

Conflicting Values in Designing Adaptive Reuse for Cultural Heritage. A Case Study of Social Multicriteria Evaluation

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Abstract. Over the past two decades the Council of Europe has addressed cultural heritage preservation policies to the use of heritage as cultural capital. Given this definition, the conservation of cultural capital is crucial, for its intrinsic value and as an investment for cultural, social and economic development. Thus, principles and areas of actions have been defined with the aim of underlying the importance of cultural values for territorial identity. Especially for cultural heritage with a potential for tourism, the decisions about valorization interventions are not always consensual, given the coexistence of different instances from local inhabitants and tourists. Selecting among the potential uses the one that could ensure the preservation of physical characters as well as intangible values, fueling economic development, is still a challenging policy and design issue. In this context, this paper proposes the use of a multi-methodological approach based on Choice Experiments and Social Multicriteria Evaluation to support the adaptive reuse on real case study. The NAIADE approach has allowed the decision maker to consider both socio-economic and technical dimensions within the same evaluation framework.

Keywords: Cultural heritage conservation · Stakeholders analysis · NAIADE · Valle d'aosta castles · Adaptive reuse

1 Introduction

Decisions problems about cultural heritage enhancement and conservation are generally complex and ill-structured, given their multidimensional nature and the large set of values they represent. Since the late 90 s, the European Council has encouraged a wider understanding of heritage and its relationship to communities and society. There are several documents, conferences and consultations that prove this long and intense debate. Cultural heritage is considered as a crucial resource for the integration of the different dimensions of development (i.e. cultural, ecological, economic, social and political). Furthermore, it contributes to the protection of cultural diversity and sense of place in the face of growing globalization and to develop dialogue, democratic debate and openness between cultures [1].

According to this premise, the decisions about what and how to conserve for representing us and our past to future generations should be based not only on a deep knowledge of the cultural heritages and their potential, but also on the recognition of the meanings and uses that society attaches to them. As a consequence, over the past two decades, the theoretical and methodological advancements in the field of cultural heritage evaluation have pointed out some crucial issues: (1) the monetary value of cultural heritage is a crucial instance for cultural policy as markets concerning heritage are not able to reflect the value users and society attach to the cultural goods [2]; (2) the allocation of public resources requires legitimation, transparency and efficiency; (3) the achievement of a balance among goal and instrumental values is still a challenging decision problem, especially for touristic sites; (4) the use of stated preference techniques for estimating the extent of collective willingness to pay for intangibles benefits; (5) the relevance of including several categories of stakeholders into the evaluation processes, starting from the modeling phase of the decision problem [3].

Moreover, the conceptual concurrence among sustainable development paradigm and cultural heritage policies [4] has led relevant changes by introducing innovative preservation practices. The idea of adaptive reuse of cultural heritage [5, 6] into accessible and usable places, by respecting tangible and intangible values, seems to be an increasingly promising strategy for achieving a balance among different instances such as: the preservation of existing buildings involving minimal changes consistent to new uses' requirements; the retention of the symbolic values of historical buildings; the achievement of sustainability principles; the community engagement; the enhancement territorial development processes. The adaptive reuse approach requires to respect the building's heritage significance and add a contemporary layer that provides value for the future [7–9]. Thus, the choice about the highest and best adaptive reuse intervention should be supported by adaptive analytical tools, able to consider subsequent feedbacks both from technical and social side during the evaluation processes. For this purpose, Social Multicriteria Evaluation (SMCE) [10–13] seems to be the most adequate theoretical framework for supporting public policies in multi-values and complex decision contexts, where several and often conflictual are the interests at stake, but all legitimate. The paper proposes an application of the SMCE for defining the most consensual adaptive reuse of a castle located in Val d'Aosta (Northern Italy).

More in deep, after the introduction the rest of the paper is divided into 3 main sections: the second section illustrates the methodological background use for solving the decision problem, focusing more on the use of Social Multicriteria Evaluation and on the NAIADÉ approach; the third describes the application of abovementioned methodology on a real world case; the last one discusses the results and proposes future research lines.

