An integrated framework to assess complex cultural and natural heritage systems with Multi-Attribute Value Theory

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1. Research aims

The paper proposes an integrated methodological framework for dealing with collective decisions about public goods, with a specific focus on integrated cultural and natural heritage assets. The aim of the research is to highlight the contribution that a multi-attribute approach can have in supporting both tangible and intangible heritage management.

In particular, a Multicriteria Analysis technique named Multi-Attribute Value Theory (MAVT) is proposed in order to answer the urgent demand for transparency, replicability and learning mechanisms in the field of public policy making.

In this research, MAVT has been applied to a real-world problem where a decision has to be taken about the management of a set of disused farms located inside a natural park in Northern Italy. These farms have a high historical and cultural value and together with the surrounding park create a multi-value resource and opportunity, thus enabling positive synergies for sustainable management and planning. The result of the analysis is represented by a ranking of alternatives to be recovered for touristic purposes.

The proposed framework allows a versatile and case specific use and represents thus an interdisciplinary tool.

2. Introduction

Integrated cultural and natural heritage has a multidimensional profile which includes socio-economic, ecological, technical and ethical perspectives and thus leads to issues that are simultaneously characterized by a high degree of conflict, complexity and uncertainty [1,2].

According to the ICOMOS approach, both tangible and intangible heritage that stimulate the recognition of certain values in man and are able to interact with our memory are to be protected [3]. Choices about what and how to preserve for this and next generations reveal that many different–and sometimes divergent–values (economic, aesthetic, cultural, historical, artistic, educational, political) are subject to discussion.

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Decision problems in this context thus refer to collective decisions which are characterized by the following five major complexities: (i) use of public resources, (ii) presence of multiple stakeholders, (iii) long-time horizons, (iv) need for legitimation and accountability and (v) need for deliberation [4].

To help address these problems, the use of policy analytics [4], which represents a framework for the use of analytics in supporting the policy cycle, has gained attention in recent years. Within this context, Multicriteria Analysis [5] can play a fundamental role in supporting integrated cultural and natural heritage assets' management.

This paper addresses the challenge of designing integrated cultural and natural heritage using the Multi-Attribute Value Theory (MAVT) [6], a particular type of Multicriteria Decision Aiding method [5].

In particular, this contribution proposes a real application of the MAVT for managing a natural protected area with multiple exceptional values (i.e. ecological, cultural, historical, architectural, and social).

International efforts to preserve the natural environment are mainly concerned with large, bio-diverse and relatively untouched ecosystems or with individual animal or vegetable species, either endangered or threatened with extinction. Much less attention, on the other hand, has been paid to green areas in urban contexts and to their benefits to people. Increasing empirical evidence, however, highlights the strategic importance of natural areas and their contribution to the quality of life [7].

The methodological framework proposed in this paper was applied to a complex territorial system where natural and cultural heritage are a vital part of the territorial capital and identity.

The objective of this research is to provide an integrated framework to support the planning and design of future actions in the field of complex territorial systems, according to both qualitative and quantitative elements. This framework is illustrated with a real-world case study and is intended to help landscape and urban planners, policy and decision-makers, land managers and public organizations to understand, evaluate and manage complex territorial systems characterized by multiple values. In particular, the aim of the paper is to highlight the contribution that a multi-attribute framework can have in supporting integrated landscape design processes, where there is a strong need for transparency, replicability and learning mechanisms.

The remainder of the paper is organized as follows: Section 2 illustrates the methodological background and state of the art of the Multi-Attribute Value Theory while Section 3 presents the methodological framework development and application. Finally, Section 4 presents some lessons learned from the overall evaluation process and some insights for further developments.

3. Multi-attribute problems: methodological background and state of the art

Sustainability evaluation of territorial transformation processes is an inherent multi-attribute problem [2]: it is simultaneously characterized by many different dimensions pursuing heterogeneous and often conflicting objectives. The literature suggests several approaches to deal with multi-attribute problems, each characterized by specific mathematical properties, which have very different implications. In this section, we briefly introduce to the reader the methodological background of a specific Multicriteria Analysis technique, named Multi-Attribute Value Theory (MAVT)[6] that has shown to be a very promising line of research in the field of sustainability assessments and strategic planning for territorial transformation processes [8].

Multi-Attribute Value Theory can be used to address problems involving a finite and discrete set of alternative options that have to be evaluated on the basis of conflicting objectives. By being able to handle quantitative as well as qualitative data, MAVT plays a vital role in the field of environmental decision-making where many aspects are often intangible. Moreover, decision-making in this context is frequently complicated by various and conflicting stakeholder views that call for a participative decision process able to include different perspectives and facilitate the discussion.

From the methodological point of view, the framework to be followed to build a MAVT model though a participative approach can be described as shown in Fig. 1.

In particular, the first step concerns the definition of the problem, which implies identifying and structuring the fundamental objectives and related attributes (which measure the degree to which objectives are achieved) [9,10].

The second step consists in the identification and design of alternative options (i.e. the potential solutions to the decision problem). Methods and models such as visioning, problem structuring methods and scenario planning can help to promote creativity for the generation of good strategies and strategic options [11]. Once the alternative options have been identified, it is necessary to assign scores for each alternative in terms of each attribute.

