromatic products. Pier C, with a water depth of -6.0 m (C.D.) is capable of receiving vessels of up to 5,000 DWT, carrying liquefied petroleum gases, various refined products and aromatic products.

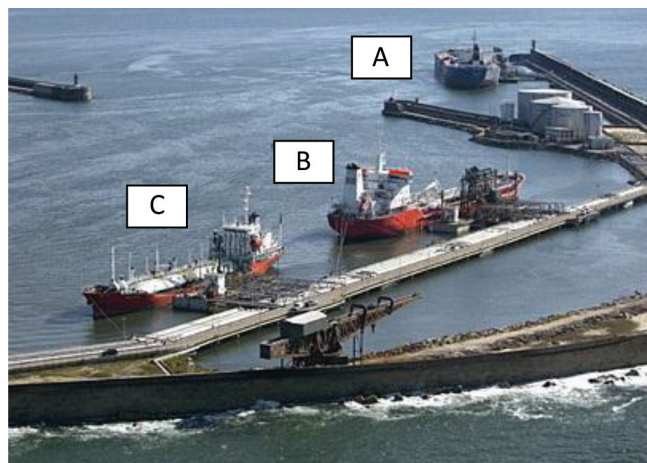


Figure 12: Oil terminal

CONTAINER TERMINALS: NORTH AND SOUTH TERMINALS

North Container Terminal

The north container terminal of Leixões has a berthing quay of 360 m with a water depth of -10.0 m (C.D.). This terminal occupies a total of 6 ha and has a handling capacity of 250,000 TEU per year (approximately 172,800 containers) and a storage capacity of 4,000 TEU, 96 of them with power supply outlets. The terminal is equipped with 2 quay-side gantries with a capacity of up to 35/40 tonnes and 5 transtainer gantries of 35 tonnes capacity.



Figure 13: North container terminal

South Container Terminal

The south container terminal of Leixões has a berthing quay of 540 m with a water depth of -12.0 m (C.D.). This terminal occupies a total of 16 ha and has a handling capacity of 350,000 TEU per year (approximately 226,000 containers) and a storage capacity of 15,000 TEU, 310 of them with power supply outlets.

The terminal is equipped with 3 quayside gantries with a capacity of up to 60/78 tonnes and 7 transtainer gantries, of which four with 35 tonnes capacity and three with 40 tonnes capacity, 4 reach-stackers and 6 front-lift trucks.

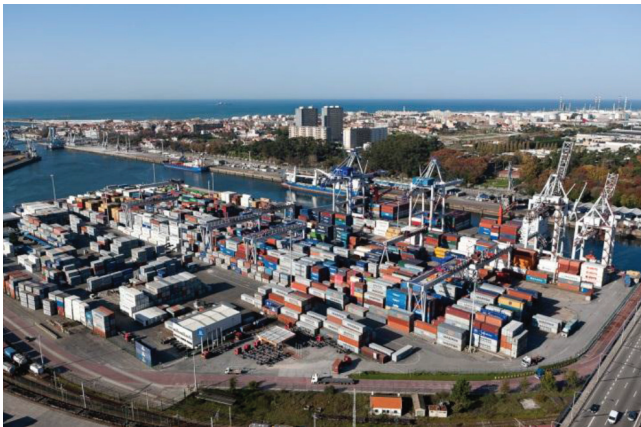


Figure 14: South container terminal

THE MULTIPURPOSE TERMINAL

Especially suited for Ro-Ro (Roll-on/Roll-off), with a 26-m wide ramp and enhancing the Sea Motorways from Leixões, the multipurpose terminal has a 310 m berthing quay with a water depth of -10.0 m (C.D.), occupying 6 ha (Figure 15).



Figure 15: Multipurpose terminal

LIQUID BULK TERMINAL: SOUTH MOLE, DOCK 1 SOUTH, DOCK 2 SOUTH

South Mole

The south mole has a berthing quay of 290 m, with a water depth of -6.0 m (C.D.), capable of receiving

liquid fuels, liquefied petroleum gases, asphalts and molasses. The mole is equipped with storage tanks for molasses (Figure 8).

Dock 1 South

The dock 1 south has a berthing quay of 520 m, with a water depth of -10.0 m (C.D.), capable of receiving molasses (Figure 16).

Dock 2 South

With a berthing quay of 690 m and a water depth of -11.0 m (C.D.), the dock 2 south is prepared to receive asphalt and fuel oil products.



Figure 16: Liquid bulk terminal

GENERAL CARGO, RO-RO AND SOLID BULK: Dock 1 North, Dock 1 South, Dock 2 South, Dock 4 North (Agri-Bulk Terminal)

The General Cargo and Solid Bulk Terminal is capable of handling multiple cargoes from timber, to granite, cotton, cereals, vehicles, scrap metal, machinery and wind turbines, among others.

