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Design of a Transdisciplinary Methodology for the Identification and Characterisation of Industrial Landscapes

María Isabel Alba Dorado

Higher Technical School of Architecture, University of Malaga, Campus of El Ejido, 29071 Malaga, Spain; maribelalba@uma.es

Abstract: Today, the industrial landscape constitutes an extraordinarily complex phenomenon, the study of which has been approached belatedly by the scientific community in general. This has given rise to a situation of conceptual and methodological insufficiency in the field of landscape study, making necessary both a reconsideration of the ways these studies have been approached to date and the development of a methodological framework that takes into account the specific nature of these landscapes. With this in mind, the objective of this article is to present a specific methodology for the identification and characterisation of industrial landscapes based on both their heritage and cultural considerations. The methodology contemplates an initial in-depth study of both the landscapes in question and the most relevant methodological trends applied to landscape study, in an effort to ascertain to what extent these methodological approaches respond to the needs of the study. On the basis of the results obtained, this article attempts to make an advance in the contribution of methodological improvements and innovations that materialise in the design of an industrial landscape identification and characterisation methodology, that contemplates a holistic, integrational approach that operates across the various dimensions attributable to these landscapes and advocates a transdisciplinary approach to the study of the same.

Keywords: industrial heritage; industrial landscape; post-industrial sites; transdisciplinary methodology; landscape identification; landscape characterisation

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1. Introduction

The imprint left by the development of various activities linked to production, extraction, transportation and consumption, carried out during the modern industrialization process on territory, buildings and industrial constructions, as well as on society and culture, constitutes an emerging heritage that to date has not been sufficiently valued and/or studied [1–3].

Landscapes generated by our industrial past constitute a phenomenon of extraordinary complexity and diversity, and are defined by the remaining factories, mines, infrastructures, housing, machinery, tools, objects, archives and so forth, all of which form part of the territorial, social and cultural context in which they arose. The very concept of the industrial landscape both integrates and lends meaning to a series of events that, taken in isolation, would barely be worthy of consideration [4–6]. The result is a physical, social and cultural reality that is reflected in the history, culture, territories and specific architectures created and shaped over the course of this industrial past. These landscapes acquire their own specific identity, not only as landscapes that have been radically transformed by industrial activity, but also as possessors of significant cultural and heritage value, as depositories of a collective memory, and as witnesses of the day-to-day existence of a time and the culture of a society.

Once the industrial activity that generates them ceases to exist, many of these landscapes, witnesses to our industrial past, become heritage sites. The process of heritagisation of these landscapes implies their assignment of certain values (historical, aesthetic, of social

use, symbolic, identity, cultural, etc.), either by a group of people who project their identity upon them or by the institutions. An industrial landscape becomes patrimonial as a consequence of the way in which society appropriates it and the values that are assigned to it. Thus, these industrial landscapes acquire their heritage dimension as bearers of values relating to work culture, to the identity of generations of workers, the history of a people, and the scientific and technological culture of a very recent period in the history of humanity. However, despite the importance of these landscapes as repositories of collective memory and as cultural frames of reference, many of them are subsequently abandoned, degraded, exposed to major transformations and, on occasion, disappear without trace [2,6,7].

Today, the industrial landscape constitutes an extraordinarily complex phenomenon, the study of which has been approached belatedly by the scientific community in general, and few of these studies have undertaken their task in any depth. Increasingly, researchers and professionals in the field of heritage and landscape are recognising the need for further analysis, enhancement, protection of and future planning for these post-industrial landscapes [1–3,6,8–10].

The complexity of these sites means it is necessary to approach them in a manner that contemplates their analysis, identification and characterisation from a perspective that integrates the numerous factors that have an impact on them, be these natural, territorial, heritage or production related, cultural, environmental, economic, historical, social, etc. What remains unclear, however, is the manner in which to approach these actions and which frameworks or methodologies to use [11,12]; While methodologies that focus on the study and preservation of natural and rural landscapes are both common and scientifically established, those that contemplate landscapes of a more commonplace, or in some cases deteriorated nature, such as those landscapes generated by industrial decay, are either scarce or still in an embryonic state.

Providing answers to these questions is not an easy task, as the complexity and specific nature of industrial landscapes renders the use of identification and characterisation methodologies designed for landscapes that have been transformed to a lesser degree by human action inappropriate.

The importance of the concept of landscape today, from both an intellectual and implementational perspective, calls for specificity and precision in the use of this complex notion that has earned the support of promulgation by the European Landscape Convention (ELC). The ELC has been responsible for an increase in intellectual commitment and supported an extensive field of work based on the broadened concept of landscape that it introduces; this concept encompasses not only more striking or exceptional landscapes, but also those that are more commonplace. While the ELC does not establish any methodological procedure or sequence for approaching landscape study per se, it does stimulate interest in these issues from a conceptual and methodological perspective. That said, it is currently possible to observe how many theoretical and methodological references, relating to landscape study in general, are incomplete [13], with deficiencies becoming more accentuated in the case of more commonplace landscapes, such as industrial landscapes.

With this in mind, this article will attempt to offer a response to these methodological and conceptual shortcomings regarding the study of these landscapes by rethinking the ways in which they have been approached to date. This is in an effort to make an advance in the design of a series of guidelines that may serve as a methodological basis for their identification and characterisation from a heritage and cultural perspective.

The aim is to propose a methodology for these landscapes, considering their specific nature as landscapes that have been highly transformed by past industrial activity. In an effort to contemplate these landscapes' study from an interdisciplinary perspective and use a transdisciplinary analytical approach to address their innate complexity, this research uses a method that approaches their study from a holistic, inclusive, integrational approach; this method operates across the multiple dimensions attributable to these landscapes and advocates an approach that transcends disciplinary specialisation.

