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AN INTERPRETATIVE MODEL FOR THE MANAGEMENT OF CONTEMPORARY CULTURAL LANDSCAPES IN LINEAR INFRASTRUCTURE PROJECTS

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Abstract. Structures and potentialities of cultural landscapes have been studied mostly under a historical perspective. This article questions if contemporary societies can develop cultural landscapes. Starting from an analysis of the structure of contemporary landscapes, it investigates methods of developing cultural landscapes with contemporary knowledge and background. The theoretical assumptions are based on an ecosystem approach and consider the social and functional values in relation to the infrastructure project. Linear infrastructures are the physical basis for material and immaterial links between societies. They structure local territories, but more often reflect upper level rationalities – thus physically cross areas without providing a local service. An interpretative model to support cultural landscape dynamics within linear infrastructure projects was developed and tested in three Italian transportation infrastructures. The model was based on the analysis of the structure and the generating processes of contemporary cultural landscapes and makes use of criteria and indicators.

Keywords: contemporary cultural landscape, linear infrastructure, environmental impact assessment, landscape management, Italy.

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Introduction

A landscape is the outcome of relationships between the local society and the transformed environment, which is the territory (Antrop 2005). A territory is a relational concept and infrastructures are its basic constituent. In fact, they represent the backbone of the inhabited territory, providing services within and among places, and their construction and renovation have always been a factor of modernization. The landscape can therefore mirror the appropriate local knowledge of a responsible community or the superimposition of upper-level rationalities.

In the European Union, a number of government documents require to consider the surrounding landscape when building any object of infrastructure. There has been considerable research into landscape, however, this research has not been utilized by infrastructure planners and only certain aspects of the landscape are dealt within the various types of documents involved in the planning process (Antonson 2009).

The article focuses on the role of linear infrastructures in the landscape and in particular on roads and railways, stressing the profound changes interposed because of their connections with the local space. The challenge to be faced is the construction of linear infrastructures activating positive cultural landscape dynamics, thus supporting functional innovation and protecting the local identity by integrating the diverse – often conflicting – aspects and the varied scales involved.

In hard infrastructures of ancient times, linear infrastructures were a part of the physical space occupied by a local community, i.e. linear infrastructures not only attracted founders of villages, towns and cities but also served as a pivot for urban space planning. They had, therefore, a central role in the definition of a shared urban identity and in the construction of the landscape. In particular, linear infrastructures organized territories by means of configurations able to integrate natural and

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human spatial dynamics, creating durable man-made ecosystems.

With the development of the industrial era, and later on with the Fordist economic model, the traditional relationships between infrastructures, local societies, and territories, became obscure. Starting in the second half of the twentieth century, the speed of the development of infrastructure networks became a central goal to support the economic development by linking together the main industrial areas, the major cities, and the harbours. The experts in charge of the elaboration of the projects were engineers and their aim was often to simplify the morphological complexity of territories and to provide fast connections. In this framework, infrastructure networks could have no relations at all with the environment they crossed. They became the initiators of new urban developments at the interchange points and provided access to previously untouched areas. In fact, the construction of networks produces a direct impact, but even more negative consequences can be brought about by the actions made possible by their presence (Antrop 2000).

In recent decades, economic restructuring and technological innovation, as well as political and economic integration among territories, have enhanced the contradictions between infrastructure lines and local territories. Multifaceted and intertwined dynamics are involved: new levels of interrelations, from large (the global, the supra-local) to focused scales; territorial integration or exclusion; competition for space; morphological changes; and social and ecosystem fragmentation.

Large-scale infrastructure lines overlap and replace preexisting ones. Usually, in long inhabited territories, infrastructure systems were based on a slow coevolution of natural and social components such as fields, woodlands, water streams, historic centres, and traditional rural areas. Linear infrastructures, most often, have negative impacts because of various factors. They produce contamination (Baltrenas *et al*. 2004), and often a disturbance of the sense of place and belonging of individuals to a peculiar and characteristic environment (Alkan *et al.* 2009). With respect to the interactions with the natural features, problems arise because of the erosion of the ecosystemic functions produced by the restructuring of the ecosystems. Moreover, apart the desertification of the directly involved soil, a barrier effect is produced, determining fragmentation, which is a phenomenon of isolation and impoverishment of many species (Bogaert *et al.* 2005). Such effects highlight the inevitable conflicts between some social and natural processes and the complexity of their relations (Farina *et al.* 2005a).

Infrastructure planning must therefore take into account these issues, appropriately managing the resources of the physical–structural, ecosystemic, and sociocultural kind, whose roles and values vary according to the particular area crossed (urban, rural, natural). It is this complexity that makes it difficult but necessary to manage the linkages between linear infrastructure and landscape dynamics. Many different local conditions are crossed by an infrastructure project and the key issue is how to transform a new proposal into a project that maintains and supports the complexity of cultural landscapes.

Many official documents have formulations concerning the landscape with which authorities must or should cope. One such document is the European Landscape Convention (ELC 2000). ELC was signed on 20 October 2000 and came into force on 1 March 2004. In February 2008, 35 countries have ratified, accepted, approved or just signed the convention. Therefore, many countries have only recently begun to apply the ELC in their social structure.

In environmental and cultural literature, there lacks a structured approach to cultural landscapes. Such landscapes are usually considered when "historic" features emerge and few reflections have been expressed about the presence of contemporary cultural landscapes and on their complex meanings. It is an important deficit, because the maintenance of the existing cultural landscapes and the creation of new ones are strictly related to a sustainable development perspective, as they are a concretization of its foundations. Cultural landscapes represent the strongest and most durable interaction between the natural and the social systems (Scazzosi 2004).

The following main questions are addressed:

Is the concept of contemporary cultural landscape relevant or are only historic cultural landscapes to be considered?

Does the planning process have a role in developing cultural landscape dynamics?

Is it possible to support and / or activate cultural landscape dynamics when planning linear infrastructure projects?

The objective of the present study was to analyze the structure of cultural landscapes and suggest a model for the development of new landscapes considering which drivers have changed and which, if adequately managed, allow new durable relations between natural and social systems to take place. To achieve this objective, a key conceptual and operational instrument was developed and then tested in the case of three linear transportation infrastructures in Italy. This interpretative model can be used to evaluate the dynamics and to support the development of contemporary cultural landscapes.