The next step might consist in the definition of a panel of experts for the development of the evaluation. The use of experts' pan-els expands the knowledge bases and may serve to avoid possible biases, which characterizes the situation with a single expert. On the other side, the use of experts' panels has a range of problems

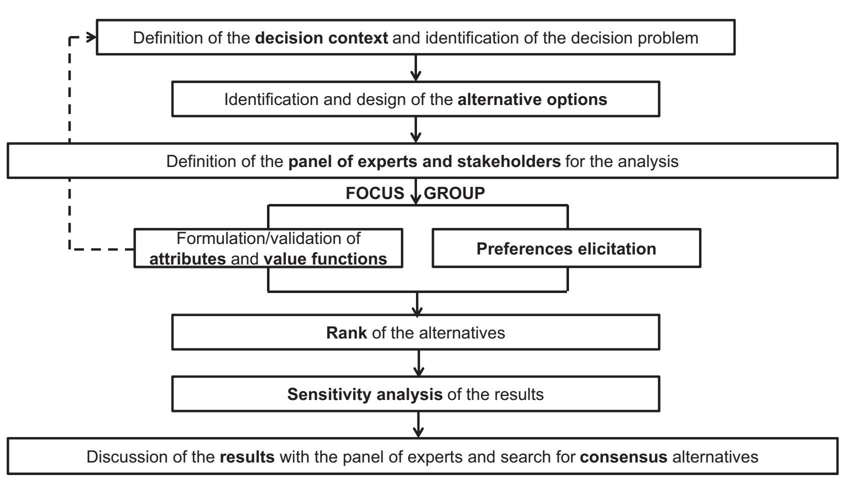


Fig. 1. Methodological steps for the development of a MAVT model making use of an experts' panel.

Table 1
Key references concerning MAVT applications in the environmental decision-making field.

Authors	Year	Decision context	Objective of the analysis	Journal
Sorvari and Seppälä [13]	2010	Management of contaminated sites	Obtain a ranking of risk management options	*Science of the Total Environment*
Stefanopoulos, Yang, Gemitzi and Tsagarakis [14]	2014	Groundwater protection	Propose policy recommendations for sustainable water resources management	*Science of the Total Environment*
Schuwirth, Reichert and Lienert [15]	2012	Hospital wastewater management	Develop consensus solutions for pharmaceutical removal from hospital wastewater	*European Journal of Operational Research*
Hostmann et al. [16]	2006	River rehabilitation project	Investigate how the MAVT method may predict the final preferences of stakeholders and therefore anticipate conflicts at an early stage	*Journal of Multi-Criteria Decision Analysis*
Stewart, Joubert and Janssen [17]	2010	Fishing rights allocation	Facilitate group consensus on the decision-making process and design a decision support template for use in future allocations	*Group Decision Negotiation*
Ferretti, Bottero, Mondini [18]	2014	Industrial building recovery	Obtain a priority ranking of former industrial buildings to be recovered for touristic purposes	*Journal of Cultural Heritage*

associated with it, such as the panel composition, the interaction mode between panel members and, above all, the aggregation of panel responses into a form useful for the decision [9].

The next step consists in modelling preferences (i.e. value functions and trade-offs). Different strategies are available for this task (i.e. the holistic scaling and the decomposed scaling) [9].

The case study illustrated in the present paper will follow the decomposed scaling approach, as will be shown in Section 4 through a detailed description of all the steps involved in the process.

The final step consists in the aggregation of the results in order to obtain the ranking of alternatives. To this end, MAVT includes different aggregation models, but the simplest and most used one is the additive model [12], which can be employed when specific preference independence conditions hold, as it is represented in equation [1]:

$$V(a) = \sum w_i \times v_i(a_i) \qquad (1)$$

where $V(a)$ is the overall value of alternative a, $v_i(a_i)$ is the sin-gle attribute value function reflecting alternative a's performance on attribute i, and w_i is the weight assigned to reflect the relative importance of attribute i.

By aggregating the options' performance across all the attributes to form an overall assessment, MAVT is thus a compensatory technique.

Finally, a sensitivity analysis is recommended in order to test the stability of the obtained results with regards to variations in the inputs. As a result, a final recommendation can be obtained and be further discussed with the decision-makers and stakeholders.

In order to better understand why integrated cultural and natural heritage assets represent a new field of application for multi-attribute value techniques, Table 1 summarizes the main scientific works available in the literature considering the application of MAVT in the environmental decision-making domain, highlighting for each of them the decision context, the objective of the evaluation and the scientific journal in which the work was published.

From the analysis of the references proposed in Table 1, it is possible to highlight that MAVT applications have proved to be a promising decision support tool in many contexts related to environmental decision-making. Nevertheless, to the knowledge of the authors, there are not applications concerning the use of MAVT for dealing with intangible heritage characterized simultaneously by natural, cultural, historical and architectural values. The present contribution has thus an innovative value and will influence future applications dealing with collective decisions about public goods.

4. Case study development and analysis

The application proposed in the present paper concerns the domain of collective decisions about public goods, with a specific focus on integrated cultural and natural heritage assets.

Developing sustainable management policies in this context has become increasingly complex in recent decades, due to the competing uses of the aforementioned assets, as for example recreational opportunities, environmental benefits, biodiversity conservation and other functions such as climate mitigation.

In order to draw recommendations for public policies decision-making in the context of integrated cultural and natural heritage assets, the following paragraphs proposes the development of a multi-attribute decision model for dealing with the multiple values characterizing a natural park in northern Italy.

4.1. Description of the area under analysis and of the methodological process

The study proposed in the present paper focuses on the set of disused farms to be recovered located inside the natural park "La Mandria" in Northern Italy.

These farms have a high historical and cultural value and together with the surrounding park create a multi-value resource and opportunity, thus enabling positive synergies for sustainable management and planning.

In particular, the natural Park "La Mandria", established as a regional protected area since 1978, is surrounded by 30 km of walls, which makes it one of the biggest fenced-in parks in Europe. The Park has an exceptional historical and architectural heritage value including more than 20 protected buildings, among which the "Borgo Castello", many farms, some medieval ruins and two rest areas for hunting. Moreover, the Park is a UNESCO site since 1977 within the system of Piedmont Royal Residences. In particular, two of these residences can be found inside the Park area: the Venaria Royal Palace and the Castle with the royal apartments.

