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Mapping the 'Magic of Huesca': a methodological proposal for the design of tourist cartography

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ABSTRACT
Maps published for tourism promotion and information constitute a particular sub-group of tourist maps made using Geographic Information Systems (GIS). This paper proposes a methodological protocol for the systematic elaboration of tourism mapping. This procedure is applied to the design of the tourist map of the province of Huesca. The cartographic tool was designed based on the needs of tourism promotion by the Public Administration, seeking the halfway point between persuasion and precision when representing elements on the map. Given that data would have to be updated and modified in the future, open-source software was used so that the administration can then run, modify and update it. In addition, the project was validated through surveys to two different audiences (general and expert).

1. Introduction

Tourist information is essentially geographical, and the cartographic representation of tourist destinations involves the processing and visualisation of a wide range of attributes and components: natural and cultural attractions, roads and paths, accommodation services, commercial areas or tourist information points, among others. For the correct processing and mapping of this large amount of geo-referenced information, it is crucial to use Geographic Information Systems (GIS).

In parallel, the design of tourist maps is one of the main business areas of cartography and producing these is considered key for the tasks of tourist information, promotion and marketing. In this respect, the production of thematic tourism cartography requires not only knowledge in the field of Geography, but also the ability of the individual to handle the aesthetics of the final product (Denègre, 2005; Zúñiga Antón, 2009), thus combining the technical and artistic nature of cartographic science. In this context, it is necessary to propose methodologies combining free GIS technologies and graphic design technologies that enable management, edition, and appropriate cartographic representation of tourist areas.

Traditionally, two types of tourist maps have coexisted. Firstly, those of a technical and analytical nature intended for tourism planning and management, full of references to scientific information and, in general, only exploited by organisations specialising in research, territorial planning and tourism management. Secondly, mass-produced maps for tourists, relating to destination marketing and persuasion of potential visitors, sometimes lacking accuracy in their representations of geographical space and functionality as an orientation tool (De Menezes & do Couto Fernandes, 2008; Uller, 2010; Weng et al., 2020). However, it cannot be ruled out that both typologies of maps can converge in the same tourist cartography.

Monmonier (1991), from a critical view of tourist cartography, diagnosed a habitual lack of precision of geographical details in tourist maps in favour of an artistic approach. To solve this problem, the scientific literature on tourist cartography, as a field of thematic cartography, focuses on the correct design of tourist maps through protocols, principles and methods based on different GIS and design technologies to visually prioritise or emphasise the elements of greatest tourist interest and generalise or simplify those less important, all for the purpose of achieving functional but visually attractive or persuasive maps that promote the attractiveness of the territory and improve visitor satisfaction (Airikka & Masoodian, 2019; Eboy, 2017; Grabler et al., 2008; Jancewicz & Borowicz, 2017; Mülazimoğlu & Başaraner, 2019;

Weng et al., 2020). On the other hand, more recent scientific approaches, such as Brokou et al. (2021), emphasise that tourism map design in a post-COVID-19 era should not only focus on the functionality and aesthetics of the cartographic product, but also on the compatibility of such mapping with sustainable development policies and the ability of the map to induce travellers' responsible choices.

This article sets out a protocol to produce a tourist map of the province of Huesca, whose tourist slogan is 'Huesca la Magia' (The Magic of Huesca). This map not only is useful for visitors' orientation, mobility and spatial contextualisation, but also meets the needs of promotion and the political interests of territorial development of the region represented. In this regard, tourist cartography is a versatile tool in terms of content, as, depending on the map's purpose, the cartographer can choose to represent the reality or only a part of it, thus generating an image of the destination that can simplify (Domínguez-Mújica, 2007) or stereotype (Navas, 2016) the area represented (Galindo Caldés & Santasusagna Riu, 2020), by prioritising the points and areas of tourist interest (Balsa Barreiro & Lois González, 2010). In addition to being functional, this typology of map should be illustrative, allowing the reader to identify the territory with a simple observation (Galindo Caldés & Santasusagna Riu, 2020; Weng et al., 2020). Incorporating elements of artistic visual expression and cartographic design manages to combine art, visual design and cartography (Airikka & Masoodian, 2019), thus obtaining more opportunities to convey the information contained effectively (Slocum, 2013). Overall, in addition to requiring specific collaborative treatment by different agents and public administrations, the cartographic product is ruled by the principles of map design (Bertin, 1983; Dent et al., 2009; Dodge et al., 2011; Kraak & Ormeling, 2013; Krygier & Wood, 2011; Li, 2012; Slocum et al., 2009; Tyner, 2010).