1. Structure and processes of contemporary cultural landscapes

Cultural landscapes have been defined differently according to the diverse approaches adopted and the

purposes pursued. A univocal vision does not exist because of the multidimensional and multidisciplinary characteristics at the basis of the landscape structure (Naveh 2001; Tress *et al.* 2009). In addition to the UNESCO definition connected to the World Heritage Convention of 1972, geographers amongst others and more recently landscape ecologists have provided a number of definitions that form the basis of this theory (Naveh 1998; Schmitz *et al.* 2003; Hazen 2008; Tempesta 2010).

This research begins from the widespread assumption that landscapes are complex systems based on the interactions between the natural and the social systems. Within this group are cultural landscapes, which are based on the optimization of the relationships among resources, information, and use. Resources comprise natural and cultural goods and values available in a specific context; information is based on knowledge and allows identifying the natural and cultural resources and supporting know-how; use refers to the actions performed according to the resources with advantages both for the social and the natural systems (Farina *et al.* 2005a). The capability of integrating the above-mentioned three systems through up-to-date solutions produces contemporary cultural landscapes.

The structure and driving processes of landscapes have been rapidly changing in the last two centuries and many experts stress the speed of the change occurring in the recent decades (Antrop 2000; Naveh 2001). The drivers of historic landscapes consisted of economic, cultural, and ecosystem processes, which acted at the same hierarchical level. Currently, economic processes are the determinants in landscape evolution (Farina *et al.* 2003).

Complexity in contemporary cultural landscapes is destined to become even harder to grasp and manage, as the increasing number of dynamics coexisting in contemporary cultural landscapes implies even more complex structures (Fig. 1). This has a number of consequences in the relationships between

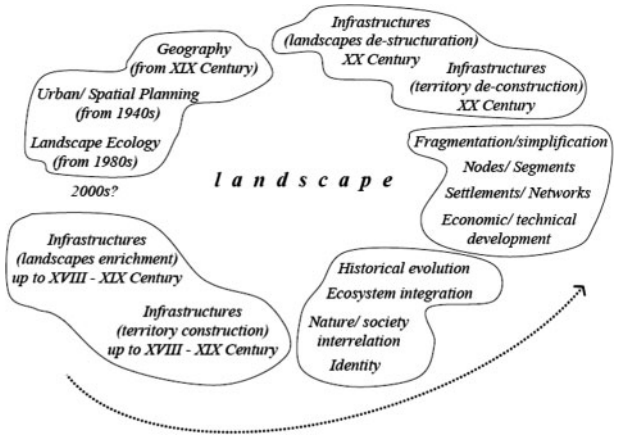

Fig. 1. Relations between landscape complexity-simplification and human drivers

the social and the natural components. As regards the social component, the awareness of local cultural specificities and uniqueness is expected to become stronger because of the comparison with external contexts. These specificities can be at the same time endangered and supported by the increased knowledge and accessibility of external resources and experiences, in many cases promoted by the normative framework (e.g. the European Landscape Convention guidelines). The mutual interactions between cultures and know-how from different backgrounds and levels may enrich the scenario of future cultural landscapes with new dynamics if safeguarding of local identities is pursued (which means site-responsive knowledge). As regards the natural component, contemporary cultural landscapes can maintain and increase their important role as biological and genetic refuges. Nevertheless, they will be characterized by an augmentation of fragility and vulnerability because of a major sensitivity to anthropic disturbance, with a consequent lowering of resilience (Farina *et al.* 2003).

According to this research, there are four major drivers to be considered: identity process, integration process, multiscale process, and innovation process.

Cultural landscapes are based on identity and integration: they are indeed the outcome of local identities and cultures as evidence of a territorial history as well as expressions of the interaction between man and nature (ELC 2000). According to Panagopoulos (2009), cultural landscapes should lead people to form emotional attachments to the land and thereby develop a greater appreciation for the sustainability goals. Multiscale dynamics using stronger and growing relationships between local, regional, national, and supra-national socioeconomic levels, together with rapid sociocultural innovations, are two determinant drivers that particularly affect contemporary landscapes (Opdam *et al.* 2006).

As far as identity is concerned, many authors (Terkenli 2001; Scazzosi 2004), together with the European Landscape Convention (ELC 2000), have analyzed and stressed the relations occurring between landscape and identity and all agree on the importance of such a relation for the development of local landscapes. Identity is related to the historical–cultural character of a place and to the sense of belonging of the local society, which means not only collective memory but also reliance on that place for constructing a future. Basic sources for local identities consist in the recognition of differences among places, in natural and cultural specificities, in the awareness of past evidence in a physical and symbolic sense, forming the collective memory and experience of a population (Scazzosi 2004). Local identity can therefore generate a reaction to modernization, homologation, and globalization. The European Landscape Convention gives primary attention to identity, assuming that landscape

underpins its development (ELC 2000, art. 5). UNESCO defines identity as the cultural tradition of a context, whereas for Tishler (1982) it is the local and regional knowledge, which defines the long-standing characteristics of a place. The sociologist Castells (1992) considers identity a resource for transformation, a social process at the basis of the construction of meanings and cultural values.

Integration is the second basic aspect of a cultural landscape and it is strictly related to multifunctionality (Wiggering *et al.* 2006). Such a process is enhanced and analyzed in particular by the Landscape Ecology, which aims at understanding the interactions between natural and human dynamics occurring within landscapes. Farina (2000) defines cultural landscapes as the highest expression of integration between human activities and environmental dynamics. According to Antrop (2005), landscape is at the basis of enduring sets of linkages based on the relationships between the physical environment and human society. In such a context, people are the developers through their engagement with the world around them. The integration process is based, amongst other aspects, on a social comprehension of natural dynamics, the conservation of diversity and heterogeneity, and the use of renewable natural and cultural resources. Integration regards not only the relationships between the natural and the social system, but is an essential function within each of them (e.g. "decision making" in the social system). Analyses of cultural heritage connectivity can inform about functions of the landscape and its social and economic conditions (Antonson *et al.* 2010).