2 Methodological Background

For addressing the complexity of the decision problem in exam, an integrated evaluation framework has been implemented in the present study. In particular, the

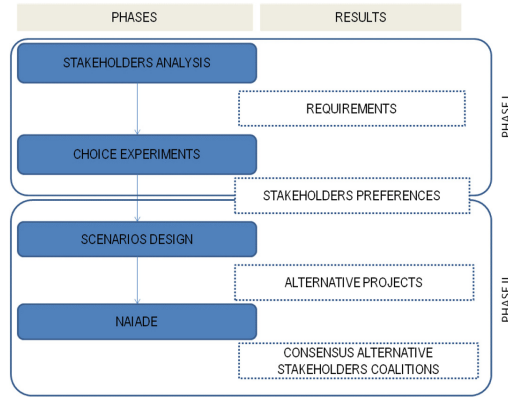


Fig. 1. The integrated evaluation framework

framework is structured according to a multi-methodological approach that has been organized in two main phases (Fig. 1):

- (1) The first phase, which is based on the application of the Choice Experiment technique [14–16] aims at designing a set of alternative projects for the reuse of the castles;
- (2) The second phase, which is based on the development of the Social Multi-Criteria Evaluation [10], is finalized at selecting the best performing alternative paying particular attention to the social actors involved in the decision problem.

With particular reference to the first phase of the proposed framework, an expert panel was organized in order to better define the decision problem. The expert panel also allowed to formulate the relevant attributes to be considered in the evaluation model and to set the proper levels for the related attributes. The attributes and levels thus defined were used for structuring the experimental design for the application of the CE method [17]. As a result of this evaluation, a set of information has been provided able to structure the generation of alternative reuse projects. These alternatives will be presented in detail in Sect. 3.2 of the present paper.

The present paper focuses on the illustration of the second phase of the aforementioned integrated method, which is related to the application of the SMCE. In particular, the NAIAD (Novel Approach to Imprecise Assessment and Decision Environments) has been considered in the research for performing a technical evaluation of the given set of alternatives and for carrying out a social analysis that allows a consensus alternative to be found and final recommendations to be formulated.

2.1 NAIAD

NAIAD (Novel Approach to Imprecise Assessment and Decision Environments) is based on the Social Multicriteria Evaluation approach that was developed by Munda [18, 10] as a useful framework for the application of social choice to complex political

problems with the aim of introducing political constrains, interests groups and collusion effects. Since its definition by Munda [18] many applications exist of NAIADÉ, namely in the context of territorial and environmental conflict management. Given the growing awareness about environmental resources' scarcity, environmental management decision problems are usually characterized by conflicts between different groups and

Table 1. Literature review on Social Multicriteria Evaluation and NAIADÉ from Scopus database with a focus on the decision problem.

[-]	Authors	Year	Decision problem	NAIADÉ
[19]	Scuderi, A., Sturiale, L.	2016	Phytopsanitary emergencies	V
[20]	Della Spina, L., Ventura, C., Viglianisi, A.	2016	Urban Planning Policy	
[21]	Walter, M., Latorre, T.S., Munda, G., Larrea, C.	2016	Mining extraction development	V
[22]	Torre, C.M., Morano, P., Taiani, F.	2015	Urban Planning Policy	
[23]	Kolinjivadi, V., Gamboa, G., Adamowski, J., Kosoy, N.	2015	Water management	V
[24]	Etxano, I., Garmendia, E., Pascual, U., Hoyos, D., Díez, M.Á., Cadiñanos, J.A., Lozano, P.J.	2015	Protected areas management	
[25]	Gomes, L.F.A.M., De Mattos Fernandes, J.E., De Mello, J.C.C.B.S.	2014	Aircraft selection	V
[26]	Nicolini, E., Pinto, M.R.	2013	Urban Planning	V
[27]	Cerreta, M., Rosa, F., Palma, M., Inglese, P., Poli, G.	2013	Water management	
[28]	De Mello, J.C.C.B.S., Fernandes, J.E.M., Gomes, L.F.A.M.	2012	Aircraft selection	V
[29]	Garmendia, E., Gamboa, G.	2012	Natural resource management	V
[30]	Monterroso, I., Binimelis, R., Rodríguez-Labajos, B.	2011	Ecosystem management	V
[31]	Oikonomou, V., Dimitrakopoulos, P.G., Troumbis, A.Y.	2011	Protected areas management	V
[32]	Cerreta, M., De Toro, P.	2010	Strategic Environmental Assessment	
[33]	Naidu, S., Sawhney, R., Dhingra, R., Knickerbocker, C.	2010	Nanotechnology development	V
[34]	Browne, D., O'Regan, B., Moles, R.	2010	Energy policy	V
[35]	Garmendia, E., Gamboa, G., Franco, J., Garmendia, J.M., Liria, P., Olazabal, M.	2010	Integrated Coastal Zone Management	V
[36]	Turón, A., Aguarón, J., Escobar, M.T., Gallardo, C., Moreno-Jiménez, J.M., Salazar, J.L.	2010	Public policy	