2. Project approach

The Provincial Council of Huesca promoted this project with the aim of updating the tourist map of the province as an instrument not only for promoting the destination at fairs and congresses and as a guide for potential visitors, but also as a tool for tourist territorial planning.

In this way, the current document reflects the process followed to design and produce an ex-novo tourist map of the province of Huesca, seeking a balanced solution between the need for accuracy and persuasiveness demanded by the purposes of tourism planning, information and promotion. The project was developed in collaboration with a series of public actors involved in decision-making and lightly influenced in style and content by the previous tourist

map of the region. Therefore, the protocol presented is adapted to the Public Administration and can be transferred to a multitude of cartographic productions for tourism.

3. Materials and methods

The province of Huesca is located in the north of the Autonomous Community of Aragon, in a central-western position with respect to the Pyrenees mountain system. This territory offers a stunning transition of landscapes from the Pyrenees mountain ranges to the Monegros desert. As well as being a paradise for nature and sport lovers, Huesca hides authentic artistic gems.

In terms of tourism, the Department of Tourism of the Provincial Council – which in itself depends on the General Department of Tourism of the Government of Aragon – faces the challenge of dealing with the dual seasonal dynamic that characterises this province, with a high concentration of tourism in the Pyrenean valleys in the summer and a lower but significant concentration in the winter months, especially in those regions with ski resorts. In order to decentralise and deseasonalise the tourist destination, one of the main challenges of the tourism strategy is to highlight and promote those rural areas that are more unknown and unpopulated but with a great natural and cultural heritage (General Department of Tourism of Aragon, 2021), as well as a wide range of tourist experiences and quality gastronomic offerings that are distributed throughout the provincial territory.

The methodology carried out through a hybrid QGIS-Inkscape work protocol has been divided into four phases (Figure 1) whose processes follow iterative workflows relating to and conditioning the remaining procedures. Constant feedback can be given during all stages, showing that the cartographic design process is flexible for each map produced and adaptable to the needs and requirements of each project.

