

Artigo submetido a 28 de janeiro 2026; versão final aceite a 14 de julho de 2026
Paper submitted on January 28, 2026; final version accepted on July 14, 2026
Doi: <https://doi.org/10.59072/rper.vi76.880>

Industrial Heritage and Tourism Development Through Luso-Spanish Cross-Border Cooperation

Património Industrial e Desenvolvimento do Turismo por Meio da Cooperação Transfronteiriça Luso-Espanhola

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Abstract

Industrial tourism and heritage have become essential instruments for promoting cultural preservation and regional sustainable development, particularly in low-density and post-industrial territories. Within the Duero-Douro cross-border region, industrial heritage represents a joint cultural asset that can strengthen cooperation and foster innovative tourism strategies between Portugal and Spain. In this context, this study focused on mapping and analysing industrial and pre-industrial heritage across 22 Portuguese and 80 Spanish municipalities, resulting in a database of 1,075 catalogued assets. The methodology combined data collection, validation, and analysis through active collaboration among cross-border institutions, involving 9 entities and 21 researchers. The results reveal a predominance of transport infrastructure, wineries, and food industries, reflecting the historical and cultural interdependence between the two territories. The findings focus on the potential of cross-border cooperation to promote the valorisation and sustainable use of industrial heritage, contributing to territorial cohesion, tourism diversification, and the construction of a shared Iberian identity related to industrial tourism.

KEYWORDS: Industrial heritage, cross-border cooperation, industrial tourism, Duero-Douro region, sustainable development.

JEL CLASSIFICATION CODE: Z3

Resumo

O turismo industrial e o património tornaram-se instrumentos essenciais para promover a preservação cultural e o desenvolvimento regional sustentável, especialmente em territórios de baixa densidade e pós-industriais. Na região transfronteiriça do Douro-Duero, o património industrial constitui um bem cultural conjunto que pode fortalecer a cooperação e fomentar estratégias inovadoras de turismo entre Portugal e Espanha. Neste contexto, este estudo teve como foco o mapeamento e a análise do património industrial e pré-industrial em 22 municípios portugueses e 80 espanhóis, resultando numa base de dados com 1.075 bens catalogados. A metodologia combinou a recolha de dados, a validação e a análise por meio de uma colaboração ativa entre instituições transfronteiriças, envolvendo 9 entidades e 21 investigadores. Os resultados revelam uma predominância de infraestruturas de transporte, adegas e indústrias alimentares, o que reflete a interdependência histórica e cultural entre os dois territórios. As conclusões concentram-se no potencial da cooperação transfronteiriça para promover a valorização e o uso sustentável do património industrial, contribuindo para a coesão territorial, a diversificação turística e para a construção de uma identidade ibérica partilhada relacionada com o turismo industrial.

PALAVRAS-CHAVE: Patrimônio industrial, cooperação transfronteiriça, turismo industrial, região do Douro-Duero, desenvolvimento sustentável.

JEL CLASSIFICATION CODE: Z3

1. INTRODUCTION

Cross-border cooperation has increasingly emerged as the basis for regional development policies in Europe, particularly in territories characterised by common historical, cultural, and economic relations (Sebentsov, 2020). Within this framework, industrial heritage represents a demonstration of collective memory and a strategic asset that can foster cohesion, sustainability, and innovation across national boundaries. The joint valorisation of heritage resources through cooperation constitutes a distinctive field of study that connects cultural policy, spatial planning, and sustainable tourism (Sebentsov, 2020; Fogarazi, 2024).

The *Duero-Douro* region, which lies between Spain and Portugal, exemplifies this reality. This region presents a natural corridor of interaction, where both countries share industrial legacies, economic interdependencies, and socio-cultural continuities. Historically, the frontier has simultaneously served as a line of division and a bridge of exchange, where production systems, trade routes, and human networks have evolved in mutual influence. The contemporary challenge lies in transforming this inherited industrial landscape into a cross-border tourism resource that strengthens territorial cohesion, while preserving local authenticity (Scalabrini et al., 2024).

In this context, this study was developed within the scope of the Interreg POCTEP, a cross-border cooperation project that promotes cross-border cooperation in the cross-border area (POCTEP, 2024). The project aimed to promote sustainable regional development by enhancing the industrial and pre-industrial heritage of the *Duero-Douro* region in Portugal and Spain. The initiative adopts an integrated and participatory approach, mobilising public and private entities on both sides of the border to jointly design strategies for the valorisation of industrial heritage. This approach promotes shared governance and reinforces a sense of joint ownership of cultural assets (POCTEP, 2024).

The research focused on mapping and analysing industrial heritage across 22 Portuguese and 80 Spanish municipalities, to build a unified knowledge base that captures the diversity and potential of industrial and pre-industrial assets in both countries. Through systematic data collection, validation, and analysis, it provides a comprehensive overview of the industrial heritage shared by Portugal and Spain, offering a basis for coordinated tourism and cultural development.

Beyond its technical dimension, this process constitutes an exercise in cross-border integration, bringing together municipalities, regional agencies, research institutions, and local actors in a collective effort to co-produce the knowledge. This dynamic reflects the essence of European cross-border cooperation, the pursuit of synergies, and the creation of added value through joint action, shared objectives, and policy alignment across historically and culturally intertwined territories.

Although industrial heritage has been addressed in tourism and regional development studies, fewer contributions have examined how cross-border inventories can support the integrated planning of industrial tourism routes. This gap is relevant in low-density border regions, where heritage assets are often dispersed, unevenly documented and managed by different institutional actors. By combining typological classification, territorial mapping, accessibility assessment and tourism interest evaluation, this study contributes to understanding how shared industrial heritage can be transformed into a strategic resource for cross-border tourism development.