The development of this research focuses on those landscapes generated during the modern industrialisation process. It is complex to establish a chronological limit for these landscapes, since the industrialisation process gives each country or region a different reference chronology. However, we could generically define a starting point between the second half of the 18th century and the first decades of the 19th century, when the application of the steam engine can be recorded as a key area of industrial development. An upper limit can be defined as the last third of the 20th century, when substantial transformations began in the economy, technology and production processes, and the obsolescence of previous industrial processes took place.

The fact that this research focuses preferentially on these industrial landscapes, does not question the consideration of those industrial landscapes linked to earlier, later or even current eras However, it does pay attention to the specificity of these landscapes, compared to the rest, when proposing a methodology for their identification and characterisation, since the characteristics, possibilities for study, the problems and dynamics that currently affect them, etc., differ considerably from the rest.

The goal of this research is to address the challenges faced by the study of these industrial landscapes, by offering a response to both the scarcity of research in this field, and the obsolescence of the instruments and methodologies used for its study, which are largely limited to and by traditional parameters.

The interest in researching this issue stems from the scarcity of actions that focus on the study and preservation of these industrial landscapes, the result being that, to a large extent, these remain in an advanced state of deterioration and obsolescence (Figures 1 and 2).

Figure 1. Mining landscape of the Reunion mines in Villanueva del Rio y Minas, Seville (Spain).

Figure 2. Mining landscape of the El Soldado mine in Villanueva del Duque, Cordoba (Spain).

2. Methodology

The proposed working methodology for the development of this research was, first of all, to approach the study of an industrial landscape with both its specific nature and identity in consideration. This was performed by examining in greater detail the various dimensions that constitute and define it (physical, material, temporal, social and cultural), and evaluating the most relevant methodological trends applied to landscape study from the first third of the 20th century to the present day, in a context of consideration that is both international and interdisciplinary in nature.

Secondly, on the basis of the study carried out, the proposal was to analyse to what extent the combination of previously studied methodological approaches and guidelines allow for an in-depth approach to the complexity of industrial landscapes, and respond to specific needs in terms of their identification and characterisation.

Thirdly, on the basis of the results obtained from this analysis, we defined a methodological proposal that offers improvements and innovations on the basis of conceptual and methodological advances made to date in the field of landscape, and in coherence with existing international documentation relating to landscape and industrial heritage. We defined this proposal in an effort to provide theoretical and technical support that assists with the identification and characterisation of industrial landscapes, with the consideration of heritage and culture, via an integrational model that articulates the various dimensions that define the landscape in question, and advocates a holistic, multi, inter and transdisciplinary approach to these landscapes.

3. Results and Discussion

3.1. Industrial Landscape Dimensions

The landscape dimension of industrial activity lends the term landscape the adjective industrial. According to Franco Borsi, the industrial landscape can be defined as "the form that man consciously and systematically imprints on the natural or agricultural landscape in the course of and for the purpose of developing his industrial activities" [14] (p. 34). The concept of the industrial landscape is, following this logic, used to refer to those landscapes that are the result of an industrial culture in a broad, integrated sense, and contemplates not only the buildings, infrastructures, installations and other elements that are the result of industrial activity over time, but also their relationship with the territorial, social and cultural context in which they develop.

The complexity of these landscapes requires their consideration in a multidimensional context. In its definition, it is worth highlighting those fundamental dimensions that the ELC integrates into the very concept of landscape that it establishes: "Landscape means an area (physical–material dimension) as perceived (perceptual dimension) by people (social–cultural dimension), the character of which is the result of the action and interaction of

natural and/or human factors (temporal dimension)" [15] (p. 2). Each of these is developed below for the specific case of the industrial landscape.

3.1.1. Physical Material Dimension

The industrial landscape gives rise to complex spatial systems that are often of great territorial relevance in terms of their typology, scale and logic of implementation [6,16,17]. This implementation illustrates one of the most complex forms of occupation of a territory, and one that is formalised by its extension into rural, urban and peri-urban areas, and the interaction of elements as diverse as infrastructures, installations, machinery, buildings, housing, collective facilities, and communication routes, among others. All of these constitute complementary components of an industrial activity, be this exploitation, extraction, manufacture, or transport, giving rise to landscapes of extraordinary complexity. On occasion, these landscapes are far broader than what may be initially observed and may refer to productive settlements located around river axes or harbour fronts, along infrastructures or energy distribution networks, and so forth [18]. This leads to these landscapes participating in their own definition on a variety of spatial scales, from local to provincial and even regional. The various elements that define them are organised on a number of spatial levels and subordinated to a point where a coherent system is defined.

3.1.2. Temporal Dimension

The dynamic nature of these landscapes and their transformation over time define their temporal dimension. These landscapes are dynamic, rather than static entities, and are subject to continual changes that are intrinsically linked, not only to the passage of time but especially to changes in the production methods and systems resulting from the rapid evolution of technology and/or changes in labour and economic activity, among other factors. In turn, these changes lead to the obsolescence of procedures and machinery and thus the continual renewal or replacement of elements or structures by others that respond or adapt to new technological, functional, productive, economic and social demands. However, on many occasions these changes are carried out in overlap with of processes, procedures, techniques, technologies, etc., so that various temporalities coexist in the same space.

Today, even when the industrial activity that generated them has ceased, these industrial landscapes are shown to be in continual transformation. Their temporal qualities, such as the rhythms of change and the sense of passing time, though less apparent than in the past, continue to be evidenced: the continuous process of ruin; of change in material qualities due to the gradual decay and deterioration of material artefacts; the collapse of buildings and infrastructure; the successive growth of vegetation; and the action of external agents.