3.1. Phase 1. Collaborative tourism strategy phase

The cartographic proposal is assumed to be collaborative, as it is the result of cooperation between several public agencies, which allows the interaction of different members with competences in administrative matters for the tourist destination (Temes Córdovez & Moya Fuero, 2015). Collaborative maps commonly constitute an alternative social way of constructing knowledge from information that is excluded from the usual maps, bringing to cartography information and popular knowledge that would otherwise be undetectable and ignored (Laconi et al., 2018). This type of mapping allows local communities to spatially
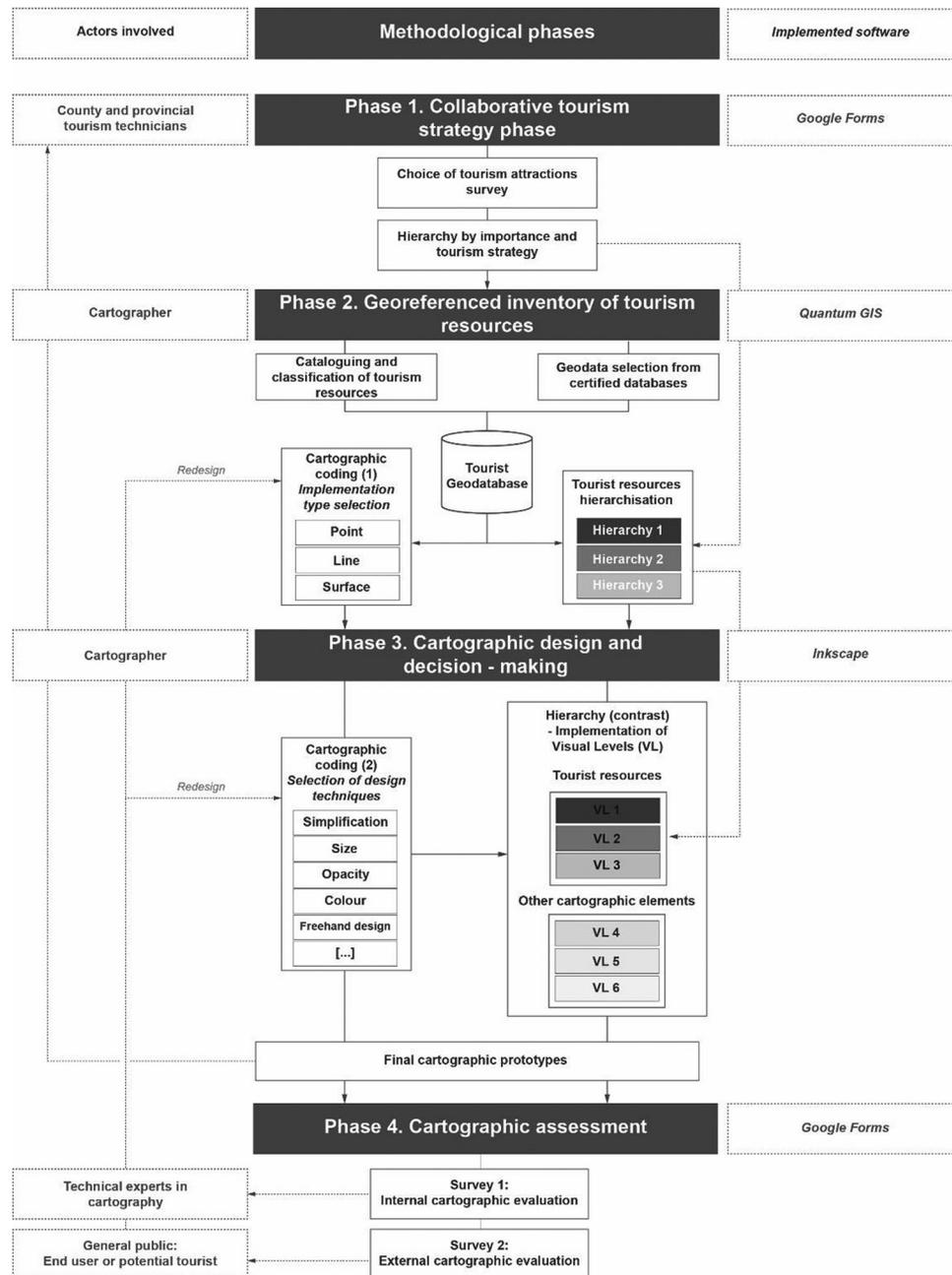
Figure 1. Methodological phases for the design of tourist cartography. Authors' own work.

represent themselves by making, in this case, decisions related to tourism policies to promote the destination.

In order to carry out this collaborative process, a survey was sent via Google Forms to the ten technicians or people in charge of tourism or promotion in each of the ten counties belonging to the province of Huesca. They were asked to choose four tourism resources (consolidated and emerging) ordered by importance according to the priorities for tourism development and promotion in each county. This order of importance, based on three hierarchical levels, influences the final representation of each tourism attraction on the map, so that those intended to be emphasised in tourism promotion will carry greater visual weight in the final tool.

3.2. Phase 2. Georeferenced inventory of tourism resources

In the second phase, a geodatabase was created with QGIS to provide a georeferenced compilation of the different tourist resources obtained in Phase 1. Sixty-nine point entities were categorised on the basis of the classification methodology of Territorial Tourism Resources by López Olivares (1998). This procedure, widely used in the Spanish context, enables tourist resources to be categorised at different levels of detail – category, typology and sub-typology. Table 1 shows this system of disintegration of information, and as an example, a level disintegration is highlighted in bold.

Table 1. Tourist attraction geodatabase information fields. Authors' own work.

FIELD NAME	CONTENT
ID	Tourist resource identifier
Name	Name of the tourist resource
Hierarchy	Value from 1 to 3 according to the importance or hierarchy assigned by the county technicians (Phase 1)
Category	1. Natural and scenic resource **2. Historical-monumental, technical, ethnological and artistic resources** 3. Gastronomic and artisan resources 4. Folklore, festivals, scheduled and intangible events
Type	**2.1 Buildings and monuments**; 2.2 Technical works; 2.3 Archaeological sites; 2.4 Ethnological; 2.5 Museums; 2.6 Works of art
Subtype 1	**2.1.1 Religious**; 2.1.2 Civil; 2.1.3 Military; 2.1.4 Historic and Artistic Sites
Subtype 2	**2.1.1.1 Cathedral; 2.1.1.2 Church; 2.1.1.3 Convent; 2.1.1.4 Monastery; 2.1.1.5 Hermitage; 2.1.1.6 Belfry; 2.1.1.7 Chapel; 2.1.1.8 Calvary**
Municipality	Municipality in which the tourist resource is located
County	County in which the tourist resource is located
Contact	E-mail or telephone to obtain information about the tourist attraction
Links	Web links to information and images of the tourist attraction

This table also includes the remaining fields completing the geodatabase of tourism resources, demonstrating the usefulness of GIS to generate Tourism Big Data for the interactive visualisation and efficient management of provincial tourism information.