Being also a Site of Community Importance (SCI), the natural Park "La Mandria" represents a strategic area, from both the point of view of the Natura 2000 network and the Sabaudian royal residences' system. In particular, with reference to the Natura 2000 network, the park constitutes an important ecological corridor which connects the Alps to the Po hydrographic catchment [19].

With its informative points, museums, didactic centers, the stable and farms with urban regional gardens the Park welcomes 1000–6000 visitors during summer days which become 500,000 visitors every year [19]. The park thus represents an example of

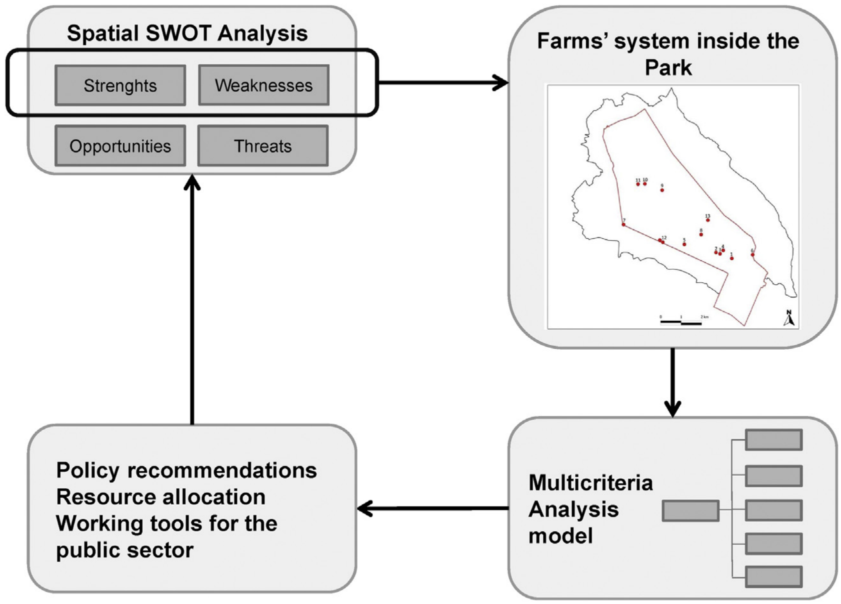


Fig. 2. Overall methodological process for the study.

the need to combine several potentially conflicting objectives, such as nature conservation, water resource protection, tourism and recreation, cattle grazing, preservation of outstanding geomorphologic sites, traditional landscapes and scenic views.

Following the aforementioned premises, decisions about what to conserve and how to conserve it represent a complex decision-making problem in this context, thus calling for an integrated approach able to take into account different and conflicting values

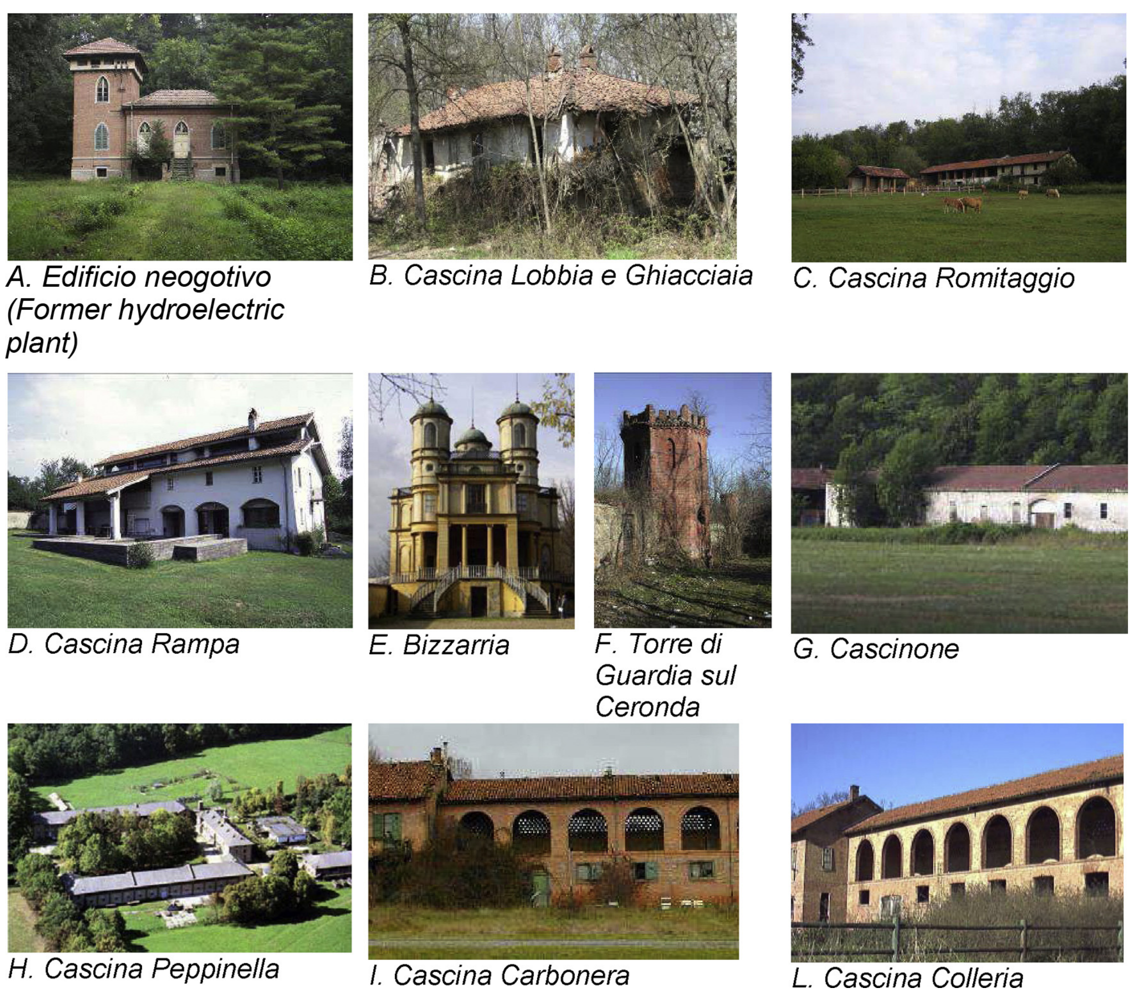


Fig. 3. The 10 alternatives under analysis [19].