The temporal dimension of the industrial landscape, then, manifests itself through the cycles, rhythms and layers of experiences of both past and present lives and memories, all of which give rise to a hidden, unexplored dimension. Like a palimpsest, these landscapes contemplate, in their definition, times and time scales of greater and lesser duration These time scales have been recorded in the territory through the vestiges of the different transformations that have taken place over time, superimposing one on the imprint of the previous one without cancelling it, thus coexisting in the same territory. Definition of the temporal dimension, then, contemplates certain historical moments while simultaneously coinciding with the present.

3.1.3. Perceptual Dimension

The perceptual dimension of landscape is the mental construction configured by those who perceive a territory and interpret it on the basis of sensory experience [19]. Where the industrial landscape is concerned, it is possible to observe significant changes in its perception over time. So, if initially the buildings, infrastructures and other installations that arose during the modern industrialisation process were for decades considered symbols of

progress, the future, and the maximum expression of the modern spirit, today, now that this industrial activity has ceased, they are perceived as symbols of the past, and acquire a new significance that is both external to the context in which they arose and far removed from the thought processes that led to their initial creation [7,20].

This situation forces us to perceive and reflect on these landscapes in a new light, with a sensibility that has little to do with that with which contemporary pioneers approached the exaltation of industrial aesthetics. Today, these industrial remains, many of them abandoned and scattered throughout the territory and deprived of the function and use for which they were exclusively created, involuntarily acquire formal, spatial, aesthetic and other values with which they were not originally conceived, giving rise to unique, incomparable landscapes. In Peter Latz's words, they constitute "post-industrial fantasy landscapes" [21] (p. 199) (Figure 3).

(**a**)

(**b**)

Figure 3. Duisburg Nord Landscape Park. Peter Latz (1990–2000). Duisburg (Germany): (**a**) Landscape park view; (**b**) Panoramic view from the blast furnace No. 5.

3.1.4. Socio-Cultural Dimension

The industrial landscape is configured as a social and cultural construction that transcends its physical, objective identity. The imprint that industrial activity and its associated processes leaves on a landscape over time, makes a decisive contribution to both the construction of new landscapes and the shaping of cultural scenarios by helping to define the core values of the society that lived and worked in the territory [22]. Over time, these have become etched into both the landscape and the collective memory.

Today, these landscapes acquire a hereditary character: as repositories of values relating to work culture, to the definition of the identity of generations of workers, the history of a people, and the scientific and technological culture of a very recent period in human history that must be preserved and reclaimed as a real part of our heritage. The traces of industrial action on a territory, whether or not they remain visible, transform these landscapes into an expression of the culture of a people and possess great cultural significance.

3.1.5. Systemic Dimension

The definition of the industrial landscape requires a broader, more complex consideration that transcends each of the dimensions outlined above. We cannot simplify the industrial landscape to just one of these dimensions as these do not exist independently, and only when all of them are combined, interrelated and interlinked is it possible to speak of the industrial landscape. It is this that defines a physical, material, temporal, perceptual, social and cultural reality that contemplates aspects that are simultaneously objective and subjective, natural and cultural, ideal and material, individual and social, among other qualifiers. The concept of the industrial landscape itself offers a wide-ranging, all-embracing vision that integrates and articulates all of these dimensions, along with their interrelations in such a way that it is perceived, within a context of synthesis, as a coherent whole.

3.2. Principal Methodological Trends Applied to Landscape Study

For decades, the notion of landscape has been instrumentalised in different knowledge areas on the basis of a wide range of visions and interests, with geography, architecture, urban planning, geology, archaeology, anthropology, history, ecology, environmental psychology, agriculture, and botany being just some of the disciplines that have been involved in its study, analysis and management. In recent decades, this has contributed to a rapid expansion in the concept of landscape; however, this is an expansion that has not been accompanied by similar developments in the definition of theoretical and methodological principles with which to approach landscape study and management. These are principles that have not achieved sufficient consensus for their application in the administrative sphere [23].

This multiplicity of approaches to the study and treatment of landscape led to the emergence, from the first third of the 20th century to the present day, of a number of national schools, and academic and professional traditions, dedicated to landscape study and organised within the domain of eminent disciplinary schools [24]. During this period, a number of turning points influenced the definition of these methodological principles. The first of took taking place in the mid-20th century, when a decidedly visual and descriptive conception of landscape, verging on the artistic, gave way to a more complex conceptualisation that took into consideration a wider diversity of factors. This gave rise to the development of analytical methods based on scientific discourse, the application of which was based on the objective judgement of experts [25]. This consideration was subsequently rejected by humanist geographers, who approached the study of landscape from a more phenomenological, existentialist perspective [26,27]. The second turning point occurred at the end of the 20th and beginning of the 21st centuries, and was based on the social interest aroused by the relationship between landscape, quality of life and environmental sustainability [25,28]. As a consequence, landscape acquired a legal character and

was incorporated into territorial planning, leading to the emergence of new methods of approaching landscape studies [25,27].

Among these methodological trends, we can highlight what has come to be known as landscape science, the fundamental keys to which are described in Rougerie and Beroutchachvili [29] and in Bolòs et al. [30]. Within this context, we can distinguish two traditions that are still in force today. One of these falls within what is known as the Anglo-Saxon school, which was widely disseminated in Anglo-Saxon countries and characterised by its retaining of landscape conceptions that were derived from very pragmatic assumptions and positions, closer to descriptive and taxonomic aspects of land use technologies. The other, based on the German School and developed in Eastern European countries, spread throughout Western Europe via the French Geographical School of Toulouse-Le Mirail.