3.3. Phase 3. Cartographic design and decision-making

The third phase consists of designing and structuring all the cartographic elements, while respecting the principles of cartographic design. These basic principles are clarity, order, balance, harmony and contrast, which should clarify the usage and usefulness of maps, as well as lead to improved design (Dodge et al., 2011; Postigo Vidal, 2016).

The incorporation of these principles requires a decision-making process explained in Table 2, which structures the following groups of decisions on cartographic representation:

- **Selection of cartographic components.** Final choice of layers to be added to the map. Including the data sources used.
- **Visual hierarchy of the elements (Harley, 1989).** Where the visual order of the elements is defined through six visual levels of visual contrast based on the informational importance of the elements, with '1' being the highest level of hierarchy.
- **Coding and type of cartographic implementation (Zúñiga Antón, 2009).** To decide whether the component will be implemented as points, lines or surfaces. All this is combined with various design techniques differentiating each of the elements incorporated in the map and defining the final cartographic representation.

3.3.1. Selection of cartographic components

In addition to relevant tourism information of the study area, the content of a tourism map should provide topographic elements to allow the user spatial contextualisation for planning activities and managing the time of the visit. It should also include other elements related to the tourist infrastructure present (De Menezes & do Couto Fernandes, 2008; Eboy, 2017; Olomo & Enaruvbe, 2005; Weng et al., 2020). However, it should be noted that the insertion of too many categories of elements in a tourist map could compromise cartographic design principles (Jancewicz & Borowicz, 2017) and increase complexity for the map reader, making the transmission of tourist information more difficult.

These layers of information (vector and raster) are obtained both from primary sources, arising from the collaborative phase (Phase 1), as well as from secondary sources of information, the latter obtained from SDIs (Spatial Data Infrastructures) and Official Agencies (Table 2).

3.3.3. Visual hierarchy of elements

Among the principles of cartographic design, it is important to emphasise the visual contrast, measured with the two-dimensional figure-background relationship (difference between light and dark), which allows the map designer to highlight the most important elements, leading the reader's eye to the areas that are intended to be highlighted, thus achieving, in addition to a harmonious design, a better aesthetic and, consequently, greater transmission and retention of the message (Dent et al., 2009; Muehlenhaus, 2013; Postigo Vidal, 2016).

For this purpose, the visual hierarchy – intellectual hierarchy mapping method first developed by Harley (1989) is used to relate intellectual hierarchy (understood as the importance of the different levels or layers of information) and visual hierarchy (the extent to which the elements should stand out) making possible to obtain an optimal visualisation plan that transmits the message successfully (Dent et al., 2009; Kraak & Ormeling, 2013; Muehlenhaus, 2013; Postigo Vidal, 2016). Thus, depending on the purpose of the map and the target user, certain elements should prevail over the others, and some elements should be generalised or even removed (Muehlenhaus, 2013).

By applying this method to the tourist map, six levels of visual hierarchy can be differentiated according to the message to be transmitted and the requirements of the Administration (Table 2):

- **NV1:** Tourist trails appear at this level, which have been carefully selected by tourism agents (Phase 1) as being the most interesting in the province from a

Table 2. Characteristics and design of the information layers included in the cartography. Authors' own work.