In this context, this study demonstrates how cross-border cooperation can act as a catalyst for the preservation and promotion of industrial heritage. It emphasises the potential of joint strategies to enhance the visibility and sustainability of tourism resources across the cross-border region between *Terras de Trás-os-Montes* and *Castilla y León*, contributing to a deeper understanding of how shared heritage strengthens European territorial cohesion and fosters innovative forms of cultural and economic collaboration.

This paper is structured into five main sections. Following this introduction, the theoretical framework outlines the conceptual foundations of industrial and pre-industrial tourism and their relevance within cross-border contexts. The third section details the methodological procedures, describing the steps for data collection, validation, and mapping across Portuguese and Spanish territories. The fourth section presents and discusses the main results, focusing on the geographical distribution, typology, accessibility, and tourism potential of the identified heritage assets. Finally, the conclusions summarise the key findings, emphasising the implications of cross-border cooperation for sustainable territorial development, and outline strategic recommendations for future initiatives in the *Duero-Douro* region.

2. THEORETICAL FRAMEWORK

Industrial tourism emerged in the United States and the United Kingdom in the 1960s. Initially, this concept was conceived to promote the appreciation of industrial heritage in regions with a significant industrial past and provide opportunities for regional regeneration. From this initial association with post-industrial regeneration, the concept gradually expanded to other geographical contexts. It became connected with cultural tourism, heritage interpretation, urban and regional development, and territorial identity (Rodríguez-Zulaica, 2017).

This tourism segment constitutes an initiative that values historical industrial landscapes, contributing to urban development, community revitalisation, and the preservation of cultural and historical heritage. It involves the reuse of tangible elements of industrial history, such as transport infrastructures, hydraulic heritage, manufacturing and processing industries, energy production infrastructures, extractive industries, and metallurgical and steel industries (Yan et al., 2024; Scalabrini et al., 2025a).

It also refers to visits to operational industrial facilities where industry, rather than tourism, constitutes the main activity (Friel et al., 2024). Kretschmann (2020) emphasises the reuse of mining assets for cultural and tourism purposes. According to Montenegro et al. (2024), industrial tourism is a tourism branch of significant economic, cultural, and social value, providing unique experiences by allowing visitors to explore historical assets or companies in their entirety and to witness manufacturing processes.

Industrial tourism encompasses visits to locations related to industrial production, such as factories, distilleries, and wineries, enabling visitors to explore the history of production processes and offering them distinctive experiential opportunities (Gu et al., 2024). According to Sonja and Aleksandar (2015), this segment of tourism is based on converting inactive industrial heritage into tourist attractions. This may represent an innovative strategy for the rehabilitation of industrial territories, highlighting the potential transformation of former industrial facilities into tourist attractions. This allows visitors to learn about historical production processes, the evolution of

techniques, and the socioeconomic impacts of industries, contributing to the preservation of cultural heritage. This approach focuses primarily on the economic opportunities generated in degraded areas (Merylova, 2024).

Taking this into account, this tourism segment is relevant because it combines cultural, economic and territorial dimensions. From a cultural perspective, it contributes to the preservation of material and immaterial memories linked to production systems, labour practices, technological change and local ways of life. From an economic perspective, it may support the diversification of tourism products, the reuse of degraded or underused industrial spaces and the revitalisation of territories affected by industrial decline. From a territorial perspective, it can strengthen local identity, promote regional differentiation and support the development of thematic routes and networks of heritage-based attractions (Montenegro et al., 2024; Merylova, 2024).

Industrial heritage includes tangible and intangible elements inherited from industrial activities. Tangible elements include buildings, machinery, transport infrastructures, hydraulic structures, energy production facilities, mines, metallurgical complexes, textile units, food-processing facilities, wineries and other production-related assets. Intangible elements include technical knowledge, labour memories, production techniques, narratives of industrial communities and the symbolic meanings associated with industrial landscapes. Therefore, industrial heritage is not limited to monumental buildings or large factories. It also includes small-scale productive structures and everyday facilities that help explain the historical organisation of economic life in a given territory (Mažeikienė & Gerulaitienė, 2022).

Andrade-Suárez and Caamaño-Franco (2020) identified three main categories of industrial tourism: pre-industrial heritage, industrial heritage, and active industries, which can be further classified into industrial heritage and active sectors. Rodríguez-Zulaica (2017) distinguishes industrial tourism activities into visits to active factories and to inactive industrial heritage assets. These distinctions are important because each type of resource implies different forms of interpretation, management and tourism use. While active industries allow visitors to observe current production processes, inactive industrial sites require conservation strategies, musealisation, adaptive reuse, or heritage interpretation. Pre-industrial heritage, in turn, allows the interpretation of productive systems that preceded mechanised industrialisation and helps explain the transition from traditional modes of production to modern industrial systems.

Pre-industrial heritage refers to productive assets, techniques and landscapes associated with economic activities developed before the consolidation of industrialisation. These may include watermills, olive presses, wine presses, kilns, forges, craft workshops, hydraulic systems and other small-scale production structures. Although these assets are less visible than large industrial complexes, they are essential for understanding traditional livelihoods, local economies and historical relationships between communities and natural resources. In tourism terms, pre-industrial heritage can support narratives linked to rural life, traditional knowledge, local products, gastronomy, craft production and cultural landscapes. (Ibrahim & Mohammed, 2023).