The German School, characterised by innovative developments in landscape studies, together with the Soviet School, its heir, are possibly those that have contributed most to the progress of landscape studies and have had the greatest influence on subsequent trends [31,32]. Both schools focus on the study of landscape on the basis of the physical elements of the territory and their interdependence. The German School uses physical geography as its foundation and employs methods of chorological analysis that are both integrated into landscape study and based around its consideration as a meeting point for a number of spheres (lithosphere, hydrosphere, atmosphere and biosphere) [33]. The Soviet School, which also focussed on the natural aspect of the territory [34] and was initially interested in studies relating to the soil, subsequently focussed its efforts on a comprehensive understanding of the natural environment and the landscape as a geosystem [35].

While the French School takes into consideration some of the Soviet and German experiences, its academic tradition and ties to geography as a discipline means that its contributions acquire a unique character, and it is at the University of Toulouse-Le Mirail that the research carried out is most significant. Among others, the work of Professor George Bertrand [36–38] stands out, as it is he who adapts the concept of geosystem, of naturalistic origin, towards a more integrative approach that attempts to unblock previous sectorial approaches in an effort to offer a theoretical, methodological proposal that allows for an interactive, integrative approach to geographical phenomena. This systemic approach is based on three distinct but complementary concepts—geo-system, territory and landscape—and is identified by its acronym GTL.

Perspectives very much akin to geosystemic approaches, such as ecology and biology, have been incorporated into disciplines, which, in turn, have been grouped around what is known as landscape ecology [39]. This greater theoretical, conceptual and methodological presence of landscape in disciplines other than geography was observed throughout the 20th century and resulted in the contribution of new approaches and innovative ways of both reading and interpreting landscape [40].

In contrast to these methods of landscape analysis, which are based around expert objective knowledge, in the early 1970s study models emerged that shared a perceptual approach by linking the existence of the landscape to the physiological phenomenon of perception and its psycho-sociological interpretation [41]. These models attempt to reach a deeper understanding of landscape on the basis of more subjective knowledge that can only be attained through direct contact and experience with the environment, and in which aspects such as intuition, beliefs, culture and behaviour, among others, come into play.

Prominent among these are the psychological and phenomenological models. Phenomenological models are part of what is known as humanistic geography [40,42–46], which approaches landscape study from an innovative perspective in the field of geography; this perspective entails the use of a phenomenological and existential approach that incorporates cultural and immaterial aspects relating to human experience, such as emotions and value judgements regarding the site in question, among others, into the reading of the landscape [40].

Psychological models of landscape study, for their part, contemplate a conceptualisation of landscape in which the human being is an essential factor, is based on the

interpretation that society makes of the landscape, and includes variables pertaining to perceptual and cognitive processes. Prominent in this line of research is environmental psychology [47].

More recently, conceptual and methodological approaches that integrate study models based on both expert knowledge and models based on perception have begun to gain prominence. This is the case of the methodology based on the Landscape Character Assessment (LCA) system, created by The Countryside Agency and Scottish Natural Heritage, which proposes a new conceptual and methodological approach to landscape practice that represents a shift in the dominant conception. Landscape is now understood as an intimate and complex relationship between people and place, a combination of nature, culture and perception [25,48–50].

3.3. Analysis of the Principal Methodological Trends Applied to Landscape Study

When analysing the set of trends and methodological approaches outlined above in depth, we can observe the diversity of existing models, not all of which are fully coherent [51,52]. This diversity is partly due to the scope that the concept of landscape has acquired in recent decades, the diversity of objectives with which its study has been approached, and the plurality of disciplines involved.

The study of these theoretical, methodological and conceptual principles as a whole reveals how they underlie the traditional rift between nature and culture, and the objective and the subjective, a viewpoint that is very present in the western vision of landscape [53]. This duality can even be observed in a number of reviews that have attempted to reflect this multiplicity of models by classifying methodologies according to whether they are based on expert knowledge or on perceptual models.

Likewise, numerous methodologies exist that contemplate the study of landscape from a conceptualisation that barely manages to address its complexity, as either they are based on partial interpretations, or the analysis has been developed on the basis of the independent study of principal factors or dimensions involved, thereby ignoring the interrelationships that define a true systemic symbiosis [54].

A more holistic, comprehensive view of the concept of landscape, based on the understanding of landscape as a specific natural—social—cultural entity, has its roots in French human geography. Vidal de la Blache, together with other researchers, redefined the concept of landscape from a scientific point of view in such a way that it contemplated the totality of the characteristics of a territory, the significance of which was reached by mentally uniting all of these. Carl Sauer also introduced this broader concept of landscape into American geography, referring to it as "an area made up of a distinct association of forms, both physical and cultural" [43] (p. 25). This conceptualisation was rejected and eliminated from the field of geographical research by Hartshorne [55], however, citing the confusion introduced by the duality of the term.

This constitutes an example of 20th-century landscape research, in which the organisation of science into disciplines meant that a more holistic, comprehensive approach to the conceptualisation and study of landscape was relegated to the background. As a consequence, it can be observed that many methodologies relating to the study of landscape respond to compartmentalised disciplinary universes and tend to be conditioned by their ascription to one or another field of knowledge, shying away from the multidisciplinary nature of landscape study and rarely transcending the limits of the discipline in which they were contemplated. Only in some more creative, artistic fields of knowledge is it possible to observe a wider range of approaches to landscape study, although these tend to be based on the development of a highly heterogeneous, little-shared epistemological and doctrinal corpus [56].

With the entry of the ELC in Europe, the concept of landscape was modernised in an effort to include an integrational, totalising, transdisciplinary perspective. The renewed sense of landscape that the ELC adopts, which is based on a variety of contemporary traditions and predominant conceptions in Europe, leads it to define this as "an area, as perceived

by people, whose character is the result of the action and interaction of natural and/or human factors". This conceptualisation, which is based on three essential notions, namely territory, perception and character, is certainly innovative. While it is true that the ELC does not establish any procedure or methodological sequence for approaching the study of landscape, it does arouse interest in these issues by favouring the rapid dissemination of methodologies that advance the concept of landscape study. The ELC contemplates a diversity of approaches with a conceptual latitude that transcends thematically partial approaches that are only valid for those landscapes with a predominantly natural or rural component, revealing itself as a conceptualisation that attends not only to those landscapes that are more striking in nature, but also to those that are more commonplace, ordinary or deteriorated.

