An interdisciplinary methodology for the analysis and visualization of the heritage of road corridors

Abstract

Roads and particularly those adapted to the automobile, constitute an essential element in the shaping of landscapes. In Europe they were built within historic corridors and incorporate both heritage assets of the period of construction of the road as well as valuable pre-existent assets. Heritage studies have provided partial valuation that tends to focus on the scenic aspect of roads, the technical valuation of original sections or the architectures built to offer services to the infrastructure. The article aims to define a method to enable the integral analysis of the heritage complexity of roads. This research focuses on the Spanish N-340 corridor, a historic connection between Europe and Africa that was very much transformed over the 20th century as a result of tourist occupation. The research also develops an online heritage database that allows the inter-relation of the different assets, maximum accessibility and continuous updating.

Keywords: heritage visualization, historic road corridor heritage, information and communication technology.
Introduction

Roads and particularly those built on the appearance and consolidation of the automobile, constitute an essential element in the shaping of landscapes as these substantially influence the occupation and organization of their surroundings.

Throughout the 20th century, the "everyday" landscapes associated with roads have evolved dramatically, up to the point where the increasingly high level of transformation may no longer be considered as worthy of heritage appraisal.

However, the corridors incorporating these roads frequently contain highly valuable heritage assets. This heritage may be considered in terms of the technical heritage of built roads or those modified to suit the first automobiles, as well as that of its surroundings and, more specifically, the natural and rural heritage of the area incorporating the road or the architectural and urban heritage structured or given access by the road.

From a European focus, the fact that many of the main roads and highways were built within historic corridors, has ensured that, together with the heritage elements corresponding to the period of construction and the greater transformation of the road, we may still encounter preexisting elements that form part of its heritage.

In spite of the heritage value of these infrastructures, very little has been written on the subject to date and most of the studies that do exist provide only a partial or individualized study of some of the heritage elements outlined above or, instead, concentrate on those sections where there are more evident heritage elements. This is the case of those road sections that were abandoned
over the early part of the 20th century, or those that are rarely used and that pass through areas that have been little affected by modern change.

In this context, the present article aims to define an interdisciplinary method developed in four stages that enables the integral analysis of the complexity of architectural, technical, urban and natural heritage of these road corridors. This project has been developed within the framework of a competitive research program backed by European Regional Development Funds (ERDF) and has been conducted by professionals from the heritage sector engaged in different aspects of spatial-related studies, ranging from civil engineering to geography, architecture and urban planning.

The study focuses on the Spanish Mediterranean N-340 corridor, a historic connection between Europe and Africa, with highly valuable historic and cultural stratigraphy. The infrastructural dimension of its modern heritage was already recorded in the 80's by Ramírez (1987) and has more recently been examined by authors such as Rojas (2010) Loren (2012, 2014) or De Lacour (2014). However, this coastal corridor was very much transformed over the latter half of the 20th century as a result of tourism development (Morales 1982; Galacho Jiménez 1996; Mesalles and Sumoy 2002). The methodology and heritage database are specifically applied to a southern section of the N-340 road passing through Cadiz and Malaga.

In order to systematize the findings, the research employs GIS technology and develops an online heritage database, specifically designed to consider the singularity and diversity of road corridor assessment and incorporating geospatial information of the heritage assets. The methodology provides essential linking of spatial information with the data and allows simple
visualization and circulation, while providing for the necessary public participation.

This heritage database seeks maximum accessibility and continuous updating for both researchers and the general public alike. The database seeks to bring attention to the heritage dimension of these corridors and overcome the generally limited online heritage information available to tourists, while raising public awareness of their fragility.

**Background**

As outlined above, the heritage assets of road corridors are of very different nature: ranging from architecture, historic centers, production landscapes, natural areas or elements related to the infrastructure itself that are worthy of conservation.

However, the entire heritage of these corridors has not generally been considered as a whole and existing heritage studies tend to fall into three groups according to objective: those considering the infrastructure itself; those examining the scenic qualities of the area; or those dealing with the architecture and urban formations that give service to the road.