(continued)

Table 1. (continued)

[-]	Authors	Year	Decision problem	NAIADE
[37]	Montrone, S., Perchinunno, P., Di Giuro, A., Rotondo, F., Torre, C.M.	2009	Urban Planning	
[38]	Siciliano, G.	2009	Farming system management	V
[39]	Shmelev, S.E., Rodriguez-Labajos, B.	2009	Sustainability assessment	V
[40]	Zabala, A.	2009	Transport Policy	V
[41]	Munda, G.	2009	Sustainability Policy	
[42]	Ramirez, A., Hagedoorn, S., Kramers, L., Wildenborg, T., Hendriks, C.	2009	Environmental management	V
[43]	Buchholz, T., Rametsteiner, E., Volk, T.A., Luzadis, V.A.	2009	Energy system design	V
[44]	Munda, G., Russi, D.	2008	Rural renewable-energy policy	V
[45]	Kain, J.-H., Söderberg, H.	2008	Knowledge management	V
[46]	Benetto, E., Dujet, C., Rousseaux, P.	2008	Life Cycle Assessment	V
[47]	Tangari, L., Ottomanelli, M., Sassanelli, D.	2008	Transport Policy	V
[48]	Dinca, C., Badea, A., Rousseaux, P., Apostol, T.	2007	Energy policy	V
[49]	Gamboa, G., Munda, G.	2007	Energy policy	V
[50]	Gamboa, G.	2006	Environmental management	V
[51]	Munda, G.	2006	Sustainability management	V
[52]	Wenzel, V.	2005	Water management	V
[53]	Brand, C., Mattarelli, M., Moon, D., Wolfler, C. R.	2002	Transport Policy	V

competing values and interests they hold. Despite cultural heritage represent a resource often subjected to conflictual uses, the overview of NAIADE literature show that it has been still used in this decision domain (See Table 1).

The method implies two types of evaluations:

- a technical evaluation, that is based on the score values assigned to the criteria of each alternative and is performed using an impact matrix (alternatives vs criteria).

In this case the ultimate output given by NAIADE is the alternatives ranking according to set of criteria preferences;

- a social evaluation that analyses conflicts among the different interest groups and, through an equity matrix, which provides a linguistic evaluation of alternatives by each group, studies the possible formation of coalitions among different stakeholders.

The methodology follows these steps: (i) construction of the impact matrix; (ii) pairwise comparison by means of preference relationships. Indifference and preference thresholds have to be defined for this task; (iii) criteria aggregation procedure. NAIADE uses the number of criteria in favor of each alternative instead of another and the intensity of preference; (iv) obtaining the ranking of alternative; (v) performing the coalition formation analysis; (vi) looking for the compromise choice.

The aforementioned steps will be described in detail in the remaining part of the present paper with reference to the application of the NAIADE approach to the case study of the Valle d’Aosta Castles.

3 Case Study

3.1 The Val D’Aosta Castles Between Tourism and Local Communities

In this study the multi-methodological evaluation has been applied to a group of three castles owned and managed by the Regional government in Valle d’Aosta. Consistently to the idea of bringing cultural heritage back to local communities, the Regional Government has enhanced a cultural policy based on the notion of “Restitution” policy [54, 55]. Given the growing reduction of financial resources, the reuse of the abandoned castles becomes an opportunity for fostering economic development whilst improving the quality of life of inhabitants. Among the 13 castles owned by the Region Valle d’Aosta, the study focuses on the Chateau Vallaise (Arnad), the Sant-Germain (Montjovet) and the Ussel castle (Châtillon). With respect to the analysis of intrinsic and positional features of the three castles under evaluation, their potential and alternative adaptive reuses have been defined.