Table 2
Raw values of the alternatives.

Farms	Cost [Euros]	Presence of naturalistic landmarks [number]	Presence of architectural landmarks [number]	Presence of touristic-recreational landmarks [number]	Conservation state [qualitative judgments]	Historical value [year]	Accessibility [minutes]
A	569,000	6	2	8	Medium	1921	6
B	1,091,000	6	1	11	Bad	1860	16
C	1,180,000	4	1	7	Medium	1200/1300	39
D	414,000	5	1	3	Very good	1700	16
E	790,000	3	0	3	Medium	1860	78
F	60,000	4	1	5	Bad	1862	52
G	1,075,500	2	0	2	Very bad	1937	33
H	12,340,000	3	0	2	Good	1926	83
I	918,600	2	0	2	Medium	1941	104
L	918,600	2	0	3	Medium	1941	100

(i.e. economic, aesthetic, cultural, historical, artistic, educational, political).

To this end, the authors of the paper have developed a multi-method process of analysis and evaluation able to support the strategic planning phase for the management of environmental public resources characterized by a multi-value profile. In particular, the first step of the process consisted in the development of a spatial SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis to better support the "knowledge phase" of the strategic planning process. What emerged as an interesting result of this pre-liminary phase was that the system of the historical farms existing inside the Park represented at the same time a Strength and a Weak-ness of the territorial system under investigation. For this reason, the subsequent phase of the analysis consisted in a more detailed study of the farms' system inside the Park through the development of a Multicriteria Analysis model aiming at generating a priority ranking for the farms to be recovered. The overall methodological process followed by the authors in their study is summarized in Fig. 2.

Starting from the existing farms located inside the park, the deci-sion alternatives have been identified by excluding those buildings that do not exist anymore and those buildings that have already been recovered for other purposes. As a result of this screening pro-cedure, the 10 alternatives presented in Fig. 3 have been identified and further investigated.

The objective of the paper is thus to highlight the contribution that a multi-method framework can have in supporting public policy decisions, where there is a strong need for transparency, replicability and learning mechanisms.

4.2. *Structuring the decision problem*

As previously mentioned, the first step of the process consisted in structuring the decision problem. A set of measurable attributes has thus been identified for the evaluation of the alternatives and it has been organized according to the value tree approach (Fig. 4). As it is possible to see, the main objective of our model is to determine the suitability of the farms to be recovered for touris-tic purposes. To this end, 7 attributes have been considered. The first one is the cost of the restoration works, as estimated by the Park Authority and the Piedmont Region [19]. The second, the third and the fourth attributes refer to the presence of different types of landmarks: (i) natural (i.e. areas with high natural value, forests, lakes, wetlands, rivers), (ii) architectural (i.e. royal resi-dences and churches) and (iii) touristic-recreational (other farms, recreational areas, bicycle rental points, the riding stable, excur-sion paths, summer camps, picnic areas). These three attributes have been measured as number of landmarks inside the 1 km buffer range around each farm under investigation. This buffer represents the walking distance normally considered for planning purposes. The fifth attribute is the conservation state which refers to mate-rial conditions and has been estimated based on experts' judgments and field surveys. The sixth attribute is the historical value of the building which has been measured based on the original construction year and on expert judgments. Finally, the last attribute refers to the walking accessibility of each farm, measured as minutes needed to reach the farm from the main entrance. In our case, the walking distance to be covered inside the park to reach the buildings has been considered as a criterion to be maximized (i.e. the

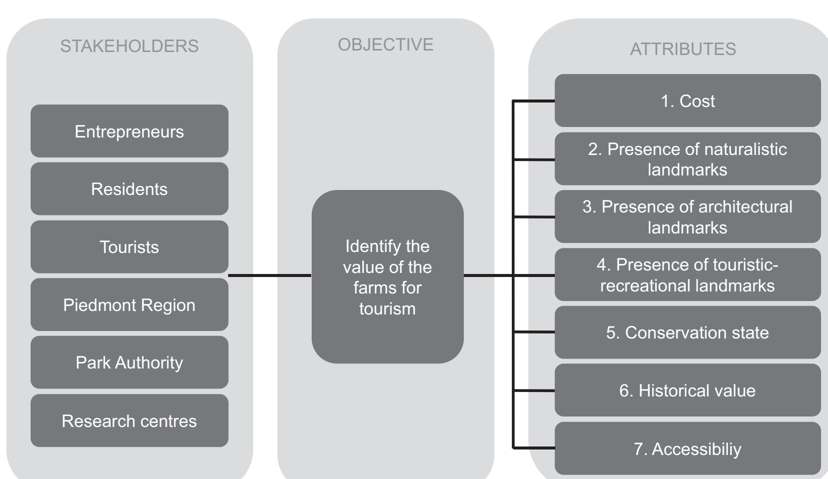


Fig. 4. The value tree for the decision problem under analysis.