This is the case of the LCA methodology, an approach that began to be consolidated in the United Kingdom in the 1990s, coinciding with the origins of the ELC. Since its inception, this methodological procedure has become widely accepted and in recent years has been used to study a variety of landscapes. As it stands today, this methodology is not a closed, limited procedure, but rather continues to be developed and enhanced [57].

The truth is that many methodologies, such as the LCA, that have arisen as a result of the expanded concept of landscape established by the ELC, require revision. This is due to the theoretical, practical and methodological difficulties posed by a conception of landscape that extends to the territory as a whole [13], and that has even contributed to the ELC not reaching sufficient levels of implementation and application [58]. These deficiencies are even more accentuated in landscapes of a more commonplace, ordinary nature, such as industrial landscapes, due to the fact that, while methodological procedures that focus on the study of natural and/or rural landscapes are common and scientifically established [13,59], those relating to landscapes that have been transformed to a greater degree by human action are both scarce and underdeveloped.

While no methodological trend focussing primarily on the identification and characterisation of the industrial landscape currently exists [60], in response to a variety of interests and objectives, a number of studies or landscape practices have addressed these landscapes either partially or tangentially. This is the case of the study carried out by Palmer and Neaverson [61] that, although it does not define a detailed methodology for the study of these landscapes, does offer certain keys for reading them by industrial sector, especially in the British case. Likewise, advances have been made in the study of these landscapes, based on the use of previous methodologies that have not been designed to address the specificity of these landscapes, and that for the most part are ascribed to a specific disciplinary field [62–64].

In more recent research it is possible to observe the existence of methodological approaches that go some way towards offering a methodology that is specific to these landscapes, and some of these examine the effectiveness of applying the LCA methodology in terms of offering a comprehensive response to the needs of these landscapes [13,65]. Others are taking steps towards the definition of methodological principles for the study of and intervention in the industrial landscape, on the basis of its consideration as a cultural landscape [66,67]. From a multidisciplinary perspective, some lines of research are even advancing in the development of interdisciplinary methods for the registration, preservation and activation of certain industrial landscapes, such as former railways, though these are still in the embryonic phase [68].

3.4. Definition of a Methodological Proposal for the Identification and Characterisation of an Industrial Landscape

The definition of a specific methodology for the identification and characterisation of an industrial landscape, requires us to face up to the challenge of articulating a methodological approach. On the one hand, it must contemplate new frameworks for approaching these landscapes that transcend the conventional discipline-specialist approaches, determining an integrational model that combines the physical, material, temporal, perceptual, cultural, heritage and other dimensions that define these landscapes. On the other hand, it must bring together the conditions that make it possible for researchers from a variety of disciplines to approach their study in a joint, interdisciplinary manner and, more importantly, on the basis of transdisciplinary analytical approaches [69–72]. The aim is to facilitate the development of comparative, more systematic inter and transdisciplinary studies, to encourage the gathering, synthesis and production of new knowledge regarding the landscape in question through collaborative learning, and also to identify new problems and challenges and offer more robust solutions [73,74].

Along these lines, a methodological proposal is suggested which, from an integrational, multi, inter and trans disciplinary approach, addresses all the objective–subjective, natural–cultural, ideal–material, individual–social characteristics that define these landscapes in a comprehensive manner, and focuses on those aspects that, over time, have characterised their inherent qualities and shaped their distinctive character.

For the development of this methodological procedure, the proposal is to implement a series of descriptive and analytical actions designed to attain a broad spectrum knowledge of the landscape under study, identify this landscape in terms of the full extent of the territory it occupies, establish a census or inventory of the different landscape units that comprise it, taking as a basis those elements (natural, cultural, heritage, perceptive, symbolic, etc.) that both characterise it and constitute its identity, but also those aspects that allow it to be placed in a particular context and reveal its true extent, and compare it with others through the identification of its differentiating features [75].

To this end, in terms of the definition of this methodology, the process of landscape identification and characterisation, proposed by the British Countryside Agency and Scottish Natural Heritage (2002), is considered relevant. Therefore, in line with the approaches contained in the LCA methodology, a landscape study procedure is established that contemplates the identification not only of those aspects which are distinctive and set some landscape units apart from others, but also those of a more general nature which are shared by the various individual, separate units [76].

Along the same lines, several parameters have been considered relevant in terms of their incorporation into the definition of this methodology and which respond to certain characteristics of the industrial heritage landscapes studied in more detail beforehand when addressing the dimensions that characterise them. These include, on the one hand, their study at different scales in an interrelated manner. The complexity of the spatial systems that define these landscapes makes it necessary for their study to be carried out from a comprehensive, integrational vision that contemplates the hierarchical systematisation of their analysis through the diversity of spatial scales that affect them. On the other hand, the dynamic nature of these landscapes makes it convenient for this methodology to consider the convergence of historical periods coexistent in these landscapes, as well as the coexistence of historical and contemporary dimensions that arise within them. Likewise, the highly anthropised nature of these work–culture landscapes and their cultural value make it necessary to incorporate social agents into their identification and characterisation.

On the basis of these questions, a methodological proposal has been defined for the identification and characterisation of these industrial heritage landscapes and structured in the following five phases [77]:

Phase 1. Definition of the scope and area of the study (multidisciplinary work team). The aim of this phase is to carry out a series of tasks prior to the development of the landscape study, such as defining its objectives, delimiting the study area, establishing

the working scales, specifying a timetable and work schedule, and creating a multidisciplinary team of experts comprising specialists from a variety of disciplines with ties to landscape study.