Unless for the landscape quality, that is very high for all the three cases, the castles under evaluation show very different features in terms of state of preservation and age of construction, connections to the transport system, current use and seasonal openings, as well as of surroundings uses. This high variability calls for a specific conservation strategy based on their peculiar characteristics according to general adaptive reuse criteria, aimed at avoiding decay and abandonment of cultural heritage through the enhancement of economic and social resources whilst preserving the architectural object from an historical and cultural point of view. In addition, the assumption of an adaptive conservation approach addresses the choice of reversible and compatible functions that could play a key role for reinforcing local identity, traditions and practices.

In order to support the design of adaptive reuse alternatives, the main categories of stakeholders with different levels of interest/power regarding the castles have been considered and a requirement analysis has been developed with reference to a framework that takes together human based, technical-functional, business-corporate, regulatory-policy aspects (See Table 2).

3.2 Generation of the Alternatives

As stated by Munda and Gamboa [13], one of the main features of the Social Multi-criteria Evaluation framework is that alternatives are constructed considering information from several sources, for instance, the participatory process, technical interviews, and so on.

In the present application the alternative scenarios correspond to different adaptive reuse hypotheses that were elaborated making use of the preferences of tourists and residents as resulting from the application of the CE method (Fig. 2). More precisely, according to the CE findings the most preferred attributes were selected as fundamental elements to be considered in the design of the reuse project for the castles [17].

With reference to the Arnad castle, the alternative scenarios considered for the reuse will be illustrated in the remaining part of the present section.

3.2.1 Scenario 1: Craft University

This scenario is mainly devoted to residents and it foresees the reuse of the spaces of the Arnad Castle as Crafts University. The idea is to offer study courses about the techniques of production of the local products and the regional eno-gastronomic culture. The most representative spaces of the castle, as the rooms containing the precious cycle of paintings, are designed as spaces for lectures, public meetings, and conferences. The area that revolves around the patio is used instead as a space for the display and sale of local products (food stands) while the eastern part of the castle will be dedicated laboratories and spaces aimed at food preparation.

3.2.2 Scenario 2: Food Commerce Activities

The second scenario is mainly targeted to residents and it aims to valorize the Valle d'Aosta culinary excellence by promoting a strong interaction between the castle and the productive and concerned social context of the region. The castle is conceived as a showcase for the local products and the enogastronomic culture of Valle d'Aosta.

The part of the castle interested by the presence of the pictorial cycle is designed as a flexible space, with rest rooms or lecture and conference halls. The patio is an open-air hall for tasting and selling activities. The east wing of the building hosts cook labs recipes and taste education labs or classrooms for food courses. This solution guarantees a good level of conservation of the castle's ancient structure in its most artistically valuable parts and a discrete level of multifunctionality in the most damaged areas, which present more possibilities of intervention.

3.2.3 Scenario 3: Museum and Temporary Exhibitions

This scenario takes into account the expectations of interviewed tourists, who have expressed the desire to preserve as much as possible the original structure of the castle. The rooms that revolve around the patio are designed as temporary exhibition spaces. The high flexibility of these spaces allows diversified uses (events, stands of local products, festivals, etc.). The eastern area of the castle includes didactic laboratories and a small library with attached storage space, always accessible to the public. In the rooms containing the painting cycle, a permanent museum will be created: this exhibition could be centred on the story of the castle and to the Region history and customs.

Table 2. Actors and requirements for adaptive reuse. The requirements have been divided into 4 classes according to Gershenson and Stauffer [56].

Actors/requirements	Human-based end-user			Technical functional				Business corporate				Regulatory Policy		
	Availability	Involvement	Attractiveness	Flexibility	Continuity with the architecture	Continuity with the surroundings	Complementarity in time	Complementarity in space	Conservation	Usability	Low investment	Economic feasibility	Complementarity in profitability	Safety regulations
Soprintendenza valle D'aosta region	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tourists	X		X						X					
Municipalities	X	X	X	X	X	X	X	X	X	X	X	X		
Tourism facilities	X		X				X		X					
Local producers	X	X	X		X	X	X	X	X					
Festival organizers	X	X	X		X	X	X	X	X					
Cultural associations	X	X	X		X	X	X		X					
Inhabitants	X	X	X	X	X	X	X	X	X					