The multiscale processes underpin both the natural and the social systems, which are based on multilevel relations. According to Antrop (2000), landscapes evolve continuously by "internal" and "external" factors. Internal factors are those that may be controlled at the local level (e.g. by the direct action of the inhabitants). External factors are mostly indirect and influence the local landscape conditions through upper strategies and policies. Decisions are made on different hierarchical levels of policy-making and manifest themselves in terms of actions at different levels. The multiscale processes work on connections, junctions, and linkages between the dynamics at different levels. For instance, the local ecological networks are connected to the regional and the national and continental ones; local identities should be recognized at the regional level, at the national one, and so forth. To control such dynamics, it is helpful to use recent guidelines and tools provided at European and national levels that aim at supporting the local context under a multiscale perspective. Examples of these tools are the European Landscape Convention (ELC 2000), the Environmental Impact Assessment (EIA) and the Strategic Environmental Assessment (SEA). Under this perspective, some scholars underline the importance of a multiscale planning development, which is considered the more adequate approach to face and manage complex systems such as landscapes (Mortberg *et al.* 2007).

Currently, multilevel cultural exchanges are stronger and local contexts are enriched with new stimuli. As a consequence, new complex multilevel relationships requiring an appropriate management emerge: the risk, however, is to weaken local socioeconomic dynamics, identity values, and nature–society interactions, in the name of upper powerful relations.

Together with the multiscale process, innovation is one of the main driving forces for the development of contemporary landscapes, because they are time-dependent. The durability of a cultural landscape is connected to the ability to renovate, through appropriate actions, the interactions between society and nature. Starting from the landscape structures inherited from the past, it is essential to activate innovation processes defining new functional systems, where previous values (both natural and social) are the basis for new coherent solutions. Innovation means shifting from one phase to another and according to the geographer L. Gambi (1973), the society re-creates its living space through modalities based on evolutionary steps. Nowadays innovation happens fast. This may challenge some of the characteristics of historic cultural landscapes, based on long-time stability and nature adaptation, with few and slow changes (Farina *et al.* 2005a). This process, if not properly managed, may trigger other dynamics that are detached by identity–historical matrices, and more in general can weaken the interactions between natural and social systems.

Appropriate local knowledge was at the basis of the construction of historical cultural landscapes. Thus, the ability of a local society to provide responses of long duration to its living needs using the environmental recourses meant constructing territories functionally operating but also rich in identity and symbolic meanings. As the basis of contemporary cultural landscapes, there must be projects that are simultaneously technically sound, socially recognized, and economically viable. The role of a project is to support, develop, and strengthen the processes that are in a context. To trigger constructive dynamics and to avoid a weakening of the system, identity process, integration process, multiscale process, and innovation processes need to be planned and managed together.

2. Interpretative model for cultural landscape dynamics

The development of contemporary cultural landscapes is affected by many interrelated factors so that variations can be triggered not only by planning, but also by community values, sense of place, environmental

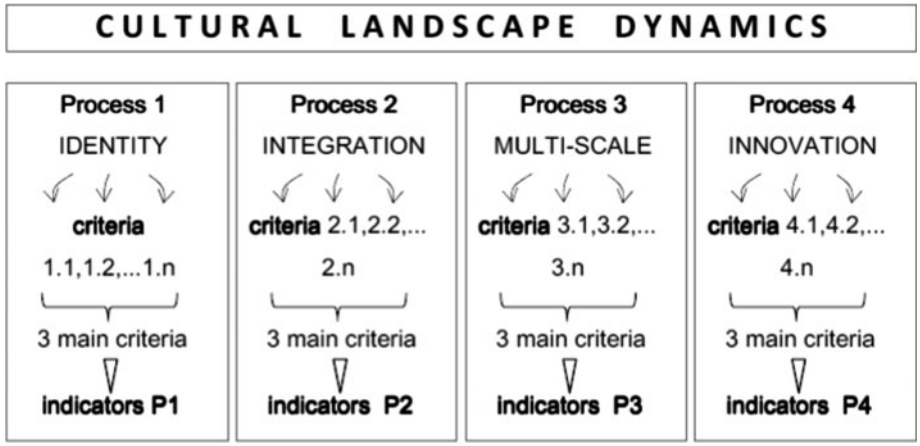

Fig. 2. Conceptual scheme of the Cultural Landscape dynamics Interpretative Model

attitudes, administrative skills, and political and economic situations.

The dynamics of a cultural landscape could be either carried on, started, restarted or weakened, interrupted, or cancelled through a planning process. To empirically support some of such dynamics, the Cultural Landscape Dynamics Interpretative Model (CLDIM) has been developed. The methodology of this conceptual and operative model has been developed bearing in mind that cultural landscapes rely on the rules of complex systems, and their evolution and change are influenced by processes of different dimensions in space and time (Farina *et al.* 2005b). The model is a result of combined criteria that are the outcomes of the elaborations of aspects, principles, and tools taken from spatial planning best practices, landscape ecology, and from the analysis of two historic cultural landscapes (the Roman Centuriazione and the historical railways). Spatial planning best practices have contributed to elaborate criteria based on cultural heritage and identity preservation, large/local actions management and integration, local development, flexibility, and participation. Landscape ecology perspective has contributed to elaborate criteria based on social–environmental systems analysis, physiognomic structural elements analysis, multifunctionality, growth limits estimation, and multiscale approach.

The four contemporary landscape processes analyzed (identity, integration, multiscalarity, innovation) underpin the four parts of the model. Each part is divided into a number of criteria and a number of indicators (Fig. 2).

Criteria (1.1 . . . 4.n) aim to analyze the state of the art of a process in a context and to understand a process in its complexity. The aim of the table of indicators is to activate a number of planning actions, i.e. to support a cultural landscape process in relation to a linear infrastructure plan. The indicators that characterize the second part of the model have been elaborated according to 12 main criteria of the interpretative grid. Each criterion is related to one or more indicators. Some derive from the elaboration of existing indicators, others have been structured ex novo. They are divided into pressure indicators and response indicators. They aim at addressing a number of actions to contrast pressure factors to support cultural landscape dynamics in planning processes, and in general to support sustainable conditions (OCS 2005).

The score system related to each indicator has been unified with the aim both at making their compilation easier and to allow a compared reading at the end of their application. The score system is a qualitative scale and is based on four levels: $+++=3$; $++=2$; $+=1$; $-=0$. This score method is useful as long as the results are interpreted with a degree of caution and not out of context. The scale has a limited number of classes, which often means groups of alternatives may hold the same position. The meaning of each score level is specified for each indicator.

The following four tables of the model were used to describe the cultural landscapes using the four processes respectively, and the criteria, pressure, and response indicators.

Cultural landscapes are related to identity. They are based on the evolution of the know-how of local societies. Loss of social interest determines landscape destructuration. Table 1 shows the three criteria of the identity process and the respective indicators related to the criteria.