Phase 2. Information resources (multidisciplinary approach). This phase contemplates the collection of information of a multidisciplinary nature, allowing the spatial, territorial, temporal, perceptive, social, cultural, identificatory, symbolic, and other dimensions of the landscape in question to be revealed.

Phase 3. Office work and Phase 4. Fieldwork (interdisciplinary reading). These phases deal with the analysis and synthesis of the structures and variables that define the character of the landscape under study by means of office work, but also via direct and collective in situ recognition. The aim is, from an interdisciplinary perspective, to identify the various landscape units that constitute the landscape by offering a preliminary delimitation and identifying those attributes that characterise and differentiate these units from the rest.

Phase 5. Identification and characterisation (transdisciplinary reading). The objective of this phase is to develop a definitive, transdisciplinary landscape interpretation. This is based on the previous phases and its purpose is to carry out a reading of these landscapes that, to some extent, fills in the gaps in the individual disciplines that converge in its reading, and which materialises in the identification and definitive characterisation of the various landscape units outlined above.

Over the course of these phases the reading, identification and characterisation of these landscapes should transition from multidisciplinarity to interdisciplinarity and, finally, transdisciplinarity. The complexity of these industrial heritage landscapes, combined with the convergence of components (natural, historical, heritage, social, economic, perceptive, symbolic, and identity and memory related, among others) that are present in them, requires that both their detailed analysis and subsequent required understanding, be carried out by a multidisciplinary team in which each expert analyses the landscape under study from the point of view of his or her own discipline. This multidisciplinary team should progressively transition towards an interdisciplinary approach in which all the experts in question attempt to converge in a unified reading of the landscape, with a view to developing a transdisciplinary reading in which each of them transcend the limits of their various disciplines.

Each of these phases is discussed in more detail below (Figure 4):

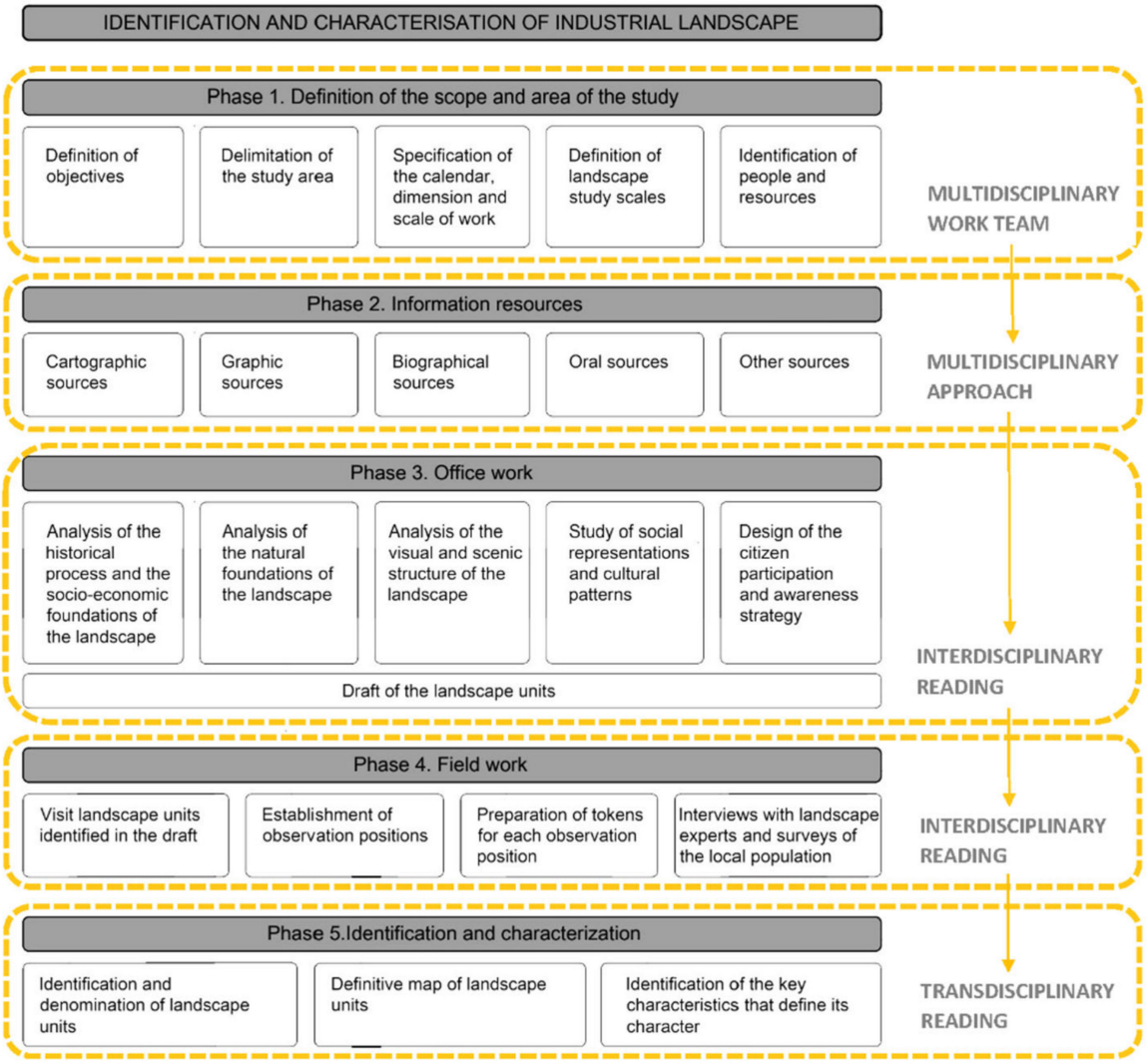

Figure 4. Structure of the methodological proposal.