Fig. 2. Alternatives reuse project for the Arnal Castle (1: Craft University; 2: Food commerce activities; 3: Museum and temporary exhibitions, 4: Interactive museum)

3.2.4 Scenario 4: Interactive Museum

This scenario is thought on the needs of a specific target of tourists such as schools, young and families. Internal and external spaces of the castle will address a teaching function through the application of digital tools and educational activities in which the visitors are protagonists. In such context, they will be able to assess traditional practices like producing foods or small objects with local techniques. For this purpose the west

wing of the building, including the patio, will house the interactive museum, while the east wing will be occupied by a dining area and a shop of local products. On the other hand, the top floor is managed as a space for laboratory activities or lectures.

This type of scenario allows reaching a good level of preservation, since the spaces of intervention can be set up without affecting permanently the structure of the castle.

3.3 Technical Evaluation

Before applying the NAIADÉ approach the Stakeholder Analysis has been deepened in order to explicit values and preferences and to define the set of criteria for comparing the four adaptive reuse scenarios.

In a social multicriteria domain, criteria are not given but they should be defined with respect to the role and the position of the stakeholder against the scenario under evaluation. Thus, a collaborative approach has been assumed and the key representatives of the Municipality of Arnad, where the castles under evaluation is located, has been involved in some brainstorming sessions for discussing and identifying the main objectives associated to the conservation decisions.

With help of a questionnaire, followed by a collective brainstorming, a set of quantitative and qualitative criteria have been defined that represent the experts' translation of stakeholders' expectations [13]. The Table 3 describes the stakeholders directly involved in the process of criteria definition, their position against the castles and their needs.

More in deep, the quantitative criteria are defined as follows: possibility of reusing the castle for a different function according to changes of environmental and social systems over time (*Flexibility*); presence of public spaces (*Public spaces*); events for inhabitants (*Events*); new installations and equipment required by the new function (*Invasivity*). The qualitative criteria include the following elements: the return of image for the municipality of Arnad (*Promotion*); accessibility to the castle (*Accessibility*); investment value (*Cost*); population's needs met by the scenario (*Target*).

Each of the 4 scenarios has been evaluated according to this set of 8 criteria, as the Impact matrix shows (see Table 4) and a first technical ranking has been obtained from the application of the NAIADÉ method (see Fig. 3). As it possible to see, the most preferred alternative from a technical point of view is the Museum and temporary exhibition (3), followed by the Crafts university (1), the Interactive museum (4) and finally the Food commerce activities (2).

3.4 Social Evaluation

According to the NAIADÉ approach a second matrix has to be defined and it is represented by the Social Impact Matrix, which is shaped upon the evaluation expressed by each stakeholder by the use of a questionnaire (See Table 5). Differently from the Impact Matrix, that is a technical translation independent from stakeholders' preferences, by the Social or Equity Matrix social actors are allowed to evaluate each alternative using linguistic variables, that are variables whose values are words or

Table 3. Actors, needs and criteria

Actors	Scale of action	Position regarding the castel	Criteria	Needs and expectations
Soprintendenza	Local - Regional	Flexibility of spaces and functions	Flexibility	*possibility of reusing the castle for different functions in the future, according to the changes of the economic and social system over time
		Invasivity control to guarantee cultural heritage adaptive reuse	Invasivity	*reducing the number and dimension of the new installations
			Tradition	* strenghtening local traditions
Arnad Public administration	Local	Public spaces and promotion in order to give back the castle to citiziens	Public Spaces	*improving presence of places always open to the public
			Attraction of new Inhabitants	*increasing the number of new inhabitants and related services
Tourism & Trading Sector	National - International	Events availability, for both tourists and residents	Events	*increasing the possibility to organise events for the town
		Consideration about the Accessibility	Accessibility	*control the amount of people who can access the structure
Experts	National	Consideration about the Targets	Targets	*enlarging the population categories the project refers to
		Consideration about the Costs	Cost	improving investment and economic return
Industry Sector	Local	Promotion of events	Promotion	*reinforcing the return of image for the town of Arnad and strengthening of the castle system
		Flexibility in the duration of the work	Timing	*minimizing the period of realization
Inhabitants	Local	Events	Small scale events	*achievement of population needs rather than of tourists needs
		Consideration of new job opportunities	Social sustainability	*creation of career opportunities and new job positions