Table 3
Elicitation of value functions for the considered attributes (dashed lines are used for discrete functions).

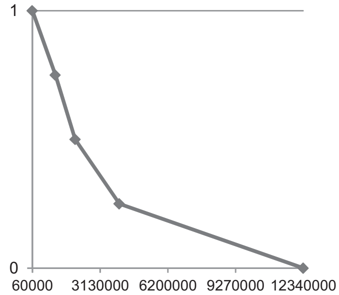
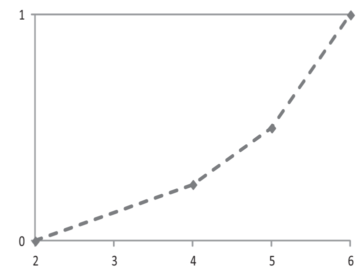
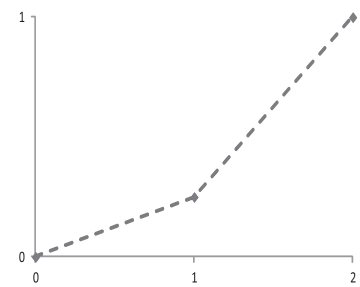
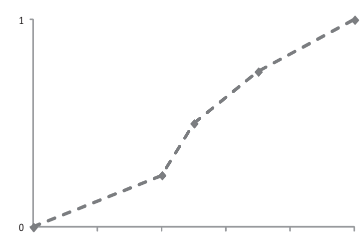
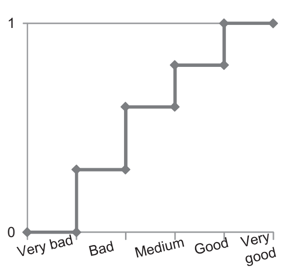
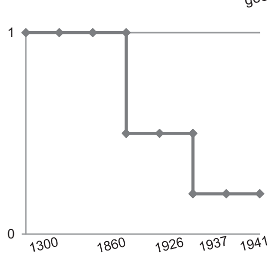
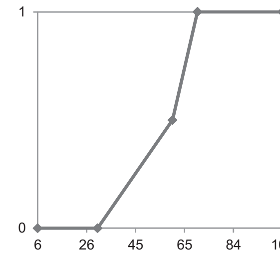
Attribute	Value function
Cost [Euros]	
Presence of naturalistic landmarks [number]	
Presence of architectural landmarks [number]	
Presence of touristic-recreational landmarks [number]	
Conservation state [qualitative judgments]	
Historical value [year]	

Table 3 (*Continued*)

Attribute	Value function
Accessibility [minutes]	

longer the distance to be covered, the more pleasant the recreational experience since it is inside a natural park).

Table 2 provides the raw values of each alternative for all the considered attributes.

4.3. *Elicitation of the value functions*

The next step consisted in the elicitation of the value functions, which are mathematical representation of human judgments. Following the MAVT methodology, each attribute is described by a value function, which allows to scale the attributes between 0 and 1 in order to compare non-commensurable items. In particular, a value of 1 indicates the best available performance and a high objective achievement, while a value of 0 indicates the worst performance and a low objective achievement. The construction of a value function for every evaluation criterion in the model is a task that can be accomplished through different numerical and non-numerical techniques [12,21,22].

In the present study, an interactive interview protocol has been used for the assessment of the marginal value functions. In particular, the Midvalue Splitting technique with consistency check has been experimented making use of a panel of 2 experts. The authors of the paper worked as facilitators and asked questions about the midvalues of the intervals [v = 0, v = 1], [v = 0, v = 0.5], and [v = 0.5, v = 1]. In order to clarify the explanation, we provide an example of the first question asked to the experts with reference to the attribute “Presence of natural landmarks”.

“Imagine two situations in which the number of natural landmarks that you can visit in the buffer around the farm increases from 2 to 4 or from 4 to 6. Would you be equally satisfied?” In our case the two experts answered no, so we repeated the question ask-ing to consider an increase from 2 to 5 natural landmarks and from 5 to 6 and we found that the indifference point for the interviewees was 5 natural landmarks (v = 0.50 in Table 3).

The midvalue of the interval [v = 0.25, v = 0.75] was used as a con-sistency check [15]. Considering, for instance, the value function obtained for attribute “presence of touristic-recreational land-marks” (Table 3) the consistency check was made by asking the experts the following question: “based on the information that you provided, you should be equally satisfied if the number of touristic-recreational landmarks that you can reach from the farm increases from 5 to 7, as well as from 7 to 9. Is this the case?”

If disagreement between this point and the midvalue of the interval [v = 0, v = 1] occurred, the procedure was resumed. If necessary, further intervals were elicited. It was possible to resolve inconsistencies in all cases. Moreover, elicitation was facilitated by a graphical tool, a ruler labeled with the attribute range. The points were also transcribed on a graphical plane and interpolated to a value function for graphical examination by the interviewer.

Mention has to be made to the fact that the application of classical models and techniques for cardinal measurement of values usually requires a person to answer quite difficult questions.

Table 4
Standardized scores of the alternatives.

Farms	Cost [Euros]	Presence of naturalistic landmarks [number]	Presence of architectural landmarks [number]	Presence of touristic-recreational landmarks [number]	Conservation state [qualitative judgments]	Historical value [year]	Accessibility [minutes]
A	0.87	1	1	0.75	0.6	0.5	0
B	0.92	0.5	0.25	0.13	1	1	0
C	0.83	0.13	0	0.13	0.6	1	1
D	0.76	0	0	0.06	0	0.2	0.05
E	0	0.13	0	0.06	0.8	0.5	1
F	0.75	1	0.25	1	0.3	1	0
G	0.79	0	0	0.06	0.6	0.2	1
H	0.79	0	0	0.13	0.6	0.2	1
I	1	0.25	0.25	0.25	0.3	1	0.37
L	0.87	1	1	0.75	0.6	0.5	0

For this reason, other methodologies have been proposed in the literature such as MACBETH [23] and aggregation-disaggregation methods [24].