Therefore, industrial heritage refers to assets associated with industrialisation and with the technological, economic and social transformations that accompanied it. This includes manufacturing and processing industries, railway and transport infrastructures, energy production facilities, extractive industries, metallurgical and steel industries, textile heritage, warehouses and other production-related structures. These assets are relevant for their architectural and technical value, and also for revealing how industrialisation transformed territories, mobility systems, labour relations, settlement patterns, and regional economies (Andrade-Suárez & Caamaño-Franco, 2020).

Active industries constitute a third category within industrial tourism. In this case, the industrial site continues to operate as a place of production, but it is also opened to visitors for educational, cultural, commercial or experiential purposes. Examples include wineries, distilleries, food-processing units, craft industries and other companies that organise guided visits or demonstrations. This category is important for tourism because it connects heritage, production and consumption, allowing visitors to observe how products are made, understand their territorial embeddedness and associate them with local identity and destination branding (Gu et al., 2024).

Building on these conceptual distinctions, the present study introduces an operational classification of industrial and pre-industrial heritage, dividing it into 10 categories: transport infrastructure; wineries; food industries; hydraulic heritage; manufacturing and processing industries; energy production infrastructure; extractive industries; metallurgical and steel industries;

textile heritage; and others. This classification enables the inventory to transcend mere asset enumeration, transforming it into an analytical tool for examining the prevailing productive traditions, spatial concentrations, and tourism potential within the Duero-Douro cross-border region.

Transport infrastructure includes railway stations, bridges, roads, ports, and other facilities associated with the movement of people, goods, and raw materials. They are relevant for interpreting the historical role of mobility and connectivity in the development of industrial territories (Shevtsova, 2023). Wineries and food industries reflect the importance of agro-industrial production, local products, and the relationship between industrial heritage, gastronomy, and wine tourism (Andrade-Suárez & Caamaño-Franco, 2020; Bu et al., 2024). Hydraulic heritage includes mills, dams, canals and other structures that demonstrate the historical use of water as a source of energy and production (Beer et al., 2018). Manufacturing and processing industries transform raw materials into finished or semi-finished products. In contrast, energy production infrastructures, extractive industries, metallurgical and steel industries and textile heritage reveal different stages of technological development and economic specialisation (Buitrago & Cànoves, 2022).

The classification of industrial heritage is relevant for tourism planning, as different categories require distinct valorisation strategies. Wineries and food industries may be integrated into experiential routes linked to local products and gastronomy (Andrade-Suárez & Caamaño-Franco, 2020; Bu et al., 2024). Transport infrastructures can support narratives related to mobility, trade and territorial connectivity (Shevtsova, 2023). Hydraulic and pre-industrial assets may be associated with rural landscapes, traditional knowledge and environmental interpretation (Beer et al., 2018). Extractive, metallurgical and manufacturing heritage may require more complex interpretation strategies when assets are degraded, inaccessible or disconnected from existing tourism flows (Buitrago & Cànoves, 2022).

In cross-border regions, these classifications also acquire an additional meaning. Industrial heritage may reveal shared productive histories, complementary economic trajectories and common cultural landscapes that extend beyond administrative borders. In the Duero-Douro region, the classification and mapping of industrial and pre-industrial heritage therefore provide a basis for identifying potential thematic routes, heritage clusters and opportunities for cooperation between Portuguese and Spanish municipalities (Scalabrini et al., 2025b). By linking heritage classification to territorial distribution, accessibility, and tourism interest, industrial tourism can contribute to cultural preservation, tourism diversification, and the construction of a shared cross-border identity.

Beyond classification, the inventorying of industrial heritage has been recognised as a strategic step for territorial development and tourism planning. Studies conducted in European regions with industrial traditions show that identifying and systematising industrial assets can support the transition from dispersed heritage resources to structured tourism products. In regions such as the Ruhr in Germany, Zabrze in Poland, Catalonia in Spain, and Tourcoing in France, industrial heritage inventories have emerged as a key force in the transition from manufacturing to service and leisure economies. This shift has helped alleviate the impact of structural unemployment by generating new job opportunities in tourism and creative industries (Laloyaux, 2016, Somoza-Medina & Monteserín-Abella, 2021, Pozzer, 2024).

These experiences demonstrate that industrial heritage can be an effective resource for tourism development when it is connected to broader strategies of interpretation, governance, and territorial promotion. Therefore, the inventory is a planning tool that helps identify heritage clusters, prioritise interventions and support public and private decision-making.