3.4.1. Phase 1: Definition of the Scope and Area of the Study

Prior to the identification and characterisation of the landscape, a series of tasks should be carried out in an effort to define the scope of the landscape study. These are the clear, concise and precise definition of the general and specific objectives to be pursued, the delimitation of the study area by means of a primary description (written and cartographic), the establishment of a work schedule and timetable that includes the tasks to be carried out and their expected timeframe, the definition of the various scales of study (local, sub-regional or regional), the identification of the professionals and social agents who will participate, and the resources necessary for the correct execution of the plan.

The work team should consist of professionals from a variety of disciplines, for example architects, town planners, archaeologists, geographers, historians, sociologists, anthropologists, etc. It is also advisable to draw up a map of social agents that includes a list of potential participants (local population, associations, town councils, etc.) in the identification and characterisation process.

3.4.2. Phase 2: Information Resources

When approaching the study of these landscapes, it is important to be aware of the starting point that is provided by the data relating to them that is available in libraries, archives, institutions, etc., in a variety of formats (bibliographic, cartographic, graphic, institutional, oral, statistical, etc.), and from a range of perspectives.

The purpose of this phase is to carry out a preliminary knowledge study based on a thorough search, compilation and restructuring of the existing available information on the landscape under study. To this end, the objective of forming a multidisciplinary team is that each member should gather the available information relating to his or her own discipline, thereby allowing for the creation of a summation of multidisciplinary approaches to the physical, material, spatial, temporal, perceptive, social, cultural, economic and other essential aspects of the landscape under study, which, on the basis of dialogue and consensus, will lead to an expert, interdisciplinary reading of the same.

3.4.3. Phase 3: Office Work

Once the initial information has been obtained by each member of the team from the viewpoint of their respective disciplines, it is time to carry out an integrated analysis and synthesis of the structures and variables that constitute the foundations of the landscape under study. This analysis will take into account the diversity of dimensions that define this landscape and highlight its specific features. In order to achieve this, the study must refer both to those elements, processes and/or structures that define the homogenous nature of the various areas that constitute these landscapes (historical processes and socio-economic foundations, natural foundations, etc.), as well as those others that contribute to their individuality with respect to the rest of the territory, in terms of their visual and scenic structure, or to the links that society maintains with these landscapes (cultural, social, perceptive, traditional, etc.).

It is important that this analysis be carried out via an integrated procedure that brings together the diversity of considerations associated with these landscapes and the available studies. To this end, it is pertinent that the disciplinary approaches carried out by each researcher be oriented towards the landscape under study, understood as a reality in which a diversity of spatial, territorial, perceptual, temporal, cultural, social and other aspects converge, so that the teamwork involved should transition from multidisciplinarity towards interdisciplinarity, as partial disciplinary analysis transitions towards a consensual, comprehensive understanding of the landscape.

This interdisciplinary reading should take into account the various scales of the landscape under study and refer to the whole territory, rather than just those parts or elements considered significant or exceptional. It should also pay attention to the dynamics and interrelationships between the various components that constitute it by identifying the most notable discontinuities that make possible the establishment of the various landscape units. Likewise, it should consider the evolutionary processes of the landscape via the verification of past, present, and/or foreseeable dynamics. While carrying out this task it is essential to incorporate the participation of citizens and other social actors who establish an everyday relationship with the landscape under study.

On the basis of this analysis, an initial draft of the landscape units constituting the landscape under study will be defined at different scales, taking into account the partial results of the studies carried out.

3.4.4. Phase 4: Fieldwork

In order for this holistic, integral approach to lead to a far more complex, richer reading than simply the sum of the different contributions made by each researcher from the perspective of their own discipline, the team should also carry out in situ reconnaissance of the landscape under study. The objective of this is, on the one hand, to become intimately acquainted with the landscape as it contains elements and dynamics that can only be experienced first-hand, for example, certain aesthetic and perceptive features, recent trends and dynamics that, to date, have not been recorded, and to verify, complement and update the data obtained in the previous phase, validating these or making corrections where necessary. On the other hand, the objective is to focus the various viewpoints and efforts on certain aspects, themes and specific or significant elements of these landscapes. The convergence of the views of the different researchers, both direct and shared, on very specific,

representative aspects of the landscape will enable progress to be made in the delimitation, identification and characterisation of the various landscape units that constitute the whole.

In terms of delimitation, it is helpful to define a series of categorised guidelines, regarding the various perspectives, on the basis of a team-wide definition of the various work scales; identification of the limits or transition areas between neighbouring landscape areas; the principal components, i.e., the visible or perceptible elements, both physical and material and social, cultural, economic, symbolic, etc., that define its character; and its attributes, in reference to the abstract and singular qualities or characteristics of the landscape.

It is convenient that the development of this fieldwork will be carried out over a series of distinct operations. It would be advisable to carry out a first operation once the general area of study has been defined, in an effort to establish an initial contact that will allow us to observe the landscape elements that constitute the area, the relationships that have made its structure possible, and to begin a photographic catalogue. For this, the location of different observation points and itineraries to be carried out, that are key to the observation of the territory and its understanding in its entirety, will be previously defined on a basic cartography. Depending on the complexity and extension of the territory to be studied, it is possible that, in order to make this work more operational, it will be advisable to divide the study area into different sectors and establish a calendar from which to organize the different visits. In this first approach to the landscape, an attempt will be made to travel through the study area via the main communication routes, trying to detect the main viewpoints or observation points. Subsequently, a second campaign will be carried out once the different landscape units have been identified and delimited. This will consist of visiting each of the landscape units in order to confirm or correct their delimitation and evaluate them directly. Access will be sought to those locations that allow a good observation of the different units, with the aim of verifying their limits, taking photographs and collecting data about their landscape character. This information will be recorded in a database and in a file that identifies the different components of the landscape, their relationships and characteristics. Finally, a third campaign will be carried out to collect information through citizen participation. This will be carried out through interviews with landscape experts and surveys of the local population.