Dock 1 North

The Dock 1 North has a berthing quay of 455 m, with a water depth of -10.0 m (C.D.) and is equipped with a 45/90 tonnes crane. The storage capacity is 17,850 m² and includes a Ro-Ro ramp with 11 to 22 m wide ramp.

Dock 1 South

The Dock 1 South has a berthing quay of 520 m, with a water depth of -10.0 m (C.D.) and is equipped with 7 cranes and a storage capacity of 16,650 m².

Dock 2 North

The Dock 2 North has a berthing quay of 670 m, with a water depth of -11.0 m (C.D.) and is equipped with 12 cranes ranging from 6 to 104 tonnes capacity. The storage capacity is of 34,700 m².

Dock 2 South

With a berthing quay of 690 m and a water depth of -11.0 m (C.D.), the Dock 2 South is equipped with 14 cranes ranging from 6 to 104 tonnes capacity.

Dock 4 North

With a berthing quay of 400 m and a water depth of -12.0 m (C.D.), the Dock 4 North is the Agri-bulk terminal and is capable of handling most of the solid bulk agricultural foodstuffs.

YACHT MARINA

The Leixões Marina has a capacity of 248 places, at a maximum depth of -4.0 m (C.D.), for yachts of up to 30 m (Figure 17).



Figure 17: Yacht marina

FISHING HARBOUR

The fishing harbour of Leixões has three intake jetties with a total of 1,890 m, at a maximum depth of -4.0 m (C.D.) (Figure 18). The refrigerated warehouse has 5,500 tonnes of capacity.



Figure 18: Fishing harbour

4. Riding the Crest towards a Prosperous Future

The constant growth of commercial trade and the

increase on the level of exigency required, leads to the need of defining strategic plans to meet future demands. To that end, the port of Leixões Authority defined in 2004 a set of investments to improve the conditions that Leixões port has to offer to stakeholders. This Strategic Development Plan of the Port of Leixões is almost accomplished and included among other objectives:

- The increase of the navigability capacity of the Port, by increasing the depth of the access channel and of the rotation basin to -12.0 m (C.D.) and deepening several docks
- Refurbishment of the South Mole and adjacent areas
- Improvement of Oil Terminal Operating Conditions
- Single Gateway Project
- Conversion of the Containerised Cargo area
- Refurbishment and Restoration of the Areas and Buildings
- Improvement of the Perimeter Areas and Enhancement of Urban Fronts

A short description of ongoing works and future projects is presented ahead.

LOGISTICS PLATFORM (Under Construction)

With an estimated investment of € 108 million, the logistics platform of Leixões is one of the key investments of Leixões port (Figure 19).



Figure 19: Logistics platform

The platform includes two sites:

Site 1: with a total area of 31 ha and a construction area of 9.1 ha, it is the one closest to the port at only 2 km. It will include warehouses, some of them modular (to be used by different clients), a Service Centre, a Gateway for access control, as well as support services for drivers and trucks (Figure 20).



Figure 20: Logistics platform – Site 1

Site 2: with a total area of 35 ha and a construction area of 8.6 ha, it is 3 km away from the port. It will include warehouses (some of them modular), a Service Centre, a Gateway for access control and an Intermodal Terminal with 9 ha (Figure 21).



Figure 21: Logistics platform – Site 2

NEW CONTAINER TERMINAL (Future Project)

In the past decades container handling has been growing significantly and the expectations are that they will keep growing in the future. Therefore, the Port Authority is studying the possibility of creating a new Container terminal at the South Mole (Figure 22).

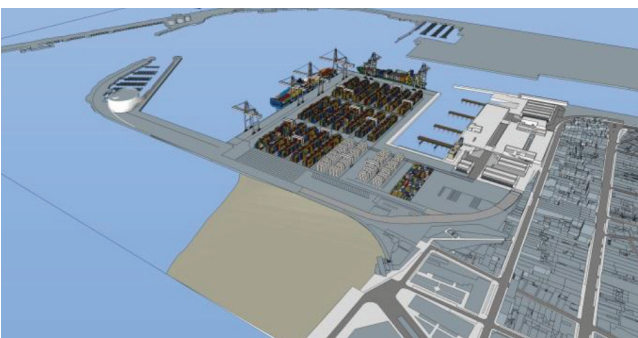


Figure 22: New Container Terminal

CONCLUSIONS

Maritime transport and commercial trade in ports has suffered significant changes during the past centuries and especially during the second half of the 20th century. From the exponential growth of containers to logistics, to environmental concerns,

to traffic and to technological development, there were multiple challenges to overcome.