Criterion 1 is about the acknowledgment of the local-social heritage and methods to sustain local processes for the valorisation of cultural heritage and has three indicators: "activism of local associations in the project elaboration"; "activism of local institutions in the project elaboration"; "use of local projects already planned in the areas involved".

Criterion 2 is about managing land quality changes and has four indicators: "expropriated ha/km"; "repair strategies for loss of value in sensitive

Table 1. Criteria and indicators used at the identity process of the cultural landscapes

PROCESS	CRITERIA / DESCRIPTION	MEASURES / INDICATORS
I D E N T I T Y	**1. Sustaining local processes for the valorization of cultural heritage** Acknowledgment of the local-social heritage: A. INVOLVEMENT OF ASSOCIATIONS / GROUPS (related to cultural/ environmental heritage) B. INVOLVEMENT OF LOCAL INSTITUTIONS C. ENHANCE / USE EXISTING LOCAL PROJECTS already developed by local institutions	A. INVOLVEMENT OF ASSOCIATIONS / GROUPS 1.1. activism of associations / spontaneous groups in the project elaboration a. in problems identification b. in choosing options c. in project approval + + +many in the 3 phases + + many / some in 2 / 3 phases +one (few) in one phase – options that did not change the project / obstructionism because not involved; – no activism from local associations B. INVOLVEMENT OF LOCAL INSTITUTIONS 1.2. activism of local institutions in the project elaboration a. in problems identification b. in choosing options c. in project approval + + +many in the 3 phases + + many / some in 2 / 3 phases +many / some in one phase – obstructionism because not involved – no activism from local institutions C. ENHANCE / USE EXISTING LOCAL PROJECTS 1.3. use of local plans / projects already planned in the areas involved + + +acknowledged and re-elaborated where possible + + re-elaborated in some cases +re-elaborated in few cases – not considered
	2. Managing land quality changes A. CHANGES OF SURFACES comparison between agricultural land, sustainable land, urban areas reduction B. REPAIR STRATEGIES activation of repair measures (mitigations) concerning the relations with sensitive areas, loss of quality value of the fields, loss of quality life	A. CHANGES OF SURFACES 2.1. ha/ km expropriated (agricultural, urban, natural) B. REPAIR STRATEGIES 2.2. Repair strategies for loss of value in sensitive areas + + +systemic project (integrated project) + + shared projects between planners / local institutions +some interactions between planners / local institutions – no actions 2.3. Repair strategies in agricultural areas + + +systemic project + + shared projects between planners/ local institutions +some interaction between planners/ local institutions; – no actions 2.4. Repair strategies to prevent loss of quality life + + +systemic project + + shared projects between planners/ local institutions +some interaction between planners/ local institutions; – no actions
	3. Supporting the structure of local milieu The criterion aims at enhancing whether or not the infrastructure matches with the local milieu.	3.1. objectives and actions declared to support the structure of local milieu + + +main aim or integrated aim since the preliminary steps + + enhanced after the presentation to local institutions +considered only after the presentation to local institutions – no actions

areas''; ''repair strategies in agricultural areas''; ''repair strategies to prevent loss of life quality''.

Criterion 3 is about the structure of local milieu and has one indicator: ''objectives and actions declared to support the structure of local milieu''.

Cultural landscapes are characterized by multi-functionality determined by a variety of uses: the outcome is an integrated landscape where natural and social processes are compatible. Contemporary cultural landscapes originate from integrated goals: physic, ecosystem, and social elements are planned together. They are based on local know-how integrated with experts' knowledge (outside tools). Table 2 shows the three main criteria of the integration process, and the respective indicators related to the criteria.

Table 2. Criteria and indicators used at the integration process of the cultural landscapes

PROCESS	CRITERIA / DESCRIPTION	MEASURES / INDICATORS
INTEGRATION	**4. Interdisciplinarity** Presence/absence of experts from different disciplines. Early or late presence? (macro-areas: agronomy, architecture, ecology, economy, engineering, geography, geology, history, sociology)	4.1. participation since the early steps of the project elaboration. + + +maximum interdisciplinarity + +medium/ high interdisciplinarity +few interdisciplinarity – absence of interdisciplinarity 4.2 calls for specific studies (late/partial participation). + + +the majority of disciplines + +half disciplines +few disciplines – one discipline
	5. Integrated land configurations Capability to carry out an integrated territorial project through integrated solutions which consider urban and environmental solutions in the territories involved	5.1. Opportunity for urban regeneration + + +widespread approach of the local institutions together with the infrastructure planning group (integrated initiative) + +approach in some areas of the local institutions together with the infrastructure planning group (integrated initiative) +sporadic cases of local initiative – no cases 5.2. Opportunity for environmental regeneration + + +widespread approach of the local institutions together with the infrastructure planning group (integrated initiative) + +delimited approach of the local institutions together with the infrastructure planning group (integrated initiative) +sporadic cases (local initiative) – no cases 5.3. Coherence / integration with the existing transportation-network + + +total coherence/integration with the network + +coherence for the majority of the infrastructure +partial coherence – no coherence
	6. Flexibility Elaboration/evaluation of alternatives projects during the planning phase	6.1. elaboration and evaluation of alternative projects + + +alternative projects undertaken by the planning group + +project re-organization after requests +acknowledgment of limited requests – no alternatives undertaken

Criterion 4 is about the interdisciplinarity involved in the planning phase and has two indicators: "participation since the early steps in the project elaboration"; "calls for specific studies (late-partial participation)".

Criterion 5 is about the capability of carrying out an integrated territorial project through integrated solutions that consider urban and environmental aspects. It has three indicators: "opportunity for urban regeneration"; "opportunity for environmental regeneration"; "coherence / integration with the existing transportation network".

Criterion 6 is about the flexibility during the planning phase and has one indicator: "elaboration and evaluation of alternative projects".