Over recent years there has been a growing interest in the technical heritage related to roads. This concerns particularly vulnerable assets subject to transformation as, with very few exceptions, these continue to form part of the road network in use (Grazuleviciute-Vileniske and Matijosaitiene 2010; Ruiz, Rodriguez and Coronado, 2015). While attention has mainly focused on specific elements of the road, and particularly bridges (Fernández 1995), new
approaches consider the need to embark on a form of conservation that takes into account the infrastructure as a whole (Marriott 1998; Lay 2006; Hubbard 2008). This new approach encompasses the simultaneous consideration of the road alignment, cross-section and auxiliary structures and elements (Ruiz, Rodriguez and Coronado 2014).

There are also abundant works related to the natural and cultural heritage visible from the road. In this respect, and ever since the publication of View from the Road (Appleyard, Lynch and Myer 1964), many authors have examined the visual experience of road trips, focusing on the search for outstanding views (Garré, Meeus and Guilinck 2009) or the attributes most appreciated by road users (Hallo and Manning 2009). The road is mainly considered as a vantage point and the heritage value of the corridor then lies primarily in the surroundings perceived from the road. This particular area of study also includes those of prospective nature considering the necessary integration of the road within the landscape (Copps 1995; Clementi 2003; Otero et al. 2006; Zoido 2006).

Finally, the works by Merriman (2006) or Raitz and O’Malley (2012) have focused on the architecture and urban areas that have sprung up along the corridor, while Banham's studies of Los Angeles (1971) constitute a historical reference for authors on the infrastructural assessment of urban transformations (Varnelis 2008). With regards to the analysis made from a heritage focus, the majority of studies have tended to focus on those buildings offering services to road users, such as gas stations, restaurants or motels (Liebs 1995; Jakle, Sculle and Rogers 1996: Morrison and Minnis 2013). In this respect, reference may be made to the conservation plans developed on
some of the more emblematic roads in the United States and Australia. In these cases, and while the road is still considered as the fundamental component serving as the backdrop to these elements, far greater importance is given to the architecture that came into being once the road had been built (Barthuli and Taylor 2007).

It is important to underline that, as opposed to this latter focus and, namely, the analysis of very humanized territories that are more likely to incorporate architecture or urban forms of interest, the two former approaches (the consideration of road heritage and the scenic beauty of the corridor) tend to concern areas that have withstood the passage of time and undergone little transformation. It is the case that most landscape studies (Aplin 2007; Mata and Fernández, 2004; Mata, Meer and de Puente 2012) generally concern environments of more traditional nature where the heritage aspects are more readily discerned.

In this context, this manuscript insists on the interest that might be raised by "everyday" landscapes (Jackson 1984; Dewarrat et al. 2003), by examining a stretch of road that has undergone intense transformation.

**Methodology: Identification of road corridor heritage**

The proposed interdisciplinary methodology is developed over four stages, starting with the identification of the road and its corridor and followed by a heritage character assessment on three scales.

As it has been mentioned, the study employs GIS, a tool widely used in heritage studies on a territorial scale (Kaimaris et al. 2010; Maio et al. 2013),
and more specifically GVSIG, QGIS and ArcGis. For reference purposes in this particular study, recourse has been made to material available in both WMS and Shape formats from different institutions and international, national and regional levels (main sources in table 1).

Location of the historic road and its corridor

Identification of the historic road

As a result of transformations made to adapt the road to the successive requirements of the automobile, the original route existing at the beginning of the 20th century (or even earlier periods) is no longer readily recognizable. This then makes it necessary to resort to maps and historic photogrammetric flights.

In this particular case we had access to maps of the original construction project of the road (beginning in the mid-19th century) as well as the first edition of the National Geographic Institute (IGN) National Topographic Map at 1:50,000 scale (MTN50) (produced by the German Army General Staff, 1916) and the American Photo Mapping Flights of the 1945/46 Series A and 1956/57 Series B, this latter in WMS format (the first flight of national coverage, conducted by the United States Army Map Service).

When comparing these sources with the most recent orthophoto imagery (Panchromatic Digital Orthophotography of Andalusia of 2010-2011 and the Unified Digital Street Map of Andalusia (CDAU) of the Andalusian Institute of Statistics and Cartography (IECA) it is possible to ascertain the current state
of the old route and to sub-divide this into sections according to the formal and functional characteristics of the road (Figure 1).

The large degree of sub-divided road sections gives some idea of the level of transformation of the corridor. On the original road sections (those withdrawn from use) there are more probabilities of finding technical remains of the original road. However, those sections that have been very much modified are also worthy of consideration as these bear testimony to the geometric alignment of the historic road.