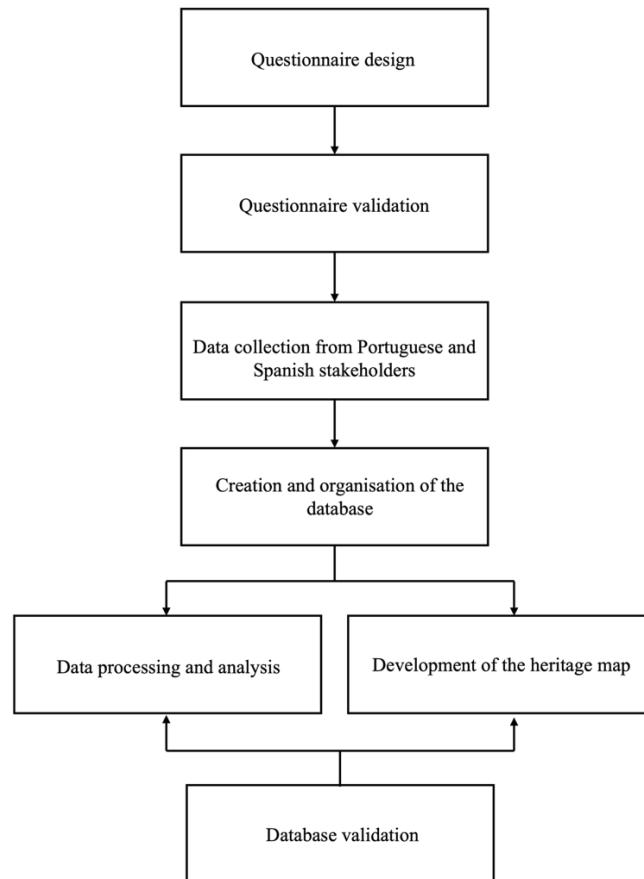
3. METHODS

The project's intervention area covers the cross-border territory along the *Duero-Douro* river, encompassing 22 Portuguese and 80 Spanish municipalities. These territories were selected based on their strategic location within the *Duero-Douro* region, the presence of relevant industrial and pre-industrial heritage for the project, and their potential for integration into a thematic tourism network.

To achieve the proposed objective, a collaborative methodology was established, involving 9 entities participating in the project and 21 researchers. This approach enabled the design and validation of a questionnaire for data collection from Portuguese and Spanish stakeholders, the

creation and organisation of a database cataloguing industrial heritage, the subsequent analysis of these data, the preparation of an industrial heritage map for the cooperation territory, and finally, the validation of the collected information (Figure 1).

Figure 1: Flowchart for the development of the database



Source: Authors' elaboration.

This methodological design was grounded in the principle of cross-border cooperation, ensuring that all stages, from questionnaire design to data validation, were jointly discussed and implemented by the Portuguese and Spanish partners. Such cooperation was not operational but strategic, seeking to harmonise data-collection procedures and develop a shared conceptual framework for classifying and evaluating industrial heritage. The involvement of both national teams ensured that the resulting database reflected the territorial diversity and cultural particularities of the two countries, while also promoting the creation of a common language and criteria for future joint tourism planning strategies.

The development of the database was guided by the conceptual distinctions presented in the theoretical framework, especially the differentiation between pre-industrial heritage, industrial heritage and active industries (Table 1). These conceptual categories were operationalised into ten empirical categories adapted to the productive and territorial specificities of the Duero-Douro cross-border region: transport infrastructures, wineries, food industries, hydraulic heritage, manufacturing and processing industries, energy production infrastructures, extractive industries, metallurgical and steel industries, textile heritage and others.

Table 1: Identification of variables

Variable	Alternatives of answers
Location	Country (Portugal; Spain); Municipality (Portugal; Spain); Full address
Name of Heritage Asset	Fill in with the name of the heritage asset
GPS Coordinates	Latitude; Longitude
Category	Transport infrastructures; Wineries; Food industries; Hydraulic heritage; Manufacturing and processing industries; Energy production infrastructures; Extractive industries; Metallurgical and steel industries; Textile heritage; Others
Description	Brief summary of the heritage asset
Prepared to receive visitors	Yes / No
Visiting hours	Fill in with weekly operating hours
Level of universal accessibility	5-point Likert scale: 1 – Totally inaccessible (no adaptations for reduced mobility, physical barriers to access); 2 – Inaccessible (some adaptations but insufficient, creating barriers); 3 – Partially accessible (some areas not fully adapted); 4 – Accessible (most areas adapted); 5 – Totally accessible (no barriers, entirely accessible)
Contact information	Telephone, Email, Facebook, Instagram, YouTube, Website
Tourism interest level	5-point Likert scale: 1 – No interest (poorly known, no facilities); 2 – Low interest (some basic visitor structures, no complementary attractions); 3 – Moderate interest (some historical or cultural appeal, basic infrastructure); 4 – High interest (known asset, historical/cultural value, complementary attractions); 5 – Extremely high interest (widely known, strong historical/cultural significance, meets visitor expectations)
Ownership	Public / Private
Protection status	Yes / No
Level of importance for the project	5-point Likert scale: 1 – Not important (little historical or cultural relevance); 2 – Less important (limited importance); 3 – Indifferent (regionally recognised, some visitor potential); 4 – Very important (high historical and cultural value); 5 – Extremely important (well-preserved, highly valued, widely known)

Source: Authors' elaboration.

It is important to emphasise that the questionnaire was implemented using Google Forms. This tool was chosen due to its ability to integrate all stages of the process, automatic data organisation in Google Sheets, creation of the heritage map (using Google Maps), and generation of analytical reports (via Looker Studio). Moreover, it allows for real-time data sharing among all project partners.

Following this, the data collection process was initiated. A Google Forms questionnaire was disseminated to the Municipalities and project partners in both Portugal and Spain for their completion. Alternatively, an Excel spreadsheet was provided, enabling entities to enter the information directly, which was subsequently incorporated into the final database.

To ensure a higher response rate, the implementation team contacted institutional representatives by telephone and email to clarify the questionnaire's content, purpose, and the relevance of the data collection to the project's execution. Additionally, the team complemented the data using secondary sources (official documents from Municipalities, websites, and other publicly accessible digital platforms), filling in missing information and cataloguing industrial heritage elements, particularly in Portugal. This approach enriched the database by integrating direct field data with secondary information, ensuring broader coverage and representativeness of existing heritage assets.

The collected data enabled the construction of a detailed database, which is essential for valorising and promoting industrial tourism in the region. The identification and mapping of these elements were fundamental to fostering cultural and industrial tourism development, contributing to heritage preservation and the economic revitalisation of the involved territories.

Upon the completion of data collection, the information was systematically stored in a Google Sheets file within the project's cloud system. Data on 1,075 heritage assets in Portugal and Spain facilitated the development of a map illustrating the geographic distribution of industrial tourism resources. Additionally, a descriptive analysis was conducted to enhance the understanding of the current state of industrial and preindustrial heritage.