Cultural landscapes are based on multiscale relations structured in interdependencies and exchanges. Natural system: local ecosystem dynamics are related to upper dynamics through linkages (e.g. flows and migrations). Social system: in historic cultural landscapes local societies were the main actors. Upper interests that weigh on local systems lead to development of tools (European Landscape Convention – Environmental Impact Assessment – Strategic

Table 3. Criteria and indicators used at the multiscale process of the cultural landscapes

PROCESS	CRITERIA / DESCRIPTION	MEASURES / INDICATORS
MULTI-SCALE	**7. Multi-level compensations** Relations between planning infrastructure and planning local compensation.	7.1. Active compensations + + +systemic project (integrated project) + +shared projects between planners / local institutions (master plan) +local independent actions (money provided to local administrations) – no actions
	8. Managing land transformation Relations between planning infrastructure and planning local transformations.	8.1. Active territorial transformations + + +systemic project (integrated project) + +shared projects btw planners / local institutions (master plan) +local independent actions – no actions
	9. Supporting system complexity **A. Infrastructure as a component of a complex system (large scale)** Infrastructure coherency in relation to the ecological system, settlement system and agricultural areas **B. Infrastructure as a system (intermediate scale)** Infrastructure as a system: coherence of typological choices and materials **C. Single work as a system (focused scale)** Single work as a system: ecological and technical values of the single work (tunnel, viaduct, bare road, trench road) and relation with the settlement system, and ecological system.	A. INFRASTRUCTURE AS A COMPONENT OF A COMPLEX SYSTEM 9.1. Compatibility with the ecological network + + +re-structure a new ecological network after the changes provoked + +provide effective solutions for the majority of the incongruities provoked +provide only sporadic solutions – not considered 9.2. Compatibility with settlements (inhabited areas) + + +analyze and plan new effective scenarios + +analyze and plan effective scenarios in some cases +provide only sporadic solutions (mitigations) – not considered 9.3. Compatibility with land-use values (e.g. agricultural areas) + + +analyze and plan new effective scenarios + +analyze and plan effective scenarios in some cases +provide only sporadic solutions (mitigations) – not considered B. INFRASTRUCTURE AS A SYSTEM 9.4. Typological and materials coherence + + +planned and recognizable as a unique infrastructure + +recognizable the coherence for the majority of the infrastructure +recognizable partial coherence – no coherence of solutions C. SINGLE WORK AS A SYSTEM 9.5. Value 1: technical value (quality of the choices) + + +high value + +good +fair – low / not considered 9.6. Value 2: ecological value + + +high value + +good +fair – low / not considered 9.7. Value 3: relation between the single work and the context + + +planned considering each different context + +planned considering different works for a number of different contexts +planned only in sporadic contexts – no relation

Environmental Assessment) to manage such dynamics at local level. Table 3 shows the three main criteria of the multiscale process and the respective indicators related to the criteria.

Criterion 7 is about the relations between the planning of the infrastructure and the planning of the local compensations and has one indicator: "active compensations".

Criterion 8 is about the relations between infrastructure planning and the local transformations and has one indicator: "active territorial transformations".

Criterion 9 is about the complexity of the supporting system. It is divided into the subcriteria 9a – infrastructure as a component of a complex system – in relation to the ecological system, settlement system, and agricultural areas (large scale); 9b – infrastructure coherence of typological choices and materials (intermediate scale); 9c – ecological and technical values of the single work (tunnel, viaduct, bare road, trench road), and relation with the settlement system and ecological system (focused scale). Criterion 9 has 7 indicators: "compatibility with the ecological network"; "compatibility with settlements"; "compatibility with land-use values"; "typological and materials coherence"; "technical value"; "ecological value"; and "relation between the single work and the context"

Cultural landscapes are evolving systems that reflect natural and cultural processes, which guarantee renewable dynamics. The use of innovative tools compatible with local specificities may denote added value to local know-how. Contemporary cultural landscapes answer to problems of contemporary society–nature interactions.

Innovation was considered to overcome the basic mission of the infrastructure (transport).Creativities may rise at local level in relation to the project development (e.g., use of infrastructure spaces for social cohesion – alternatives to transport, creation of laboratories, exhibitions, cultural meetings). Table 4 shows the three main criteria of the innovation process and the respective indicators related to the criteria.

Criterion 10 is about the use of the infrastructure project as a guideline to other projects and has one indicator: "Acknowledgment of innovative models". Criterion 11 is about the actions and processes aimed

Table 4. Criteria and indicators used at the innovation process of the cultural landscapes

PROCESS	CRITERIA / DESCRIPTION	MEASURES / INDICATORS
INNOVATION	**10. Innovative models acknowledged** Use of infrastructure project models as guideline	10.1. Acknowledgment of innovative models + + +determinant for the project development + + partial benefits +low benefits – no acknowledgment
	11. Extraordinary institutional relations Actions and processes aimed at improving governance (social–institutional learning)	11.1. Supporting experiences of interrelation between institutions + + +yes with all / majority of the institutions involved. Long-term duration (at least during planning execution) + + +innovative early experiences of interrelation + + yes with all / the majority of the institutions involved. Medium / short-term duration (during the planning phase) +with some institutions – sporadic experiences of interrelations 11.2. Ad hoc significant studies elaborated by other institutions and / or informal bodies in itinere / ex post + + +determinant for the project development + + partial benefits +low benefits – no acknowledgment
	12. Creativity (inclusion of unusual, complementary, innovative uses / actions) Capability to overcome the basic mission of the infrastructure (transport).	12.1. Project creativity + + +ex: creative solutions (e.g. permeable motorway in urban areas – Boulevard JFK, Luxembourg, arch. T. Latz) + + ex: peculiar projects for complementary aspects i.e. stop areas, specific single works with a symbolic value +ex: call for competition (ideas) for complementary aspects – ex: only transportation 12.2. Local creativities started-up with the project + + +new / existing associations work out related creative projects. Widespread the outcomes, awaken the society + + new or existing associations (formal-informal) elaborate creative projects related to the infrastructure project +limited experiences – no reactions at local / informal level