**Definition of the corridor**

The road corridor creates its own area of proximity in the form of the strip of land incorporating the infrastructure and directly occupied and transformed by the same. It is then the corridor and not just the infrastructure that must be considered in terms of heritage value.

In order to identify the corridor and its different historic environments, a planimetric approximation was made, superimposing different layers corresponding to the developments in land usage, heritage information and the sub-division of lands.

In this case, and starting with the area incorporated between elevations from 0 to 100 meters (which on account of topography and geographical arrangement forms the area closest to and most affected by the road), we proceeded to overlay layers of heritage information (DERA); and land usages for 1956, 1977, 1984, 1998, 2007 (REDIAM), 1990, 2000, 2006 (Corine Land cover),
scale 1:100,000, and 2005, ending in 2009, scale 1:25,000) through the Spanish Land Occupation Information System, SIOSE).

It is essential that the final boundaries are verified by recent topographical maps, historic cartography and field work. While the majority of the corridor was confirmed to be within the said contour interval, there are sections at higher elevations (up to 400 meters in exceptional cases), as a result of the topographic and geomorphological characteristics of certain sections of the coast (Figure 2).

**Analysis of the physical-geographical characteristics of the general area**

In order to provide geoecological and scenic significance to the physical-geographical location of the road, it is necessary to consider its general confines within topographical boundaries. This characterization will then allow the identification of the natural heritage of the general area interacting with the road incorporating the geology, hydrology, vegetation and biodiversity.

As the N-340 is a coast road, one of the boundaries is formed by the coastline and the transformation of the space between the road and the coast is inevitably effected by the construction of the same. The other boundary is formed by the pre-coastal mountain ranges, of variable heights, and the penetration of the more open lower valleys of some of the rivers, within a terrain rising from sea level to a maximum height of over 1600 meters (Figure 2).
Geologic and geomorphic characterization

Identification of the geologic time scale, lithology and key geologic units using the Mining-Geological Map of Andalusia, scale 1:400,000 (Mining Geology Information System, SIGMA on DERA). The three landform assemblages serving as the base and backdrop to the road are defined and are considered as a visual dimension of the same. The morphological diversity, rare rock formations, complex distribution of physical elements of the landscape and contrasting landforms along the N-340 are identified as values in themselves and as the basis for other elements and processes (Figure 3).

The hydrographic network and geomorphic features of the coast

The hydrological data provided by the Andalusian Environmental Information Network, (REDIAM) was employed for the study of hydrographic sectors, sub-sectors and sub-basins.
Within highly built-up road corridors such as this one, rivers and streams serve as the main biological and ecological corridors, as sanctuaries of biodiversity and the individuality of the landscape, with many of these incorporating traces of surviving vegetation and traditional practices worthy of protection. In this way, river may then be considered as noteworthy assets in the heritage and spatial organization of the N-340 corridor.

Vegetation and biodiversity
The natural/semi-natural, potential and surviving vegetation and biogeographic sectors were identified and the structural and phytocenotic vegetation diversity was assessed by the Land Cover Map, scale 1:100,00, of 2006 (Corine Land Cover) and by the Vegetation Map of Andalusia, 1:10,000, of 2008 (REDIAM).

The N-340 corridor supports a high level of biological diversity of great ecological and aesthetic value, in the form of: small marshes, estuaries and coastal vegetation; traces of woodlands and historic replantings assimilated within the landscape; dune belts and psammophile vegetation associated with dune formations.

Analysis of human activity in the corridor: background, occupation and transformation

A historic study is made integrating the chronologies of the road with the urban and architectural transformations of its corridor. A historic timescale is considered running from the early adaptations of the road for motorized traffic (carried out in the twenties) up to the present day, preceded by a snapshot that summarizes the values presented by these historic strata.

This analysis allows both the confirmation of the validity of the proposed corridor area and the identification of the heritage values associated with the modern processes transforming the corridor. This section entails multi-disciplinary historical research with considerable bibliographical and archival study.
The first roads for automobiles in Europe were built within preexisting and historically established corridors and this stage should subsequently consider the earlier stratum.

The N-340 is aligned within a corridor that has been occupied since early times, the area serving as a strategic enclave between the Mediterranean and the Atlantic and between Europe and Africa, and subsequently one with a historical and cultural stratigraphy of utmost value (Figure 4).