The validation phase further underscores the project's collaborative nature. Nine institutional partners, on both sides of the border, collectively assessed the database's consistency and accuracy. This process exemplifies the benefits of cross-border governance, where shared knowledge and complementary expertise enhance data reliability and foster mutual learning between Portuguese and Spanish institutions.

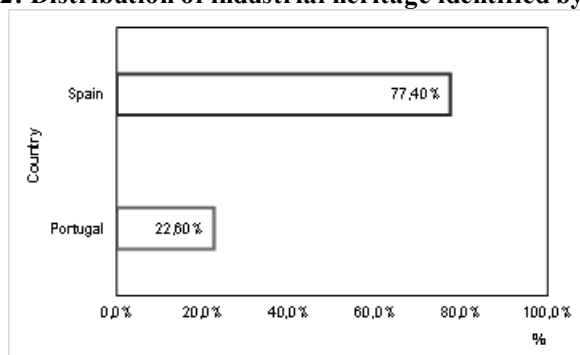
The final stage of database development consisted of data validation by nine partners from the project. The compiled database was presented to the consortium members during a meeting, where all partners had full access and, based on their prior knowledge of the territory, validated the content related to industrial heritage.

4. MAIN FINDINGS

4.1. Geographical Distribution of Industrial and Pre-Industrial Heritage

The geographical distribution of industrial heritage within the project's cooperation territory is illustrated in Figure 2. The data reveal that Portugal accounts for 243 identified assets (approximately 23%), whereas Spain registers 832 assets (77.4%), totalling 1,075 catalogued industrial heritage assets. The disparity between the two countries may be associated with their territorial size, diversity of industrial activities, and historical processes of industrialisation. However, this difference does not imply a disparity in the relative importance of industrial heritage in Portugal and Spain.

Figure 2: Distribution of industrial heritage identified by country



Source: Authors' elaboration.

When analysing the distribution of industrial heritage by municipality in Portugal, the highest concentration was found in *Mirandela*, with 31 records (approximately 13%), followed by *Tabuaço*, with 28 (about 12%), and *Bragança*, with 27 (11%). *Peso da Régua* records 19 assets (approximately 8%), and *Torre de Moncorvo* follows with 17 (7%), as listed in Table 2. These results indicate a significant concentration of industrial heritage in specific municipalities, which may reflect both the historical relevance of industrial activity in these areas and the effectiveness of local heritage inventories and valorisation processes. Municipality-based analysis also allows identification of spatial distribution patterns, which can serve as a foundation for developing strategies for heritage conservation, valorisation, and tourism promotion at the regional level.

Table 2: Distribution of Industrial Heritage Identified by Municipality - Portugal

Municipality	n	%	Municipality	n	%
<i>Mirandela</i>	31	12.8	<i>Macedo de Cavaleiros</i>	11	4.5
<i>Tabuaço</i>	28	11.5	<i>Vila Nova de Foz Côa</i>	10	4.1
<i>Bragança</i>	27	11.1	<i>Carrazeda de Ansiães</i>	10	4.1
<i>Peso da Régua</i>	19	7.8	<i>Miranda do Douro</i>	10	4.1
<i>Torre de Moncorvo</i>	17	7.0	<i>Alfândega da Fé</i>	9	3.7
<i>Sabrosa</i>	14	5.8	<i>Alijó</i>	9	3.7
<i>São João da Pesqueira</i>	12	4.9	<i>Others</i>	24	10.0
<i>Vinhais</i>	12	4.9	Total	243	100.0

Source: Authors' elaboration.

Table 3 shows the distribution of industrial heritage across Spanish municipalities within the project's cooperation area. The city with the highest number of registered points of interest is Valladolid, which has catalogued 250 assets, representing 30% of the total, followed by *Toro* (75; 9%), *Zamora* (53; 6.4%), and *Peñafile* (47; 5.6%). Other noteworthy municipalities included *Tudela de Duero* and *Pesquera de Duero* (28 each; 3.4%), *Fermoselle* (22; 2.6%), *Tordesillas* and *Hinojosa de Duero* (21 each; 2.5%), *La Seca* (18; 2.2%), and *Quintanilla de Onésimo* (14; 1.7%). *La Fregeneda* and *Sardón de Duero* had 12 records (1.4%), whereas *Laguna de Duero* and *Quintanilla de Arriba* had 10 each (1.2%). The remaining 211 assets (25.5%) are dispersed among other municipalities, indicating a broad geographical distribution of industrial heritage across the Spanish territory covered by this project.

The predominance of *Valladolid* may be related to its historical role as an industrial and logistical centre in *Castilla y León*, as well as the maturity of its local heritage inventory processes. Municipal distribution analysis enables the identification of high-density heritage areas and supports the design of strategic conservation, enhancement, and industrial tourism development initiatives in Spain.

Table 3: Distribution of Industrial Heritage Identified by Municipality - Spain

Municipality	n	%	Municipality	n	%
<i>Valladolid</i>	250	30.0	<i>La Seca</i>	18	2.2
<i>Toro</i>	75	9.0	<i>Quintanilla de Onésimo</i>	14	1.7
<i>Zamora</i>	53	6.4	<i>La Fregeneda</i>	12	1.4
<i>Peñafile</i>	47	5.6	<i>Sardón de Duero</i>	12	1.4
<i>Tudela de Duero</i>	28	3.4	<i>Laguna de Duero</i>	10	1.2
<i>Pesquera de Duero</i>	28	3.4	<i>Quintanilla de Arriba</i>	10	1.2
<i>Fermoselle</i>	22	2.6	<i>Others</i>	211	25.5
<i>Tordesillas</i>	21	2.5	Total	832	100
<i>Hinojosa de Douro</i>	21	2.5			

Source: Authors' elaboration.