CARTOGRAPHIC COMPONENTS	VISUAL LEVEL	CARTOGRAPHIC CODING		CARTOGRAPHIC REPRESENTATION
		IMPLEMENTATION	DESGIN TECHNIQUES	
Tourist trails Source: Senderos Turísticos de Aragón	1	Line	• Different tonality • Line simplification • Line thickness to increase visual hierarchy	
Tourist attractions (Hierarchy 1) Source: Collaborative survey (2019)	1	Point	• Graphic design of illustrations (See 3.3.4.)	
Tourist attractions (Hierarchy 2) Source: Collaborative survey (2019)	2	Point	• Graphic design of iconographies • Different tonality	
Tourist attractions (Hierarchy 3) Source: Collaborative survey (2019)	3	Point	• Point icon	Point of interest
Protected Natural Areas Source: MAPAMA (2019)	3	Surface	• Opacity • Border simplification	
Reservoirs and Lagoons Source: MAPAMA (2019)	3	Surface	• Border simplification	
Roads Source: MAPAMA (2019)	4	Line	• Line thickness to enhance the hierarchy of road network	
Hydrographic network Source: MAPAMA (2019)	4	Line	• Line thickness to enhance the visual hierarchy of river sections with recreational activities	
Landscape domains Source: IDEARAGON (2019)	5	Surface	• Different tonality	
Shadow map Source: CNIG (2019)	5	Surface	• Opacity	
Population centres Source: IDEARAGON (2019)	6	Point	• Population size represented by proportional circles • Labels sized according to population hierarchy	
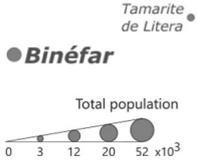
cultural and scenic point of view. The trails have pastel tones, and the thickness determines the importance of the composition. This visual level also includes illustrations representing tourist attractions to be promoted primarily. These representations must stand out well above the rest of the attractions. The reader's eye should be drawn directly to these elements at a glance. The appearance and distribution of the illustrations and tourist trails generates 'visual clusters'.

- **NV2:** The tourist attractions in hierarchy 2 are found in this level, represented by icons.
- **NV3:** Tourist attractions in hierarchy 3 are incorporated here, using smaller scale points than the icons of NV2, but with brighter colour for quick identification on the map. Amongst others, natural spaces, reservoirs and lagoons also appear at this level, as well as sections of rivers where there are tourist activities. These have thicker lines, so that they stand out from the rest of the river sections.
- **NV4:** Roads acquire a hierarchical level of order 4. They are shown in desaturated grey which does not focus the attention of the user, although it is a relevant element which should help the spatial location and mobility of the tourist user of the map.
- **NV5:** Contains the main population centres together with their labels. The base map of landscape domains and the shadow map (topography) are also found here.
- **NV6:** Secondary population centres and their labels are located at the last level. In this case, despite the importance of the population centres for tourist orientation, the large number of entities makes it necessary to locate them on the last visual level, in order to avoid making the view too complex.

3.3.4. Coding and type of cartographic implementation

Finally, codification of the different layers of information is established thanks to the combination of two software programmes – QGIS and Inkscape. This hybrid method achieves, on the one hand, the scientific and technical approach to the tourism phenomenon and the geographical precision provided by GIS and, on the other hand, the high-quality output and the communicative potential of infographic and vectorial design software.

The first bout of decision making is carried out in the GIS environment (QGIS), where all the necessary operations and geoprocessing are run to visualise, order and edit the information layers. The most important actions and processes include the following:

- Selection of the type of implementation – point, line or surface – of each of the cartographic components (Table 2).
- Extraction of three different layers of tourist attractions – Hierarchy 1, Hierarchy 2 and Hierarchy 3 – each with different symbology (Table 2).

- Generation of hillshade to represent relief modelling from a Digital Terrain Model (DTM) in raster format.
- Labelling of elements.

Following the first cartographic coding in GIS, the first layout of the tourist map is carried out and the cartographic content is exported to the graphic design software (Inkscape) in Scalable Vector Graphics (.svg) format.

The graphic design software provides flexibility when designing, as it incorporates functions such as free editing of components or the generation of vector drawings providing authenticity and personality to the cartography, which is very difficult to achieve when only using GIS (Kraak & Ormeling, 2013; Postigo Vidal, 2016). In addition, there is the possibility of applying different visual effects and design techniques; redistribution of elements; edition of text; management of colour, value, size, shape, orientation and texture of objects; as well as cartographic generalisation and simplification of entities to avoid unnecessary details that add complexity to the map (Table 2).

Since the target audience is potential visitors to the province of Huesca, the final map should be characterised by the display of persuasive visual elements. In this context, the design techniques carried out in Inkscape will also allow the free design of symbology and illustrative and iconographic elements that are explained in detail in the following section.

3.3.5. Design process for Hierarchy 1 and Hierarchy 2 illustrations

One of the advantages of the vector edition software is the drawing and design of most of the illustrations of tourist attractions of hierarchy 1. Taking the Cathedral of the city of Huesca as an example (Figure 2), first of all, a photograph was obtained and, using the graphic design software, thin lines were drawn in order to obtain its component polygons. Once created, they were filled in by extracting the colours from the original image and applying shadows in some parts to give the illustration three-dimensionality. Finally, the outlines were cleaned to obtain smoother illustrations (Table 3).