The results of this phase will materialise in an initial proposal for the delimitation and mapping of the identified landscape unit/s, their characterisation via brief texts alluding to their principal characteristics, and their naming and coding at different scales as a means of facilitating their identification and geo-referencing.

This delimitation of landscape units must be contrasted and verified through a series of fieldwork campaigns that successively allow these to be amended until such time as their definitive definition and delimitation is reached, thereby contributing to the characterisation of these landscapes in accordance with their diversity and complexity.

3.4.5. Phase 5: Identification and Characterisation

Finally, this expert approach to landscape study must, in the end, lead to an in-depth transdisciplinary study that materialises in the definitive characterisation of the various landscape units outlined above from a perspective that is capable of transcending the interdisciplinary boundaries, in order to arrive at a deeper understanding.

In order to achieve this, this transdisciplinary reading of landscape must be carried out using recently defined specific approaches, both creative and disciplinary, that have been determined on the basis of the new keys offered by an interdisciplinary reading of the landscape. They have also been determined by the need to transcend disciplinary limitations by means of procedures of cooperation, collaboration and communication between experts from different disciplines who assist in the study of these landscapes from a diversity of perspectives (territorial, social, environmental, economic, urban, geographical, archaeological, historical-functional, perceptual-visual, etc.), thereby ensuring contemporary, comprehensive and interpretative readings of these landscapes that address them in all their complexity.

The incorporation of citizen participation into the task of identifying and characterising landscape is relevant, insofar as it allows the reading to incorporate a symbolic, perceptive dimension of the local population that is capable of highlighting non-material aspects of the landscape that are important in terms of understanding its complexity and the relevance of certain spaces. Likewise, the use of databases that are compatible with digital tools such as GIS (Geographical Information System) is important insofar as it facilitates the development of the landscape study, but also favours the effective coordination of the different disciplines and agents involved in the study.

This phase concludes with the preparation of a series of documents containing the definitive characterisation of the landscape studied, based on the identification and description of the key characteristics that define its nature, the preparation of a definitive map containing the spatial delimitation of the various identified landscape units and the denomination and codification of these, and the preparation of a comprehensive, complete characterisation sheet for each of the identified landscape units that includes the results of this phase. Should the landscape to be studied be subject to rapid transformations, this information should be updated on a regular basis.

4. Conclusions

The industrial heritage landscape today is a phenomenon of extraordinary complexity, the study of which has been addressed belatedly by the scientific community in general. At a conceptual and methodological level, this has given rise to a situation of insufficiency, in terms of dealing in depth with the study of and intervention into the study of the industrial landscape. Many of the theoretical and methodological approaches that have been developed for the study of landscapes in general to date, are of limited use for landscapes that have been significantly transformed by human action; they are either underdeveloped or barely manage to address their complexity, and very few studies directly address the specific nature of these landscapes [78,79].

This raises the need for both a rethink of the traditional approaches with which the study of the industrial landscape has been approached, and the definition of a specific theoretical, conceptual and methodological framework for the same that changes the nature of existing methodological trends, in an manner that allows us to address the challenges that these landscapes face with respect to other types of landscapes. This should be based on their specific nature and identity as landscapes that have been highly transformed by past industrial activity, and landscapes that possess great cultural and heritage value and constitute depositories of a collective memory. To this end, we need to contribute to the improvements and innovations that lead to the design of a specific methodology for these industrial heritage landscapes. This must take into account, among other issues, the diversity of spatial scales in which these landscapes participate, making it necessary for their analysis to be carried out across these scales in an interrelated manner; their dynamic nature, which is in continual, constant transformation and requires that their study contemplate the convergence of generations and the coexistence of historical and contemporary dimensions; and their highly anthropised character, which raises the need for the incorporation of social agents into the various phases of their study.

However, the complexity of these landscapes requires a holistic, comprehensive approach to their identification and characterisation that transcends conventional specialist approaches and, via an integrational model, articulates the various dimensions that define them. To date, many landscape studies have focused almost exclusively on one single dimension as a representation of its global nature.

The designed methodological proposal assimilates the complexity that characterises these landscapes via a global, comprehensive study that addresses all their physical, material, temporal, social, cultural, economic, productive and other dimensions in an interrelated manner. In this sense, the landscape reading suggested here contemplates, as a proposal, a holistic, broader, more integrated approach that is carried out from a diversity of disciplines in an effort to bring together multidisciplinary views. This responds to a more complex

reading, using an inter and trans disciplinary exercise that contemplates the dissolution and transcending of established disciplinary boundaries in order to define common frameworks that allow knowledge to be compiled and synthesised [80]. To this end, it is important to define strategies of cooperation, collaboration and communication between experts from different disciplines, with the aim of converging disciplinary perspectives in order to approach the study of these landscapes from a diversity of perspectives that guarantee their analysis in all their complexity.

The transdisciplinary approach of the proposed methodology constitutes an opportunity for the production of innovative knowledge in the study of these landscapes. As Liu et al. [81] point out, the integrated study of landscape reveals new and complex patterns and processes that are not evident when they are studied separately, due to the fact that, while each discipline independently contributes valuable insights to the understanding of landscape, they are limited in their ability to capture the full, complex reality of the landscape. Only a broader vision, based on the exchange of knowledge between disciplines, allows for a more in-depth, comprehensive reading that is capable of attending to the innate complexity of these landscapes. The use of digital tools favours effective coordination between the various disciplines and aids in the development of inter and trans disciplinary readings, as well as in the performance of representational and analytical tasks.

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