4.2. Heritage Classification by Category

Considering the entire cooperation territory, the analysis of distribution by category (Table 4) provides a better understanding of the nature and original functions of the identified assets. The data reveal three predominant typologies, which together represent 75.4% of all catalogued industrial heritage. This concentration reflects the historical significance of industrial sectors in shaping the economic and productive patterns of both countries.

Table 4: Industrial Heritage by Category and Country

Category	Portugal n (%)	Spain n (%)	Total n (%)
Transport infrastructures	46 (18.9)	288 (34.6)	334 (31.1)
Wineries	66 (27.2)	189 (22.7)	255 (23.7)
Food industries	62 (25.5)	159 (19.1)	221 (20.6)
Hydraulic heritage	19 (7.8)	81 (9.7)	100 (9.3)
Manufacturing and processing industries	19 (7.8)	51 (6.1)	70 (6.5)
Energy production infrastructures	7 (2.9)	37 (4.4)	44 (4.1)
Extractive industries	16 (6.6)	9 (1.1)	25 (2.3)
Metallurgical and steel industries	1 (0.4)	11 (1.3)	12 (1.1)
Textile heritage	2 (0.8)	4 (0.5)	6 (0.6)
Others	5 (2.1)	3 (0.4)	8 (0.7)
Total	243 (100.0)	832 (100.0)	1,075 (100.0)

Source: Authors' elaboration.

Based on the information presented in Table 4, transport infrastructure constitutes the most representative category, with 334 elements (31.1% of the total). These include assets such as railway stations, bridges, ports, and other structures linked to mobility and freight transport. The wine industry ranked second, with 255 elements (23.7%), reflecting the historical and economic importance of viticulture in the Iberian regions, particularly in cross-border areas. The food industry

ranked third with 221 elements (20.6%), encompassing production and processing facilities that reflect local gastronomic and productive traditions. Together, these three categories account for over three-quarters of all catalogued heritage assets, underscoring the historical weight of key sectors such as transport, wine production, and food processing in the socio-economic development of the regions studied.

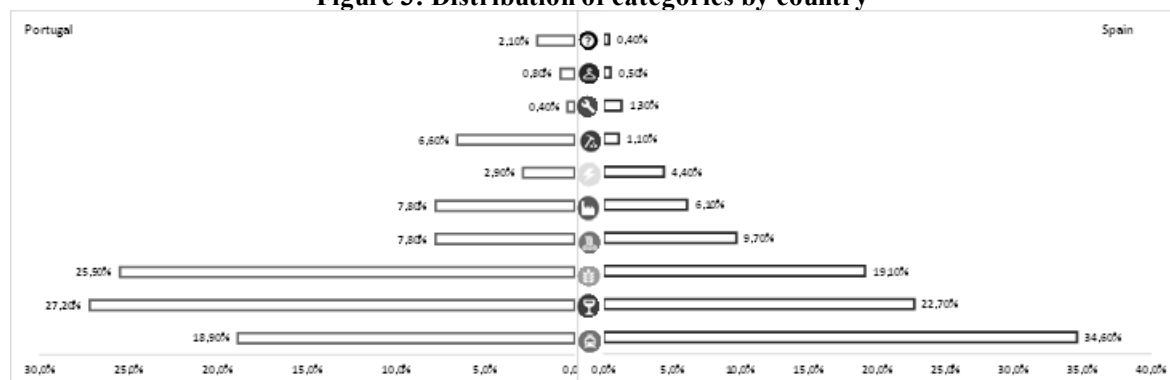
The remaining categories show lower representation: hydraulic heritage includes 100 elements (9.3%), manufacturing industries record 70 elements (6.5%), energy production infrastructures total 44 (4.1%), extractive industries comprise 25 (2.3%), metallurgical and steel industries 12 (1.1%), textile heritage 6 (0.6%), and other types of industrial heritage 8 (0.7%). This distribution pattern suggests that, while typological diversity exists, the intense concentration in specific categories can guide future valorisation and preservation strategies, focusing on sectors of the most tremendous territorial and symbolic significance.

In Portugal, the distribution of categories has some specificities. The wine industry is the most representative, with 66 elements (27.2%), reflecting the strong viticultural tradition, particularly in the *Douro* region of Portugal. Food industries occupied second place with 62 elements (25.5%), emphasising the importance of traditional food production, while transport infrastructure ranked third with 46 elements (18.9%), a considerably lower proportion than in Spain. This may reflect historical differences in transport network density or preservation and inventory criteria. Moreover, extractive industries in Portugal are of greater significance (16 elements; 6.6%) than in Spain, likely due to Portugal's long history of mining, especially in regions such as *Trás-os-Montes* and *Alto Douro*.

In Spain, transport infrastructure dominated (288; 34.6%), suggesting a more developed or better-preserved transport heritage network. The wine industry remains highly relevant (189; 22.7%), followed by the food industry (159; 19.1%), with a pattern similar to that in Portugal. The hydraulic heritage records 81 elements (9.7%), which is slightly higher than that in Portugal.

The analysis of the distribution of industrial and pre-industrial heritage in the cooperation regions between Portugal and Spain (Figure 3) reveals distinct patterns that reflect the two countries' economic trajectories. While Portugal shows a greater concentration in the wine and food industries, Spain stands out for its transport infrastructure heritage. These differences may result from national heritage preservation priorities or institutional engagement in the project. Further analysis could clarify how historical patterns of industrialisation have shaped these spatial trends.