This territory has been farmed and populated since the times of the first indigenous settlers (with a symbiotic duality of trade and farming, coast and hinterland and the urban and rural). This coastline has historically been formed as a network of cities and, throughout time, the road has given shape to this historic infrastructural formation of a territory-network. The cities within the corridor bear witness to their Phoenician origins (9th-7th centuries BC) and control by Rome, though their formal arrangement and adaptation to the lie of the land, more keenly reflect the Islamic occupation of nigh on eight centuries up to the time of the Christian conquest in the 15th century.

The layers of heritage information are incorporated (using the Andalusian Spatial Database Service, DERA and the Andalusian Institute of Historic Heritage, IAPH), in association with earlier investigations by the research team and the findings provided by field work. The most predominant transformation over time has been that with respect to agricultural use and layers of information on crop and livestock farming have been incorporated, as provided by: the Andalusian Land Occupation Map, by REDIAM; Corine
Land Cover 2006; the Spanish Land Occupation Information System, SIOSE; and the Vegetation Map of *Andalusia*, 1:10,000, as pre-existences of past production, together with planimetric and agronomic information provided by the Historic Archives of the Province of Malaga.

The analysis of the human activity before the appearance of the automobile, demonstrates that this corridor contains cultural assets of different nature and scale:

- The network of cities, the extension of historic town centers and traditional fishing villages, constituting points on the road;
- Traditional farming together with its associated architecture, communities, installations and infrastructure.
- Architectural remains of different periods, particularly Roman and Islamic remains and contemporary architecture of eclectic and regional nature from the turn of the nineteenth century.
- Defense architecture such as watchtowers, castles and barracks.
- Sections of historic paths that were not employed in the construction of roads.
- The remaining original alignment of the road, associated structures and road worker’s houses.

*Periods of occupation and transformation of the corridor*

In order to identify heritage assets contemporaneous with the automobile, four periods of transformation of the road are established. The analysis of these
periods takes into account: historic events occurring at a national and international scale; legislation introduced with a potential bearing on these transformations; the history of the city and its architecture; the rationale behind the occupation and transformation of the corridor over each particular period and their implication on the incorporated heritage values.

• **1926-1950: The road as a discontinuous cultural route passing through an agricultural landscape between historical cities**

This period witnessed: (1) the middle-class suburbanization of the city; (2) public construction with new social and functional aspirations (schools, post offices, and housing projects): and (3) the first modern architectures for the incipient tourist trade (hotels, apartments and complexes), these actions all forming urban road sequences of significant heritage value.

With regards to the road itself, the road signs, markings and roadside protection (designed according to the first Spanish Road Standards), the road surfaces used over these decades (cobbles and bitumen sprays), and the cambering of bends to adapt the infrastructure to motor vehicles, can all be considered as heritage that remits to this period. These technological assets still remain in sections that would be modified in following years.

• **1950-1975. Infrastructural and urban modernization. The new cities and their architecture. The conversion of the N-340 coastal road to a main road**
The touristic architectural heritage of the N-340 corridor mainly corresponds to this period. Modernity is combined here with tradition and craftsmanship offering creative and innovative building proposals. In contrast to the speculative nature of following years, this period would be noted for its building quality and the balance between built-up and open areas. These heritage assets, concentrated in the area of the corridor immediately adjacent to the road, confirm their functional and symbolic link to the automobile.

Over these years, the increase in traffic led to systematic road-widening (12 meters wide) and the adoption of large-radius bends. This process left certain modified sections that remit to earlier times.

- **1976-1997. Local urban sprawl. Suburban construction within the corridor**

In contrast with high-rise buildings, apartment blocks and hotels, the architecture of this period was largely suburban in nature, leading to a low-density occupation of the corridor. These heritage assets, largely dating back to the seventies, provide exquisite examples of modern Mediterranean-inspired architecture which are far removed from the iconic aspirations of earlier architecture and served to integrate these residential housing estates within the landscape with particular emphasis on collective open spaces and services. However, these examples are few and far between and banality and speculation predominates among the construction in the corridor from this time on. During this period several sections of motorways were constructed.
along the N-340 by doubling-up the existing roadway, under the auspices of the Plan General de Autovías 1984/1997. By way of contrast, new heritage legislation served to protect historical archaeological and architectural sites dating back prior to the construction of the road.