Table 3 describes the value functions that have been constructed for the attributes considered in the present application. As a result of the value function elicitation procedure, we were able to determine the performance matrix of the alternatives under consideration. As it is possible to see in Table 4, there is not an alternative that performs as the best one on all the considered attributes. It is therefore necessary to proceed with the determination of the levels of trade-offs among the attributes.

4.4. Weighing

With reference to the MAVT theory, once the alternatives have been evaluated on each attribute, it is necessary to define the levels of trade-offs between the different attributes considered in the decision problem. In this case, the Swing Weights method has been

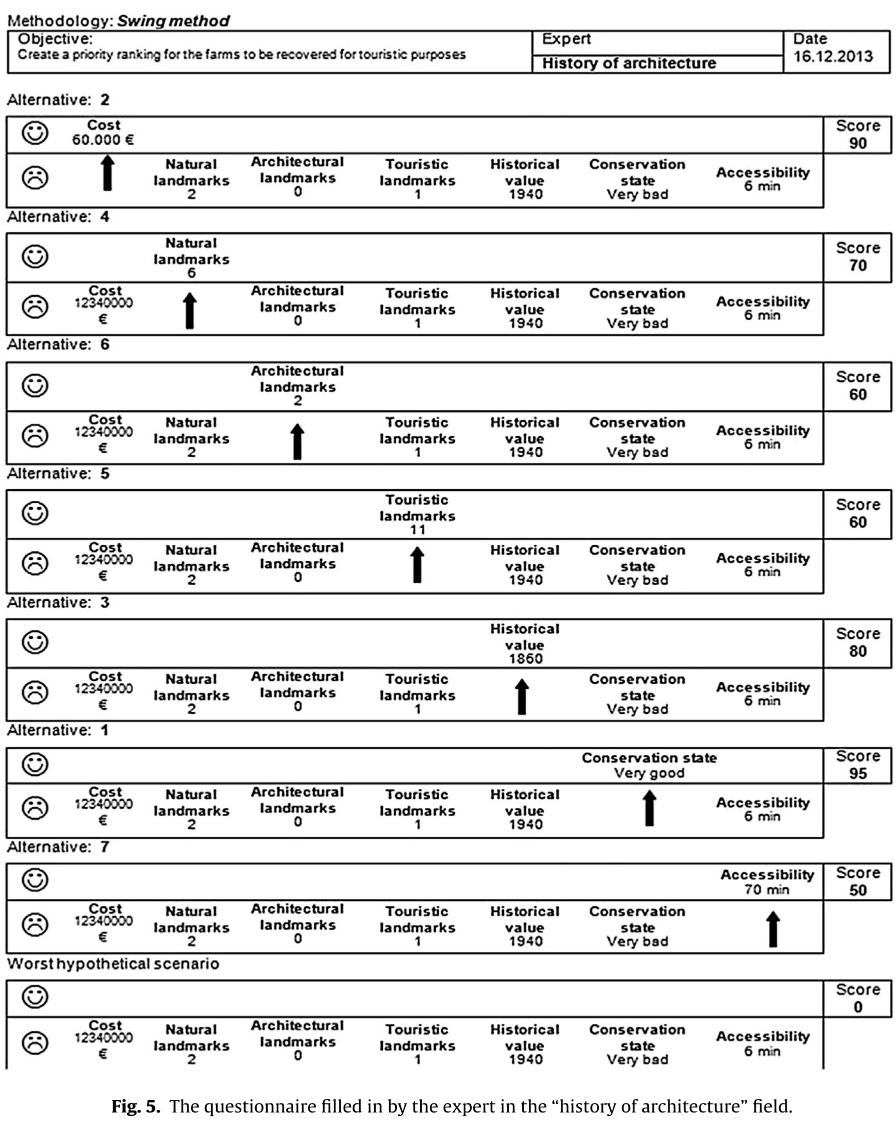


Fig. 5. The questionnaire filled in by the expert in the "history of architecture" field.

Table 5
Set of weights provided by the experts.

Experts	Cost	Presence of naturalistic landmarks	Presence of architectural landmarks	Presence of touristic-recreational landmarks	Conservation state	Historical value	Accessibility
History of architecture	0.18	0.14	0.12	0.12	0.19	0.16	0.10
Spatial analysis	0.17	0.16	0.14	0.12	0.03	0.18	0.21
Landscape ecology	0.11	0.19	0.13	0.17	0.11	0.15	0.15
Urban planning	0.22	0.14	0.11	0.17	0.25	0.03	0.08
Environmental systems	0.19	0.16	0.07	0.16	0.21	0.14	0.07
Evaluation	0.20	0.16	0.10	0.18	0.09	0.15	0.13

used in a focus group setting and the weights have been determined using a reference state in which all attributes were at their worst level and asking each expert which attribute she/he would improve to the best level, assuming that only one attribute could be improved. The next step consisted in asking to the interviewed to give a value (e.g. in the range 0–100) to this swing in terms of worthiness. The weights are then proportional to these values. This implies that the criteria weights are proportional to the discriminating power of the criteria in MAVT [25].

In particular, six different experts have been involved in the weighing procedure, with expertise in the following fields: history of architecture, spatial analysis, landscape ecology, urban planning, environmental systems and evaluation.

Each expert has been questioned separately by means of a specific questionnaire which is based on the Swing Weights approach [15].

Fig. 5 illustrates the questionnaire filled in by the expert in the “history of architecture” field while Table 5 summarizes the overall set of weights elicited from the whole panel of experts.