Figure 3: Distribution of categories by country



Source: Authors' elaboration.

Additionally, the disparity in the total number of registered elements (243 in Portugal vs 832 in Spain) may stem from differences in heritage preservation policies, the maturity of regional inventories, and the level of institutional involvement of local authorities, all of which likely influenced data comprehensiveness and quality.

These distribution patterns illuminate the historical evolution of industrial activity in cross-border regions and provide a solid basis for defining differentiated strategies for heritage valorisation, cultural planning, and sustainable territorial development.

4.3. Accessibility for Visitation and Tourism Interest

To assist in defining thematic routes for the industrial heritage of the cooperation territory, two additional variables were included in the database: accessibility and tourism interest.

A 5-point Likert scale was used to assess accessibility. Of all the listed assets, 668 were classified, yielding the following distribution: 1 - totally inaccessible (5.7%); 2 - inaccessible (20.1%); 3 - partially accessible (44.0%); 4 - accessible (17.2%); and 5 - totally accessible (13.0%). These results indicate that many heritage assets have undergone some adaptation, although full accessibility is limited. Therefore, there is a clear need for investment to improve accessibility to the catalogued assets.

Similarly, the tourism interest level was assessed for 655 assets: 1 - no interest (3.1%); 2 - low interest (19.5%); 3 - moderate interest (31.8%); 4 - high interest (27.3%); and 5 - extremely high interest (18.3%). The predominance of ratings between 2 and 3 points suggests that, while most assets are known and have some basic infrastructure, complementary attractions remain lacking. Moreover, heritage assets generally evoke historical or cultural interest. It is important to emphasise that these results reflect the perceptions of stakeholders responsible for providing information. The findings on both accessibility and tourism interest will be crucial for guiding subsequent project activities.

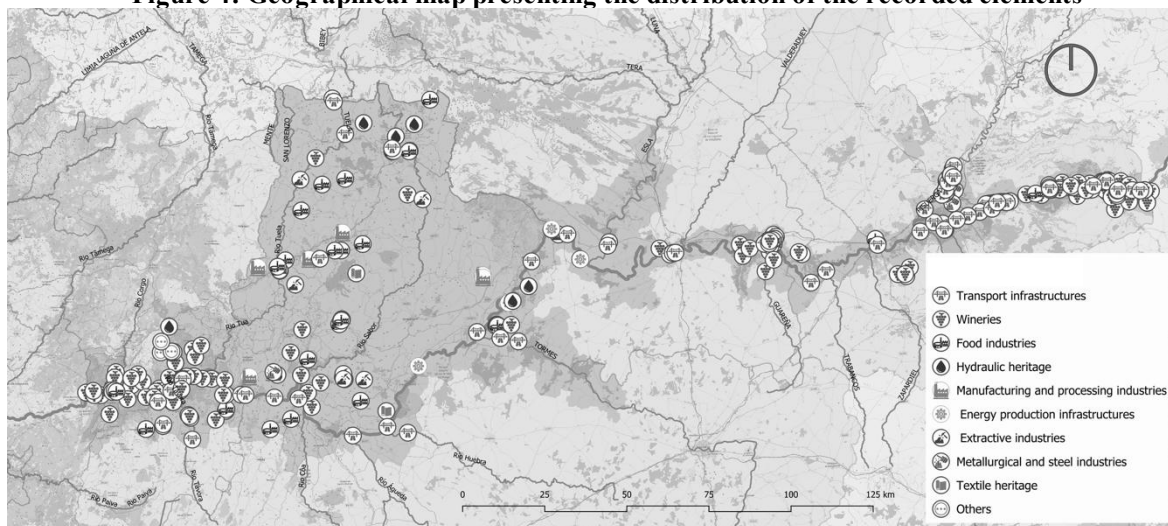
In terms of classification, only 117 assets (10.8%) are officially protected by institutions such as UNESCO or by national and local authorities, 538 (49.9%) are unclassified, and the remainder did not answer this question. Regarding ownership, 32.3% were owned by public entities, 21.9% were privately owned, and 36.7% had no ownership identified.

4.4. Development of the Map

An interactive map in Google Maps was created to facilitate the identification of industrial heritage sites. The collected data were integrated into this map, enabling a clear, detailed visualisation of the various points of interest and providing a better understanding of their territorial distribution and tourism potential.

The developed map (Figure 4) presents a detailed geographical representation of industrial and pre-industrial heritage located in the cross-border region between Portugal and Spain, with a particular emphasis on the *Douro-Duero* territory. The spatial distribution shows a significant concentration in Portuguese municipalities such as *Mirandela*, *Tabuaço*, and *Bragança*, while in Spain, higher densities are observed in *Valladolid*, *Toro*, *Zamora*, and *Peñafiel*.

Figure 4: Geographical map presenting the distribution of the recorded elements



Source: Authors' elaboration.

The categorisation of the identified heritage reflects the richness and diversity of the industrial heritage across the territory. Among the main heritage types, wineries stand out, illustrating the long-standing winemaking tradition of the *Douro-Duero* region, as well as transport infrastructures such as historic railway stations and bridges, which testify to the impact of industrialisation on regional connectivity. Additionally, hydraulic structures, such as watermills and historical dams, demonstrate the use of water resources for industrial activities over the centuries.

Spatial analysis also identified areas of high heritage density, suggesting the existence of clusters of great historical and cultural value. The typological diversity and geographical dispersion of these assets reinforce the region's significance within the context of industrial and pre-industrial heritage, offering an integrated perspective on its historical evolution.