• **1998-2011. Consolidation of conurbation: areas of primary residence**

At the turn of the century, the N-340 corridor was consolidated as a continuous conurbation, partially shedding its identity as a place of seasonal and recreation occupancy and becoming an area of permanent residence for both national and international inhabitants alike. While its heritage is still largely hidden, regional and municipal urban planning has started to provide the first form of protection to architecture dating back to the appearance and consolidation of the automobile. However, with the exception of the protection provided to certain bridges, the road and the rest of its elements do not receive consideration as heritage.

The study is based on the application of historic photogrammetric flights:

• **American Photo Mapping Flights 1956/57 Series B, US Army Map Service.**

• **Historical Panchromatic Digital Orthophotography of Andalusia 1997/83 (1997).** Mapping Flight of the Institute of Agricultural Reform


The historic evolution of land usage for 1956, 1977, 1998 and 2007 (REDIAM) has been superimposed and an analysis made of the transformation of the road over different periods. These transformations have been compared with the Unified Digital Street Map of Andalusia (CDAU) and with detailed road information provided by DERA. The information for each successive period has been overlaid to show the changes both with respect to land occupation and to the road itself. Figure 5 incorporates the period from 1950-1975, by way of example.

**Compilation of the natural and built heritage of the corridor**

In this last phase, the methodology proceeds to systematize detailed heritage information of the different assets as identified in the preceding stages and offers a global and integrated heritage consideration of the corridor. Together with the studies carried out with respect to character assessment and their associated fieldwork, a review is made of the bibliography and the heritage studies conducted earlier by different disciplines, with reference to the Topographical Map of Andalusia, at scale 1:400,000, of 2008.
On overcoming the boundary lines between the natural landscape and that modified by human activity, the historic and the more modern-day and the scale of the architecture and the cities, the heritage consideration of the N-340 can be taken to incorporate:

- Significant remains of natural spaces: surviving or naturalized vegetation, beaches, streams and rivers, sand dunes, significant geomorphological formations and, even, seabeds of outstanding value.
- Preexisting historical farming and agricultural areas.
- Historical paths and technical heritage of the road: sections of the historic route, bridges and drainage works, road signs and retaining structures.
- Network of historic cities and architectural assets: archaeological remains, fortifications, original fishing settlements, urbanized areas, elements of historic and contemporary architecture, buildings directly associated with the road and road services.

All heritage assets are identified and geographically located on GIS. The said geospatial data is supplemented by detailed information of every item. Each entry includes a description of their heritage values, including all the protection data available (international, national and regional) and current condition (Figure 6), together with indication of their historical, geographical and scenic relation to the road.

The database is built from an open source content management system and framework called ProcessWire which enables flexibility in order to define the
data fields. The flexibility provided offsets the need to work within a rigid, predetermined structure and, instead, allows personalized fields that adapt to the specific needs and requirements for the heritage definition of a corridor.

In order to integrate all this information, it is necessary that this heritage database operates in conjunction with GIS support to allow the portability of data in both directions and to prevent users from being software driven (Meyer et al 2007). The database conserves the spatial references of the GIS and supplements this with a series of information fields essential for their heritage definition. The heritage database should also be capable of establishing the relationship both between each asset and the road and among these different heritage assets. This tool overcomes the failings of more traditional catalogs, allowing a visualization of the relation between different heritage elements in order to provide a fully integrated heritage approach.

The research has confirmed the heritage diversity of historic road corridors and the scant protection provided for this heritage and particularly that of the technical elements of the road. Heritage assessment of coastal corridors requires special consideration as they have sustained profound transformation due to intensive tourism development. Heritage is generally ignored in these coastal tourist areas by both the authorities and the public in general and on many occasions is considered as a handicap to tourist development.

Results: The visualization of road heritage corridors

The interdisciplinary methodology outlined in this article is the primary result of this research. While this has been applied to a Spanish road corridor, the
methodology could be extrapolated without any problem to other geographical areas, as many of the sources of information employed are similarly available in other countries.

The development of a heritage database embraces the singular heritage of a road corridor and serves as a necessary supplement to the more conceptual methodological aspects provided in this study.

Figure 7 (a) provides a view of the interface for researchers, showing all the fields and options that have been developed. This interface is very intuitive and requires no previous learning process and allows interaction and collaboration from researchers around the globe, assisted by integrated multilingual support.