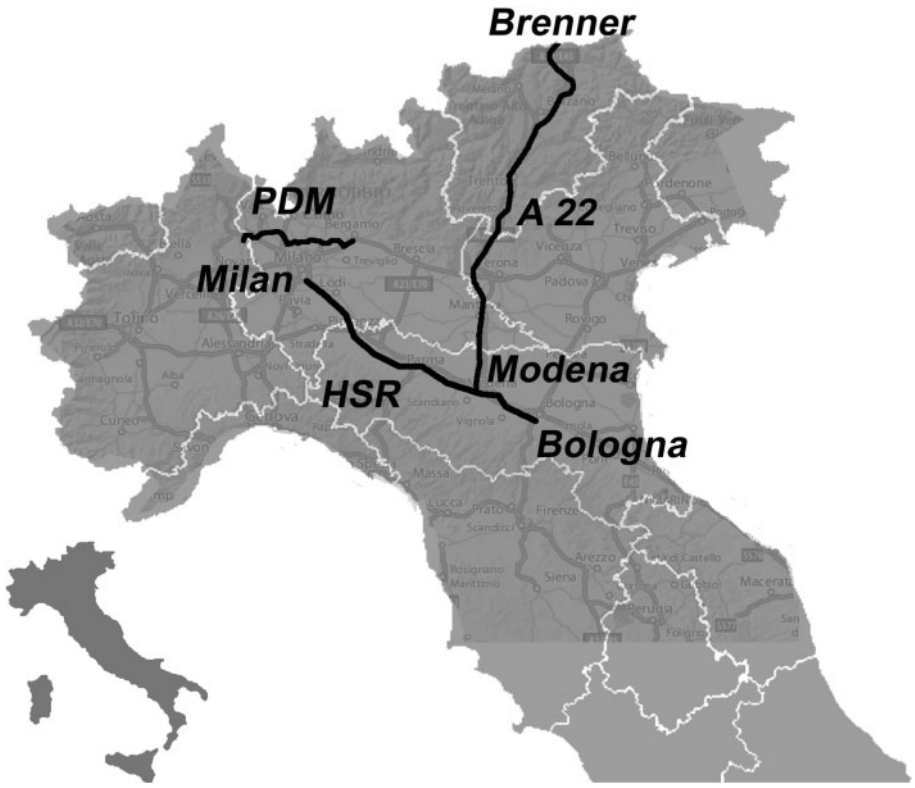

Fig. 3. Schematic map with the three case studies (A22: Brenner Motorway; HSR: high speed railway Bologna-Milan; PDM: Pedemontana Lombarda Motorway)

at social–institutional learning and has two indicators: "supporting experiences of interrelation between institutions"; "ad hoc significant studies carried out by other institutions and / or informal bodies". Criterion 12 is about the rise of creativity at local level in relation to the project development and has two indicators: "project creativity"; "local creativities started up with the project"

3. The model application to three case studies

To test the validity and improve its structure, the interpretative model has been applied to three contemporary linear infrastructure projects planned within the last 50 years (Fig. 3). This has permitted to formulate some considerations about the state of the art of contemporary cultural landscapes development in relation to infrastructure projects.

The three case studies have been chosen following four criteria:

a) selection of the projects within a national context (Italy) to understand the evolution of the approaches of linear infrastructure planning and the related legislative–cultural debate;
b) identification of the period of realization according to a peculiar phase concerning linear infrastructures development;
c) consideration of the evolution of the approaches of planners and landscape architects in relation to landscape and infrastructure planning;
d) identification of a project with an innovative character in each period.

Concerning the periods of realization, three different phases have been identified:

– the 1960s, characterized by the commencement of the Italian motorway network;
– the 1980s, characterized by a relaunch of the railway network with the high-speed railway project as an alternative to road and flight networks;
– the 2000s, representative of the current situation concerning linear infrastructure development within high-density extra-urban contexts.

The case identified in the 1960s is the Brenner Motorway, located in north-east Italy (regions of Trentino Alto Adige, Veneto, Emila Romagna). The project demonstrates the attention put in those years to the innovative technical solutions that were at the basis of the rapid development of the road system. In this case, the approach to landscape was mainly aesthetic and based on visual choices (use of arboreal and floral species). In general, landscape projects related to linear infrastructures were rare.

The second case is the High-Speed Railway Bologna–Milan located in northern Italy (Emilia Romagna, Lombardy regions). In the 1980s in Italy, the focus on the "environmental" aspect of landscape began, which culminated with the acknowledgment of the Environmental Impact Assessment (law 349/1986). In this case, a deep symbolic approach to landscape was carried out in parallel by assigning some exemplary projects to renowned architects.

The current case identified is the Pedemontana Lombarda Motorway located in north Italy. The motorway, planned within the Lombardy region, is a picture of the current Italian innovative approach to landscape development in relation to a large infrastructure plan. Particular attention has been placed to work out the compensations and mitigation aspects through a structured and organic project. A widespread involvement of the local communities has characterized the elaboration of a number of focused projects.

Information has been collected by applying the grid of criteria of the interpretative model to the three case studies. The indicators table was filed and the outcomes were outlined and compared.

4. Comparisons and trends of the processes in the three case studies

Considering that the three projects are innovative for the period in which they are planned, this comparison aims at presenting a general trend of the modalities of development that cultural landscapes are undertaking. Graphs for each criterion of the interpretative model have been elaborated to structure the comparison. They are the graphic representation of the outcomes of the indicators table, and aim both at underlying and comparing the results of the three case studies. In each figure, the x axis correspond to the three case studies: the Brenner highway (A22), the High Speed Railway Bologna-Milan (HSR) and the Pedemontana Lombarda Motorway (PDM). The y axis represents the values ($-=0; +=1; ++=2; +++=3$) and corresponds to the score system used for each case in the indicators table. The rectangles represent the outcomes of each indicator. In some cases, a graphic representation has not been performed, because of the different measurement units of the indicators (i.e. binary measure, yes / no).

The results have been contextualized in each period. For example, the indicator "technical value" has obtained the maximum score both in the Brenner motorway case (1960s) and in the Pedemontana Lombarda motorway case, although this last one has been planned more than 40 years later. A comparison of the indicator outcomes follows, together with an elaboration of the results divided into the four processes.

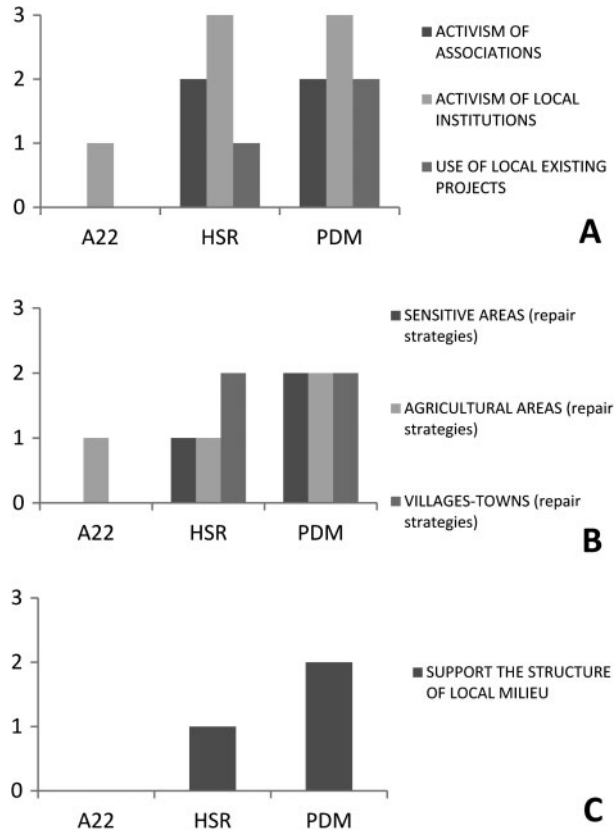

Fig. 4. Graphic representation of the identity process at the Brenner highway (A22), the High Speed Railway (HSR) and the Pedemontana Motorway (PDM)

4.1. Outcomes from the Identity process

The identity process was divided into three criteria. The graphic representation of the results obtained for the three case studies for the identity process is presented in Fig. 4 with a separate graph for each of the criteria and for each one of the related indicators.