Thus, the map represents a fundamental tool for the valorisation and safeguarding of this legacy, enabling a more comprehensive understanding of its distribution and characteristics and supporting the formulation of strategies that promote both its conservation and sustainable tourism use (Çınar et al., 2025). Ultimately, this map serves as a foundation for developing thematic cross-border industrial routes throughout the region.

5. DISCUSSION

The analysis of the results shows that the industrial and pre-industrial heritage of the Duero-Douro region is characterised by high typological diversity and a strong territorial asymmetry between Portugal and Spain. This quantitative asymmetry (243 vs 832 inventoried assets) should be interpreted with caution, not as an indication of lesser heritage relevance in the Portuguese territory, but as a consequence of structural and institutional factors that influence the intensity of inventorying. Studies conducted in other European regions with an industrial tradition, such as the Ruhr in Germany, Zabrze in Poland, Catalonia in Spain and Tourcoing in France, show that the density of industrial heritage is often explained by the historical presence of transportation infrastructures, agro-industrial concentration, and post-industrialization processes that have promoted models of territorial redevelopment geared toward tourism and culture (Pardo Abad & Benito Del Pozo, 2021, Silva & Zimmermann, 2025). In the Iberian case under analysis, the predominance of transportation infrastructures on the Spanish side (34.6 per cent) and of wine industries on the Portuguese side (27.2 per cent) reveals the coexistence of distinct historical and productive trajectories, with direct impacts on the types of resources available for building tourism offerings. The discussion of the results also allows us to identify relevant implications for public policy and regional planning. Firstly, the database created serves as a territorial diagnostic tool that can support municipalities and regional entities in the design of heritage enhancement strategies. Secondly, the identification of industrial heritage clusters can guide investments in themed routes, cultural networks, and territorial branding, aligned with international trends such as the Council of Europe's Cultural Routes or the European networks of industrial heritage. Thirdly, the collaborative validation of data between Portuguese and Spanish institutions demonstrates that cross-border cooperation, when operationalised through shared technical processes, can generate institutional value, reduce information asymmetries, and increase public efficiency in territorial management.

6. FINAL CONSIDERATIONS

The implementation of this cross-border cooperation initiative enabled the collection and organisation of a dataset on industrial and pre-industrial heritage in the *Duero-Douro* region. This process constitutes a key step toward the valorisation and promotion of the territories involved. The creation of an interactive map based on the collected data proved to be a vital tool for identifying and disseminating heritage elements, facilitating both the understanding of their territorial distribution and the future design of thematic industrial tourism routes across the border.

The mapping of industrial heritage resources demonstrates the centrality of cross-border cooperation in shaping the development strategies for industrial tourism in this region. By uniting Portuguese and Spanish stakeholders around a shared vision, the initiative demonstrated how collaboration can transcend administrative boundaries to foster shared values. This fostered the

identification of heritage assets and the construction of a joint narrative that positions the *Duero-Douro* region as a cohesive cultural and economic space within the Iberian Peninsula. This cooperative dimension was essential for transforming dispersed local initiatives into a structured transnational strategy for heritage valorisation and sustainable tourism.

The systematisation of data achieved through collaborative work enhanced the understanding of the existing heritage and supported the development of conservation and sustainability strategies. It also provides an empirical basis for decision-making and policy design, particularly for prioritising interventions and promoting a coordinated public plan for the use of cultural and tourism resources.

Furthermore, the cross-border framework offers an exemplary model of how European cooperation initiatives can operate to innovate the governance of territories. Through shared databases, participatory decision-making, and mutual capacity building, the process has strengthened institutional relations and encouraged policy convergence between Portugal and Spain. The results show that cross-border cooperation, when anchored in heritage and culture, preserves collective memory and generates tangible opportunities for economic diversification, identity reinforcement, and long-term sustainability.

The findings indicate that the industrial and pre-industrial heritage in the *Duero-Douro* region is diverse and holds significant development potential across different categories, with transport infrastructure, wineries, and food industries emerging as the most representative. Nevertheless, investments in accessibility, conservation, and visitor infrastructure are necessary to fully realise this potential. Improving interpretive materials, signs, and territorial integration would enhance the incorporation of these resources into structured, sustainable tourism products.

Finally, this study contributes to a broader reflection on how shared industrial heritage can serve as a strategic driver of regional cooperation and sustainable development. By reinforcing cultural and territorial interdependence, cross-border collaboration between Portugal and Spain emerges as an instrument for promoting cohesive, inclusive, and innovative development in the Iberian interior region.

Finally, it is noteworthy that the study offers contributions on three complementary levels. At the empirical level, it provides a systematic cross-border inventory, which is rare in the Iberian literature on industrial tourism. On the methodological level, it demonstrates the feasibility of using collaborative tools to produce territorial data across borders. On the conceptual level, it reinforces the understanding of industrial heritage as a cultural and economic resource capable of generating territorial cohesion and shared identity narratives.

It is further noted that advancing the debate on the topic may involve comparative studies with other European borders, analyses of residents' perceptions, economic evaluations of tourism products, and studies of multilevel governance applied to industrial heritage.

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Acknowledgments

This project is being carried out within the scope of the IN_GENIOS_DUERO_DOURO, Cooperación para la puesta en valor de la cultura industrial del Duero-Douro a través del turismo, 0247_IN_GENIOS_DUERO_DOURO_2_E, financed by FEDER, through the POCTEP.

The authors are also grateful for the financial support conceded by national funds through FCT - Fundação para a Ciência e Tecnologia, I.P. under the project UNIAG UID/04752/2025 (DOI 10.54499/UID/04752/2025).