The Port of Leixões has a mission: 'To provide acknowledged value services to users of the Port of Leixões through adequate provision of infrastructure, a high operating efficiency, skilled and motivated human resources, a practice of sustainability and safety, organising and developing the port area and ensuring adequate urban integration, involving the port community of Leixões.'

That mission should be accomplished without neglecting its main objective: 'To bring the Port of Leixões to a benchmark position for the logistical systems that use the Atlantic coast of the Iberian Peninsula.'

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SUMMARY

In the past, the maritime commercial trade of the northern region of Portugal mostly took place in the Douro port. However, the narrow and dangerous entrance channel and the constant floods during the winter were not compatible with the demands of the 20th century and a new port emerged, the Leixões port. The port of Leixões soon revealed a strong potential and during the 20th century its growth was constant, not only in terms of commercial trade but also in terms of facilities. The port

of Leixões is nowadays the second most important port of Portugal, occupying the same position when comparing all the ports in the north of the Iberian Peninsula.

Despite having lost to Leixões port most of its commercial trade, the Douro River is today one of the most important cruise routes in Portugal, mainly due to their impressive landscape, vineyards and cellars. A description of its evolution in more than 100 years of existence is given, focusing also on the existent facilities and on the challenges to come.

RESUME

Dans le passé, la plupart du trafic maritime commercial du Nord du Portugal était réalisé dans le port du Douro. Toutefois l'entrée étroite et dangereuse du canal et les inondations récurrentes en hiver n'étaient pas compatibles avec les exigences du XX^{ème} siècle et un nouveau port a vu le jour. Le port de Leixões. Ce port a rapidement révélé un important potentiel et tout au long du XX^{ème} siècle sa croissance a été continue, non seulement en termes de trafic mais aussi en termes

d'infrastructures. Le port de Leixões est maintenant le second port du Portugal et aussi le second port de la partie nord de la péninsule ibérique.

Malgré la perte de l'essentiel de son trafic commercial au bénéfice de Leixões, le port du Douro est aujourd'hui un itinéraire éminent de croisière au Portugal, principalement à cause de son paysage spectaculaire, ses vignes et ses caves. L'article donne une description de son évolution sur plus de 100 ans d'existence, de ses infrastructures existantes et de ses défis à relever.

ZUSAMMENFASSUNG

In der Vergangenheit wurde der kommerzielle Seehandel der nördlichen Region Portugals hauptsächlich über den Douro Hafen abgewickelt. Die enge und gefährliche Zufahrt sowie die ständigen Überflutungen während des Winters waren jedoch nicht mit den Anforderungen des 20. Jahrhunderts kompatibel und ein neuer Hafen entstand, der Leixões Hafen. Der Leixões Hafen entwickelte bald ein starkes Potenzial und während des 20. Jahrhunderts wuchs er konstant, nicht nur hinsichtlich des Handels, sondern auch bezüglich der Anlagen. Heutzutage ist der Hafen von Leixões

der zweitwichtigste Hafen Portugals, der im Vergleich mit allen Häfen im Norden der iberischen Halbinsel den gleichen Stellenwert einnimmt.

Obwohl er seine Bedeutung für den Handel an den Leixões Hafen verloren hat, ist der Douro Fluss heute eine der wichtigsten Kreuzfahrtrouten in Portugal, hauptsächlich wegen der eindrucksvollen Landschaft, der Weinberge und der Weinkeller. Seine Entwicklung in mehr als 100 Jahren Existenz wird beschrieben, unter Berücksichtigung der bestehenden Gegebenheiten sowie der kommenden Herausforderungen.

RESÚMEN

En el pasado, el comercio marítimo en la región Norte de Portugal se desarrollaba fundamentalmente a través del puerto del Duero. Sin embargo, su peligroso y estrecho canal de acceso, unido a la existencia de constantes inundaciones durante el periodo invernal, no lo hacían compatible con las demandas que requería el siglo XX, razón que llevó al desarrollo de un nuevo puerto. El puerto de Leixões pronto mostró su elevado potencial, y ya durante el siglo XX tuvo un crecimiento constante, no solo en términos de tráfico, sino también en la generación de infraestructuras. El puerto de

Leixões es, a día de hoy, el segundo más importante de Portugal, ocupando esta misma posición si se compara con los puertos situados al Norte de la península Ibérica.

A pesar de haber perdido la mayoría de su tráfico comercial en favor de Leixões, el río Duero es hoy una de las rutas de crucero más importantes de Portugal, básicamente debido a su impresionante paisaje, a sus viñedos y a sus bodegas. En este artículo se realiza una descripción de su evolución a lo largo de los últimos 100 años, centrándose en su oferta y en los retos que deberá afrontar en el futuro.