From the comparison of the three cases concerning the identity process, what emerges is that in general this grew in importance from the 1960s and always characterizes more the planning process towards a landscape based on identity values. An almost constant development of the planning actions in the direction of the objectives represented by the criteria can be observed. This is a result of the improvement of the planning instruments as well as the acknowledgment of the importance of local communities for heritage conservation and renovation.

The adoption of the European Landscape Convention from the year 2000 and its acknowledgment by a growing number of European nations confirms such awareness. Nevertheless, as shown by the graphs, the maximum level is still to be reached in the majority of the cases. An improvement of the process can be obtained through a more active involvement of the local stakeholders, in particular the cultural and environmental associations, which still do not have

any influence in the structure of the decisional bodies. A consequence of this is the lack of attention toward the residual open spaces (e.g. woods), in some cases sacrificed to safeguard other land structures (e.g. agricultural areas characterized by explicit economic values). The inclusion of local existing projects was an aspect to strengthen as well as to consider from the beginning of the planning procedure; however, the case of Pedemontana Lombarda has been undertaken only for the compensation project.

Another aspect enhanced is the relation between the expropriated hectares and the infrastructure. Further investigation is needed about the reorganization of the open areas consequent to the transformation. To provide an example of the large impact of such an aspect on the local communities, thousands of farms have been involved in those transformations consequent to the construction of the High Speed Railway Bologna-Milan. The data provided by Pedemontana Lombarda SpA, FSI SpA, and a literature overview as regards the Brenner motorway, demonstrated an increasing level of expropriations from the 1960s. Those augments of expropriations are mostly consequent to the mitigation and compensation projects.

Land quality changes have been better managed in the third case (Fig. 4b). Nevertheless, a further improvement could be carried out if the project of the infrastructure is not detached from the environmental project, and a change of perspectives is undertaken.

The strongest support to the local milieu is observable in the case of the Pedemontana project (Fig. 4c). The aim of the Pedemontana motorway was to sustain the economic structure of the productive area located in the north of the Lombardy region characterized by small-medium enterprises. In addition, the case of the high speed railway is emblematic in this sense, as its primary aim is to link faster the national and international centres; nevertheless, the activism of the local institutions enable obtaining the interconnection between the new line and the local railway network.

4.2. Outcomes from the integration process

The integration process is divided into three criteria. The graphic representation of the results obtained from the three case studies for the integration process is presented in Fig. 5 with a separate graph for each of the three criteria and for each one the related indicators.

This comparison testifies that the integration process grows following a dynamic that is less homogeneous if compared with the tendency of the previous process. As shown by the graphs, except for some indicators, the desideratum has still to be reached in all studied cases. In general, a determinant step forward is

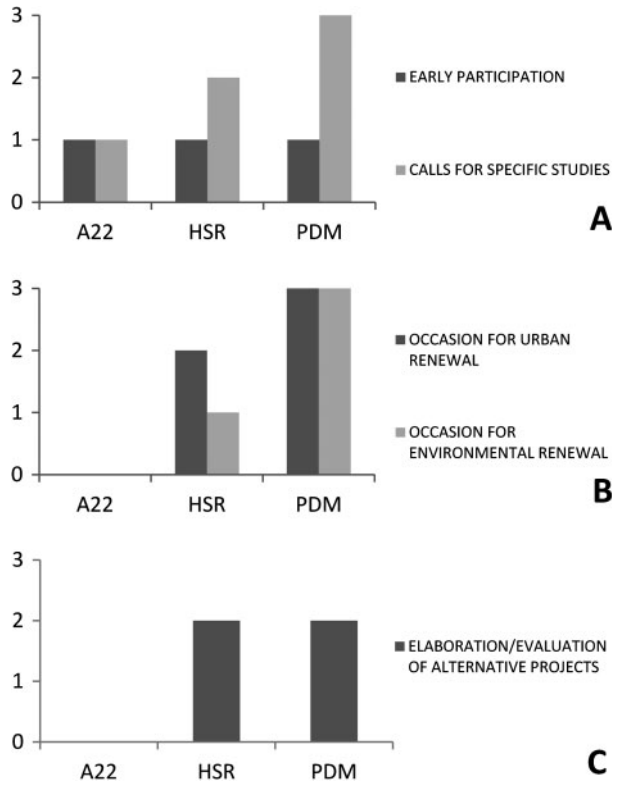

Fig. 5. Graphic representation of the integration process at the Brenner highway (A22), the High Speed Railway (HSR) and the Pedemontana Motorway (PDM)

noticeable in the case of the Pedemontana Lombarda motorway for the criteria and indicators of the integration process (Fig. 5a). The participation of multidisciplinary professionals since the very beginning of the planning phase is an aspect that has to be reconsidered and improved. Good quality levels of urban and environmental regeneration related to the infrastructure project have characterized the Pedemontana Lombarda compensation project (Fig. 5b). In this case, a high level of integration between planners and local institutions has been observed. Concerning the coherence with the existing transportation network, the three projects were developed according to the real transportation needs both at upper and at local levels.

The projects demonstrate growing levels of flexibility in relation to the elaboration and evaluation of the alternatives (Fig. 5c). Nevertheless, other steps forward need to be undertaken that will lead to diminished detachment that occurs between the early infrastructure layout and the project changes required by the regional, provincial, and local institutions.