3.4. Phase 4. Cartographic assessment

In order to evaluate the use of the cartographic model created, two phases can be distinguished: internal and external (Dühr, 2007, p. 74; Postigo Vidal, 2016, p.

Figure 2. Creation of representative illustrations of the resources. Authors' own work.

Table 3. Illustrations. Authors' own work.

NAME	ILLUSTRATION
Barfaluy, Gallinero and Lecina Superior refuges	
Santa María Cathedral	
Carthusian Monastery of Nuestra Señora de las Fuentes	
Monastery of Santa María de Sigena	
Natural areas and activities to be practised during the different seasons of the year (Pirineo Aragonés)	
Descent of the Cinca river	
Collegiate Church of Santa María La Mayor	
Monegros Desert	
UNESCO World Geopark Sobrarbe – Pyrenees	
Serrablo Churches	
Royal Monastery of San Victorián	
Gabasa ravine and Baldellou gorge	
Montañana medieval villa	
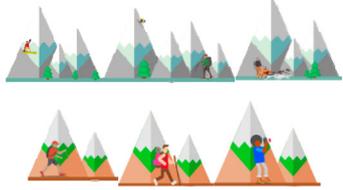
(*Continued*)

Table 3. Continued.

NAME	ILLUSTRATION
Monastery of San Pedro de Siresa	
Sanctuary of Nuestra Señora de Lourdes	
Villa Fortunatus	
Montrebei canyon	

589). On the one hand, the internal phase is based on brainstorming and feedback from the technical groups and the map promoters, which include the cartographer-designer involved. This phase was developed during all the process of cartographic design. On the other hand, the external phase includes numerous methods and techniques such as eye movement studies, the Think Aloud Method (TAM), focus-groups and surveys aimed at a wider public.

In addition to obtaining direct feedback from some of the administrative partners, two surveys were carried out. One of the surveys was addressed via email to the specialist public – Graduates of the master's degree in Geographic Information Technologies of the University of Zaragoza -, to find out whether the cartography meets the needs of geographical precision and the principles behind correct cartographic design; the other was addressed via Google Forms link to the general public, whose opinion on usability, interaction, clarity and their experience of handling the map is important to the project. The map was shown for both publics and a link to Google Drive was provided in order to improve the quality of the display. Both surveys are similarly structured. Firstly, some statistical data are collected. Then, specific questions for each group were thoroughly designed. Finally, an assessment of the map was requested.

A total of 161 responses were obtained (15 from experts and 146 from the general public). This article provides a synthesis of the results:

Expert survey:

- 89.6% considered that the cartography fulfils the principles of cartographic design, with no negative answers in this aspect.
- 80% considered it fully adapted to a general public.

- 77% considered that it satisfies its persuasive function.
- 87% considered it to be accurate.
- 100% considered that it meets its objective of promoting the tourist resources of the province of Huesca.

General public survey:

- 92% considered that the cartography awakens interest in discovering the tourist attractions represented.
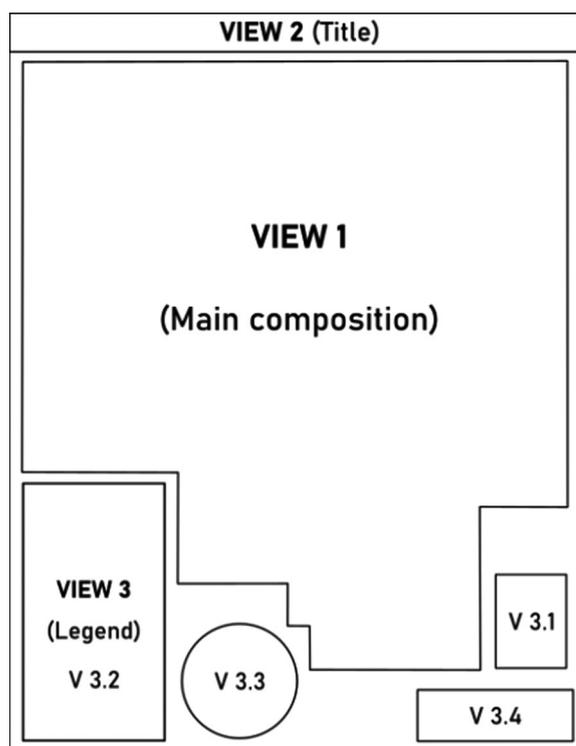
Figure 3. Arrangement of the elements according to their visual order. Authors' own work.