The weights set by the different experts varied considerably resulting in slightly different preference scores of the alternatives (Fig. 7). This was expected, since the weights reflect each person’s individual values and attitudes, personal and professional history, education, cultural background, knowledge level, the stakeholder group she/he represents, etc. [13].

Nevertheless, as it is possible to see from Table 5 and Fig. 6, three experts out of six agreed in considering the “conservation state” as the most important aspect in the decision problem under examination. Also, the “cost for the restoration works” was judged as very important from five experts out of six while the importance of the other attributes was more variable.

4.5. *Aggregation*

The single attribute value scores have then been aggregated using the obtained set of weights and additive assumptions to calculate the total value of the considered alternatives.

According to the additive rule, the assumption concerning the difference independence between attributes should be fulfilled. This assumption is necessary when using the additive model. In this case the validity of the assumption was tested by asking the participants if they could think of preferences for several levels of attributes independently from the levels of other attributes [13]. All participants stated they could.

Fig. 7 represents the overall values and the ranking of the alternatives. From the obtained results it is possible to observe that buildings A (“Edificio Neogotico”) and B (“Cascina Lobbia e Ghiacciaia”) are ranked in the first and in the second position, respectively, for all the experts involved in the decision process.

Moreover, mention has to be made to the fact that building G (“Cascinone”) is classified as the worst alternative among the considered ones for all the experts that participated in the process. In the same way, also alternative H (“Cascina Peppinella”) has a very bad overall performance according to the involved experts and is thus always classified in the ninth position of the final ranking.

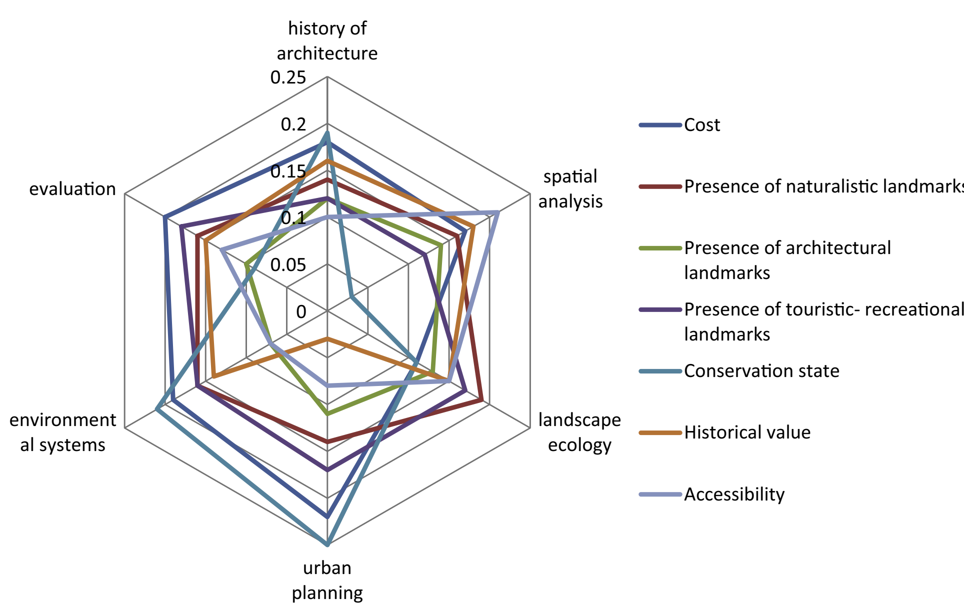


Fig. 6. Schematic representation of the different perspectives of the experts on the criteria weights.