Together with basic identification information and graphical documentation, this heritage database defines the relation of the asset to the historic road together with geographical location and detailed heritage data. As opposed to the limitations of other heritage databases, this system allows the introduction of geospatial data—such as the coordinates of heritage items, historical routes or the evolution in the use of the corridor—and their transfer, following KML conversion, to universal mapping services such as Google Maps. This heritage database does not serve as a means of entry on a traditional catalog or registry, but instead forms the catalog itself.

Finally, it is necessary to provide effective strategies to raise the interest in this valuable heritage, making this information accessible and visible for the public. As Giaccardi and Palen (2008) said: “The encounter between the complex reality of heritage and Information Communication Technology is not only an opportunity but also a need”. In order to meet the project
objectives of maximum accessibility, the heritage database is visible by any internet user and information is available to the public at all times. The screen design and contents provide sufficient information of the value and fragility of the heritage in historical corridors under constant transformation while offering an attractive and friendly interface. Figure 7 (b) shows the perspective of the user, with data fields covering the identification and location of the asset in relation to the historic road, the time period, state of conservation, accessibility from the road, protection data, graphical and bibliographical information.

It was essential that the system did not place any restrictions on content or design, allowing the creation of catalogs that incorporate multiple search criteria and complex data. This allows a global and integrated heritage approach where the assets may be related by historical or geographical criteria. Figure 8 shows the asset in figure 7 in an integrated sequence that incorporates the natural elements (lakes and bays), the historic architecture prior to the automobile (Islamic watchtowers and military headquarters) and road sections (sections that were replaced at the beginning of the 20th century and that, subsequently, remit to the period of construction. This section of the corridor, close to the Strait of Gibraltar is noted as a point of migration of birds from Europe to Africa, with the lakes, rivers and streams forming migration paths. In historic terms, the section contains military architecture from different ages, such as medieval watchtowers or bunkers from the Civil War. These natural and cultural assets confirm the strategic heritage character of this section of the corridor.
Conclusions

As opposed to the more established heritage processes related to historic town centers and rural areas in Europe, there is very scant recognition of the heritage of transport corridors, to the extent that these are often considered an obstacle that handicaps the modern transformation of the same. This explains the limited number of heritage elements within a corridor that are preserved today, and the almost complete lack of any protection for the technical assets of the road.

This lack of consideration further confirms the fragmentation of different heritage appreciations, both from an administrative and disciplinary point of view, evidencing the diversity of heritage recognition at international, national and municipal level and underlining the segmentation of the different forms of protection (natural, agricultural production, technical, architectural and urban) which then prevents the necessary integral protection and the formation of an inter-disciplinary heritage narrative. The subjective and isolated conception of heritage in traditional catalogues has influenced the fragmented and static nature of heritage protection and this research, in contrast, seeks a far more open heritage process, methodology and strategy.

The singularity of road heritage means that their corridors should be considered as a dynamic environment, which changes and broadens over time, leading to the overlapping of historic strata that bear testimony to the successive rationales for their occupation and incorporating the natural conditions constituting the same. The enclosures formed by different corridors can be established as an area of heritage influence of the historic road that
transcends its most immediate surroundings and captures the complexity of this space.

In view of the singularities of this heritage and the failings that have been noted, it is considered that current strategies for identification and preservation require a complete overhaul. As a first step in this direction, the methodology presented here makes it possible to consider the singularity of road corridors, develop a multi-scale and inter-disciplinary breakdown of its heritage and making it visible and accessible for the public.

Likewise, it is important to bring attention to the need for the permanent association between geographic information and data in the character assessment and management of this type of heritage. The contributions made in this respect allow the correct heritage integration of highly complex territorial environments.

This would enable utmost portability, ease of data transfer, ready accessibility and constant web updating. The methodology provides the essential linking of spatial information with the data and allows ease of data transfer, simple visualization and circulation, constant web updating, while ensuring the necessary public participation and appropriation intrinsic to all heritage processes. Future research should be aimed at supplementing and reinforcing this useful tool through heritage awareness and appropriation processes that both instruct and inform the public.