- 36% pointed out the need to faithfully represent the roads (firstly drawn schematically).
- 35% of respondents felt that the roads needlabels.
- 84% would use the map as a tourist tool.

The results of both surveys show positive approval of the map, although the difficulties in satisfying the needs of all final users and the challenging balance between accuracy and persuasiveness required for this tourism mapping typology were confirmed. Finally, both groups of respondents expressed their appreciation of the composition of the cartography. The ideas obtained in the assessment phase provided a guide for proposing changes and implementing
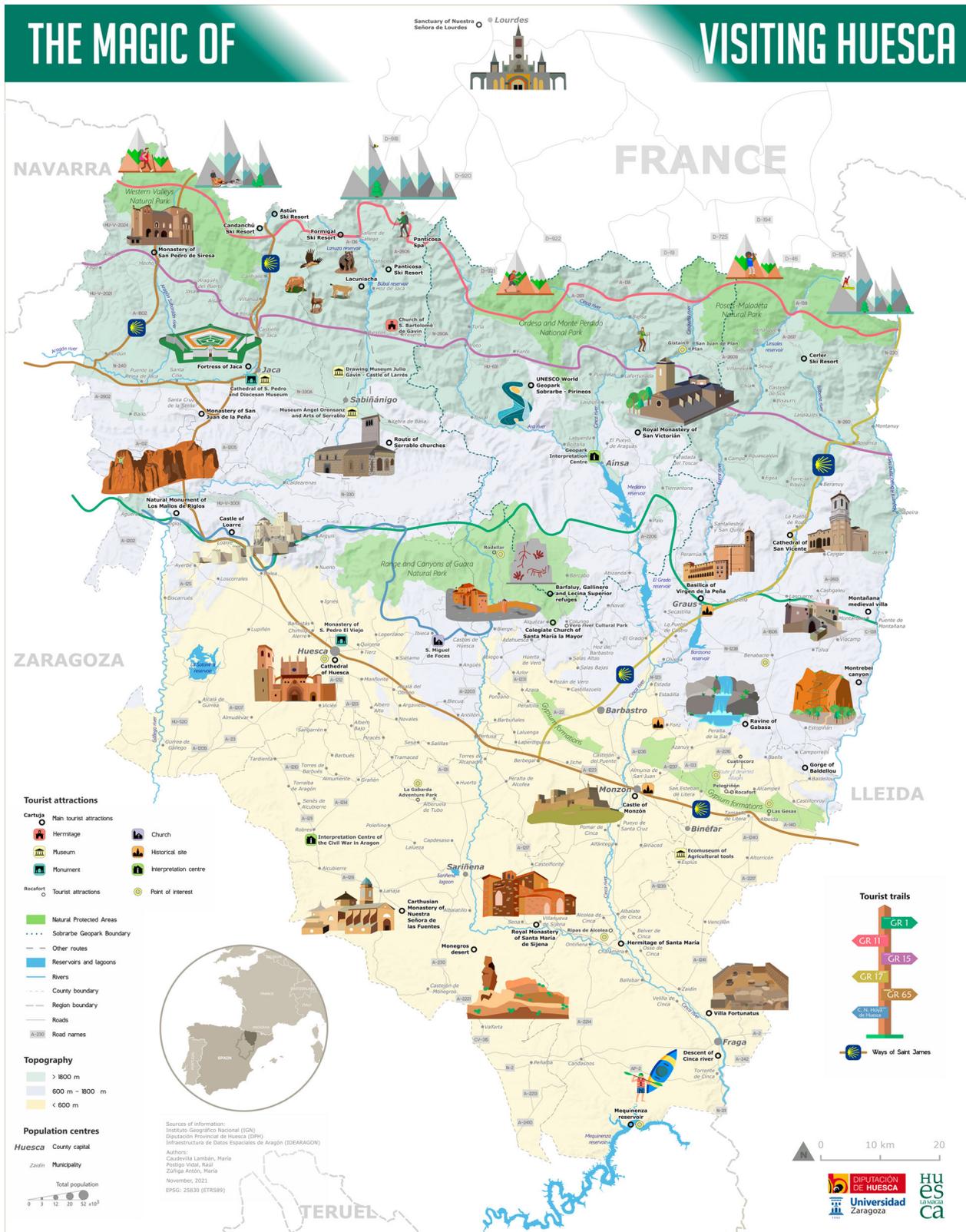

Figure 4. Tourist map. Final proposal. Authors' own work.

strategies for redesigning and adjusting the final cartographic product.