4.3. Outcomes from the multiscale process

The multiscale process has a variable trend according to the different criteria. In general, a tendency toward the desiderata is noticeable. In some cases, there is a late development of a dynamic, in others, there is a lack of attention, and a criterion loss importance. In all

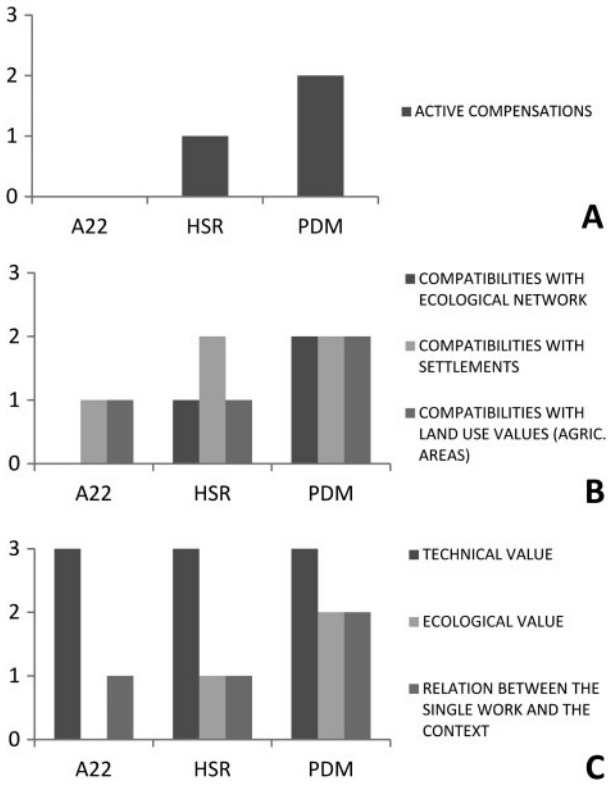

Fig. 6. Graphic representation of the multiscale process at the Brenner highway (A22), the High Speed Railway (HSR) and the Pedemontana Motorway (PDM)

the circumstances, the better condition is verifiable in the Pedemontana project. Two criteria that require some reflections emerge: "multilevel compensation" and "managing land transformation effects". The first is a prerogative mainly of the Pedemontana case (Fig. 6a). The analysis underlines a general high value of the compensation project that elaborates ex-post-remedial solutions to the infrastructure project designed in advance. To improve its outcomes, new planning perspectives should be explored toward the development of a systemic integrated project. This should be based on the inclusion and the management of the cultural and environmental dynamics.

The second criterion is related to the prevention of land exploitation in the areas involved by the infrastructure. This aspect requires deeper attention as satisfying levels of landscape management have not been achieved in the three cases analyzed. The development of an effective multiscale legal framework that engages the region, the provinces, and the municipalities could be a performing solution to manage the areas potentially included in the exploitation.

The considerations carried out for the criterion "supporting system complexity", which underlines a multiscale analysis of the projects, has reached satisfying levels mainly in relation to the intermediate scale and the focused scale. The large-scale level that was about the relations with the external structures (Fig. 6b),

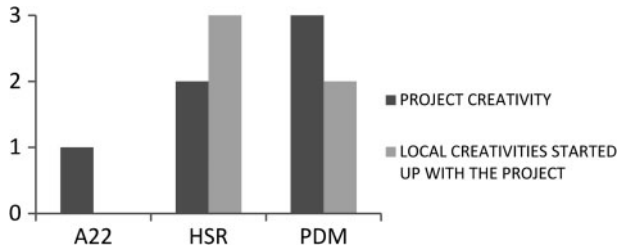

Fig. 7. Graphic representation of the innovation process at the Brenner highway (A22), the High Speed Railway (HSR) and the Pedemontana Motorway (PDM)

still have to be improved and this can be obtained through the development of a systemic project. The relation of a single work as a system: ecological and technical values of the single works such as tunnel, viaduct, trench road, and relation with, and ecological settlement system are improved at the Pedemontana case (Fig. 6c).

4.4. Outcomes from the innovation process

Innovation was one of the prerogatives that drove the choice of all three projects. Therefore, such a process was developed for the three cases. However, some differences that have characterized the development of the process from the 1960s are evident. Innovative models have been used to develop parts of each project by acknowledging outstanding projects developed in the United States, England, France, and Germany. High levels have been reached also at the three projects in relation to the development of experiences of interrelation between institutions indicating governance improvement. To this extent, the Milan Polytechnic carried out the compensation project for the Pedemontana Lombarda together with the local municipalities. Good levels of creativity have been achieved to design the single works. Regarding the novelty used to carry out the project through original solutions as well as enhancing the local creative reactions (laboratories, exhibitions), the second case demonstrated positive results (Fig. 7). The project of the high speed railway had experienced the development of local laboratories, workshops, and exhibitions. The aim was to begin reflections concerning the changing drivers of local landscapes by opening the areas of involvement in the project wide to the communities. This practice was in line with European Landscape Convention principles and guidelines. It was an interesting and innovative aspect to repropose and innovate in other contexts through the involvement of the local cultural associations.

The presented working tool has not yet been tested within the planning processes of any road or railway project. Its application to future linear infrastructure projects from the very beginning of the planning phase is required to evaluate and improve

the model effectiveness. In 2010, the model was applied also to assess landscape dynamics related to the highway A22 in south Portugal (Berte, Panagopoulos 2011) in which it was proven that the model can provide a replicable method to reduce the pressure of linear infrastructures on local dynamics in similar projects and enhance cultural dynamics. This can be achieved through the management and support of cultural landscape processes in the regional planning procedures.

Conclusions

The present study provided an analysis of the structure and potentialities of contemporary cultural landscapes. The model has been worked out bearing in mind that the interacting processes between natural and human factors underpin cultural landscape development.

From the present study it can be concluded that:

1. The methodology has provided a reading key that considers four basic landscape processes: identity, integration, multiscale, and innovation.
2. The model was effective and helpful to compare the three case studies as well as to draw a number of conclusions about the presence of cultural landscape dynamics in relation to linear infrastructure projects.
3. It permitted enhancing the outcomes of the planning processes aiming to show when these have led to the development of cultural landscape dynamics.
4. It permitted also to evaluate which processes have reached a good level and which can still be ameliorated and how.
5. The application of this model will result in improved EIA documents taking a more modern and comprehensive approach towards the landscape. In addition, it can be useful at the environmental monitoring phase during and after the construction. Such work with landscape would allow approximating infrastructure sector practices to those mandated in the current EU policies that have recently entered into force in all EU nations as a result of the European Landscape Convention.

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