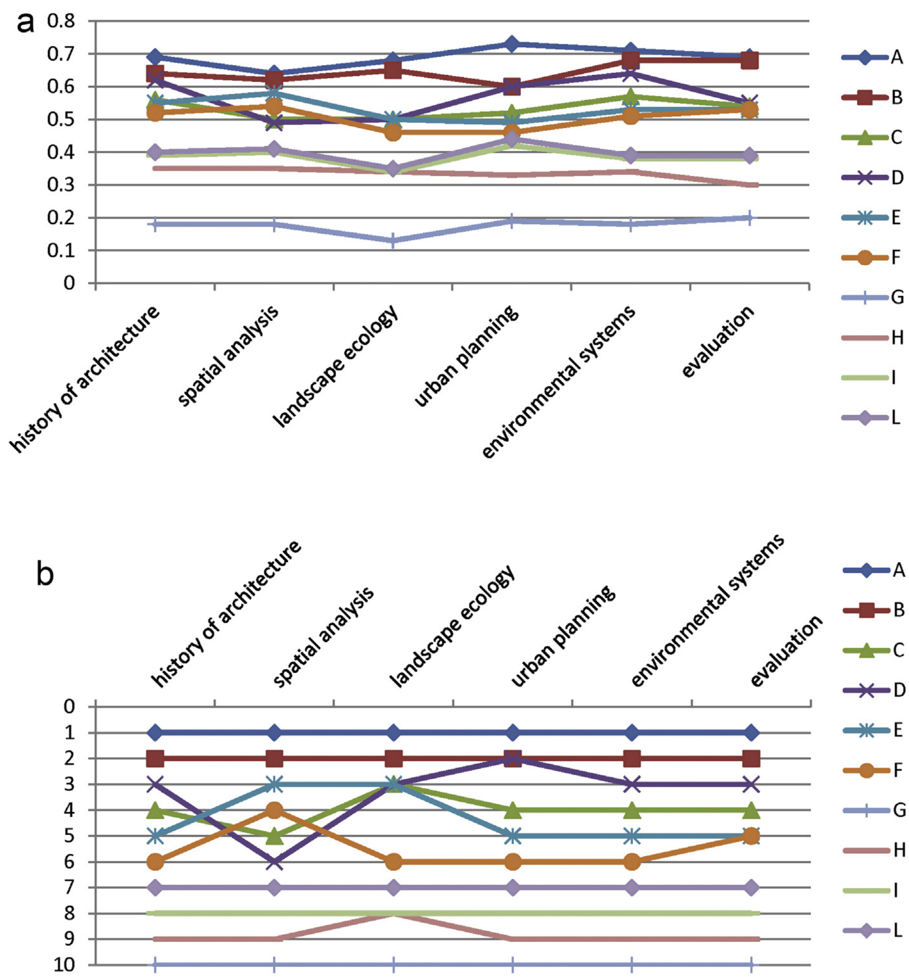


Fig. 7. Overall value (a) and ranking (b) of the alternatives for the different experts.

5. Discussion and conclusions

Well-functioning ecological systems and the protection and enhancement of cultural and natural heritage are important conditions for long-term sustainable development.

The present paper presented an integrated framework able to support the decision-making and planning process related to a complex environmental system.

The aim of this section is to shed some light on the overall evaluation process through the analysis of the notes and feedback received during the focus group sessions in order to provide guidelines for policy design and further developments.

The first type of consideration that emerged from the experts participating in the focus group concerned the opportunity of developing further analysis of some of the attributes in order to improve their significance. In particular, they suggested that future developments of the study could try to perfect the current measure of the attribute "historical value" (i.e. the year of construction) by adding information on the presence of historical highlights/constraints for similar types of buildings, if present. This will allow a more comprehensive and faithful evaluation of the value of each building.

In a similar way, the experts suggested that it could be interesting to try to perfect the current measure of the attributes related to the different types of landmarks, which is presently based only on the quantity of landmarks, by adding information on the quality of the landmarks themselves (i.e. hectares of naturalistic landmarks or architectural quality of the buildings).

A second type of consideration that emerged from the focus group concerned the subjectivity in the evaluation of the "accessibility" attribute. In our case, the walking distance to be covered inside the park to reach the buildings has been considered as a criterion to be maximized (i.e. the longer the distance to be covered, the more pleasant the recreational experience) but not all the potential end-users will agree on this approach.

To this end, future developments of the present research will investigate how the interaction and dialogue with heritage users influences the management of heritage and its environment, by understanding the meanings that cultural heritage (e.g. landscapes, sites, buildings and artifacts) holds for people and how they perceive, use and interpret it.

In particular, people from different age groups and with different backgrounds will be considered in the survey in order to obtain a set of preferences at the community level.

Another point worthy of discussion is that, even if the experts had different concerns about the relative importance of the attributes (Table 5), they came to very similar final rankings. In fact, buildings A and B are the best alternatives according to all the set of weights while buildings G and H rank last in all the cases considered.

In this context it is important to underline that, by structuring the decision process as an iterative process, the discussion with the experts during the focus group provided useful insights for the definition of the attributes and the subsequent preference elicitation phase. In particular, bringing together experts from different disciplines allowed for a preliminary screening of the attributes identified and for more detailed information on the characteristics of the relevant ones.

A vital role was played in this case by the facilitator/analyst in order to ensure that all the experts had the same understanding of the attributes under consideration and that they were able to cope with the cognitive burden associated with the elicitation pro-tocol. In particular, a facilitated modeling approach [26] was used and the entire process (i.e. definition of the nature of the problem under analysis, evaluation of priorities and development of plans for subsequent implementation) was defined together with experts and local actors.

Moreover, the framework developed (Fig. 1) is based on a transparent process that allows for a versatile and case specific use. One of the greatest advantages of the method is that it provides a structured approach to addressing the problem by using both qualitative and quantitative data. Another significant advantage is that it is simple in application and does not require sophisticated software.

On the other hand, future research will be required to design innovative and user friendly questioning protocols. Such improvements are expected to increase the use of MAVT in policy decisions.

Moreover, future developments of the present study also refer to the investigation of the contribution that robustness analysis could give to the results obtained so far. As a matter of fact, one of the new interesting challenges for decision aiding consists in the provision of robust recommendations [27]. Besides taking into account uncertainties and/or imprecision as usually done in sensitivity analysis, recent international trends propose the use of argumentation theory [28] to investigate if and how recommendations hold against counter-arguments used in order to invalidate them. Indeed, robust recommendations need to be accompanied by explanations and justifications preventing such cases.

Finally, it is important to acknowledge that the present contribution dealt with the development of an inclusive Decision Support System based on expert participation. This strategy has been partic-ularly effective for the preliminary analysis of the decision-making problem where specific expertise areas are required in order to properly evaluate the performance of the alternatives. Neverthe-less, given the current trend to democratize planning, the use of participatory or collaborative planning methods is encouraged once the set of suitable alternatives has been refined to the feasible ones. To this end, the integration of GIS and Multicriteria Decision Analysis capabilities into the Web platform offers an effective Mul-ticriteria Spatial Decision Support System with which to involve stakeholders and other groups in the evaluation process [29].

In terms of scientific contribution, the framework developed offers a creative way of combining decision-making support and spatial analysis through an approach that integrates Multicriteria Decision Aiding and spatial SWOT analysis, in order to provide a systematic means of analysis of the strengths and vulnerabilities of complex environmental systems.

In synthesis, the study offers an effective tool that could be used to address two main concerns: (i) to gain an understanding of the most important elements in the context of natural and historical heritage requalification strategies and (ii) to support the choices of public authorities with reference to strategic planning processes for complex, multi-value systems.

In conclusion, the proposed evaluation framework seems a very promising line of research in the field of integrated cultural and natural heritage management.

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