4. Results

Once the four previous phases were completed, the final cartographic product was presented. In this case, given that the final user is the general public, the map was designed for a double support: matt paper in white DIN-A3 printed at 600 dpi, and Portable Document Format (PDF).

The layout stage follows a visualisation order (Figure 3). The elements involved are:

- **The main composition:** The tourist map presented is based not only on tourism promotion strategies but also on territorial planning policies. The aim was to establish a hierarchy of the elements creating a visualisation that is as harmonious and pleasant as possible, by distributing the illustrations and icons of the attractions represented uniformly throughout the composition.
- **The title:** uses a background colour obtained from the logo of the tourism trademark of the province of Huesca to achieve a corporate design and homogenise the publications.
- **The legend:** follows its own order of visualisation according to the hierarchy of the elements referred to (V 3.1 and V 3.2). An auxiliary map with an international view is also included for the geolocation of the user (V.3.3) which also allows the destination to be projected abroad, with particular importance for France, the main outbound market for the Province of Huesca, which is represented in the cartography since there are collaborative policies to promote tourism between the two countries. Finally, other elements appear (V 3.4) such as the scale, the arrow pointing North, logos and complementary texts.

The visual layout of each of the elements comprising the map concludes with the presentation of the final map made for the Provincial Council of Huesca (Figure 4).

5. Discussion

The tourist cartographic tool presented was carried out by applying a hybrid QGIS-Inkscape method demonstrating that it has a great deal of potential for making tourist cartography that justifies its use in this project.

The final tool presented is assumed to be a hybrid map between tourist cartography, whose main characteristic is the precision of the representations, and a tourist promotion map, whose particularity is the persuasive power it has over the potential tourist. The map allows not only tourism promotion tasks to be implemented, highlighting unknown or emerging resources, but also measures related to policy, development and territorial planning, as it diversifies, deseasonalises and decentralises the seasonal flow of tourists of the Pyrenean valleys towards certain natural and cultural valuable resources that are widely spread in rural and depopulated areas of the Province, providing a balance of activity, and working as a socioeconomic dynamic for the territory.

Although there is a typology of maps specially designed for tourism planning and management, the model presented here is not only a map designed for visitors, but a collaborative design co-created by agents who know the territory and tourism policies developed there. Therefore, the confluence of both applications in the same tourism cartography is evident, demonstrating the complexity of reaching the objectives of both groups and their considerable influence on the final design.

Cartographic assessment enabled compliance with the principles of cartographic design to be verified, which is simple and legible cartography (clarity), coherent in its reading (order), organised, attractive and aesthetically pleasing (harmony), hierarchical in terms of the visual weights of the components (contrast), and efficiently finished (balance). But it has also contributed to the development of improvement strategies and recurrent redesign. This project develops, explains and demonstrates, through a final validation, the effectiveness of a hybrid methodology between GIS, which allows the development of updateable and modifiable databases for tourism planning, and graphic design software, which facilitates and improves the design and production of maps, achieving more persuasive visualisations.

Since the cartographic design process is flexible and adaptable to the needs of each project, the protocol presented, focused on the Public Administration, can be adopted as a model applicable to the design of tourist maps in other regions.

Software

QGIS version 3.8.3 has been used for the visualisation, sorting, selection, extraction, calculation of variables, application of symbology and export of the information layers.

Inkscape 0.92 was used for the design, development and layout of the map, including the drawing of the illustrations and icons used on the map.

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Disclosure statement

Data availability statement

Data layers used for the composition of the map were derived from public domain resources such as Spatial Data Infrastructures (SDIs) and Official Agencies. These data is available in:

MAPAMA (https://www.mapa.gob.es/es/cartografia-y-sig/ide/descargas/default.aspx)

CNIG (https://centrodedescargas.cnig.es/CentroDescargas/index.jsp)

IDEARAGON (https://idearagon.aragon.es/descargas)

Senderos Turísticos de Aragón (https://senderosturisticos.turismodearagon.com/descargas/)

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