References


Captions for figures

Figure 1. Location and current condition of the historic road.
Figure 2. Delimitation of the area affected by the road. General scope and corridor.
Figure 3. Analysis of the physical and geographical bases of the general terrain. Geologic and geomorphic characterization: structural units.
Figure 4. Analysis of human activity in the corridor. *Preexistences. Snapshot of the corridor prior to the adaptation of the historic road to automobiles.*

Historic cartography of the corridor prior to the adaptation of the historic road to automobiles (National Topographic Map "German Map", sheet 1072 scale 1:50,000, first edition)
Figure 5. Analysis of human activity in the corridor. Periods of occupation and transformation of the corridor. Example Period 1950-1975. Heritage assessment in a specific section.
Figure 6. Compilation and critical analysis of the heritage assets of the corridor.
Figure 7. The visualization of the heritage assessment of a road corridor. Heritage database. Left, interface for researchers 7(a). Right, interface for users 7(b).
Figure 8. Global and integrated heritage approach. Example sequence of a section of the corridor close to the Strait of Gibraltar.
Table 1.
Main sources used for GIS studies GIS. Formats: Shape, WMS and database.
The sources and bibliography for each heritage asset are specified in the heritage database developed in this research.

| Environmental Information Network of Andalusia (REDIAM) | Department of Environment and Spatial Planning, Andalusian Regional Government |
| Mining Geology Information System of Andalusia (SIGMA) | Department of Economy, Innovation, Science and Employment, Andalusian Regional Government |
| Andalusian Historical Heritage Institute (IAPH) – specifically the Andalusian Historic Heritage Database (SIPHA) | Department of Culture, Andalusian Regional Government |
| National Center for Geographic Information (CNIG) and National Geographic Institute (IGN) - specifically the Land cover and Use Information System of Spain (SIOSE) | Ministry of Development, Government of Spain |
| Geographic High Council of Spain – specifically the data provided through the Spanish Spatial Infrastructure Data Geoportal (IDEE) | Ministry of Development, Government of Spain |
| Cadastre | Ministry of Economy and Finance, Government of Spain |
| Corine Land Cover | European Environment Agency, European Union |
Identification of the authors

**Mar Loren-Mendez** (corresponding author)
PhD in Architecture. Tenure Professor at the University of Seville.
She is a Professor of Architectural History, Theory and Composition at the School of Architecture, at Seville University. She holds an Advanced Master of Design Studies at the Graduate School of Design at Harvard University. Her main research topics focuses on Contemporary Heritage and Littoral transformation and Tourism, coordinating this latter topic within the Doctoral program at the School of Architecture. She is the director of the Research Group “Contemporary City, Architecture and Heritage.”
Postal Address: E.T.S. Arquitectura. Calle San Vicente 22, 1º B, 41002, Seville (Spain).
Tlf: 0034670529725
Email: marloren@us.es

**Rafael Mata-Olmo**
PhD in Geography. Full Professor at the Autonomous University of Madrid.
He is a Full Professor and Head of the Department of Geography at the Autonomous University of Madrid. From the perspective of landscape as heritage, his main research interests lie in the analysis of landscapes for spatial planning purposes, as well as the identification of values and problems affecting them. He was awarded the National Publication Prize in 1987 (Spanish Ministry of Agriculture) and he is author of numerous publications, among them the *Atlas Nacional de Paisajes de España*, published in 2003 by the Autonomous University of Madrid.
Postal Address: Calle Francisco Tomás y Valiente s/n, Carretera de Colmenar km 15.5, 28049 Madrid (Spain).
Tlf: 0034914978520/4577
Email: rafael.mata@uam.es

**Rita Ruiz**
PhD in Civil Engineering. Assistant Professor at the University of Castilla-La Mancha.
She is Civil Engineer and she received her PhD from the University of Castilla-La Mancha (Spain), where she is currently working as an assistant professor in the Department of Urban and Landscape Planning. She is ICOMOS and TICCIH member and her research is mainly on heritage of civil engineering infrastructures, with special focus on roads built from the middle of the eighteenth century for carriages and for first automobiles.
Postal Address: E.T.S.I. Caminos, Canales y Puertos. Avenida Camilo José Cela s/n, 13004, Ciudad Real (Spain).
Tlf:0034926295300/3287.
Email: rita.ruiz@uclm.es
Daniel Pinzón

Researcher at the School of Architecture at the University of Seville. He is an architect and he is currently completing his PhD thesis requirements in the School of Architecture, at Seville University.
Postal Address: E.T.S. Arquitectura. Calle San Vicente 22, 1º B, 41002, Seville (Spain).
Tlf: 0034670529725
Email: daniel@arqyestudio.com

This work was supported by the Agencia de Obra Pública de Andalucía, within the framework of a competitive research program backed by European Regional Development Funds (ERDF), under Grant G-GI3001/IDIS.