Table 4. Impact matrix

Alternatives/Criteria	1	2	3	4
Flexibility	1115	956	1449	1294
Promotion	Very Good	Very Good	More or Less Good	Good
Accessibility	Moderate	Very Good	Good	Very Good
Public spaces	571	571	536	156
Cost	More or Less Good	Moderate	More or Less Bad	Moderate
Events	319	319	910	762
Invasivity	250	661	0	323
Target	More or Less Good	Good	Very Good	Moderate

sentences. Generally speaking, linguistic variables are very useful for characterizing phenomena which are too complex or too-ill defined to be suitable for a description in quantitative terms and they are natural representation of cognitive observations [12]. Fuzzy set theory [57] provides a framework for developing approximate calculus of linguistic variables. In fact, it has been generally agreed that representing observation by means of linguistic variables requires a less complicated transformation with respect to a numerical transformation, thus ensuring less distortion in the evaluation procedure. In the case under investigation, following the NAIADe methodology [12], a multi-level scale has been used for the evaluation of the alternatives, where 11 linguistic judgments were considered: perfect, very good, good, more or less good, moderate, more or less bad, bad, very bad, extremely bad.

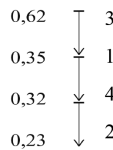


Fig. 3. Technical ranking.

Starting from the social matrix, distributional issues can be taken into consideration. In particular, for each pair of interest groups i and j , by using a distance function d_{ij} as conflict indicator, a similarity matrix $s_{ij} = 1/(1+d_{ij})$ can be constructed for all possible pairs of groups, so that a clustering procedure is meaningful. By applying this procedure to the social impact matrix, a coalition dendrogram can be obtained (Fig. 4).

The graph helps visualizing the actors’ goals proximity, as in the case of the first coalition: Tourism & Trade sector (G3) and Local Community (G5), whose credibility is very high (0.8051). G3 interests are also shared the municipality of Arnad (G2) and the Soprintendenza (G1), whose preferences focus on the same alternatives (credibility index: 0.79). On the other hand, the Industry sector (G6) and the Experts (G) show a medium high degree of credibility but a major distance. They both target the same objective: improve local economy and costs by preferring the scenario 1 and 2.

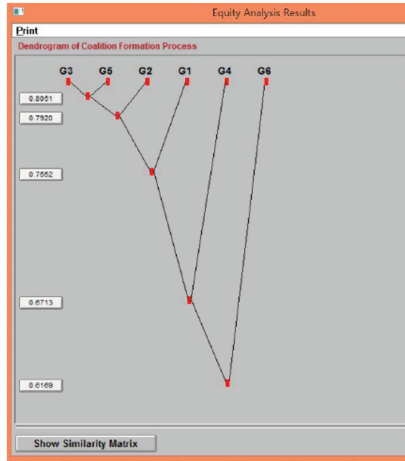


Fig. 4. Dendrogram of coalitions (G1: Soprintendenza, G2 Municipality of Arnad, G3: Tourism & Trade sector, G4: Experts, G5: Local Community, G6: Industries)

Table 5. Social impact matrix.

Actors/Alternatives	1	2	3	4
Soprintendenza	Good	Moderate	Very Good	More or Less Good
Arnad Public Administration	More or Less Bad	Good	Very Good	Very Good
Tourism & Trading Sector	Moderate	More or Less Good	Very Good	Good
Experts	Very Good	Moderate	Moderate	Good
Inhabitants	Moderate	Moderate	Very Good	Good
Industry Sector	Good	Good	More or Less Bad	More or Less Bad

4 Results and Discussion

In the light of the results of the NAIAD application it is possible to state that from a technical point of view (Table 3), the best performing solution is scenario 3, followed by scenarios 1 and 4 and finally by scenario 2. From the point of view of the social conflict analysis (Table 5), it seems that scenarios 1 is the alternative that generates maximum conflict as it is not well appreciated from the coalition of actors G3 (Tourism & Trade sector), G5 (Local community) and G2 (Arnad Public Administration) that has an high level of credibility (0.79). Moreover, it is also possible to notice that scenario 2 is not appreciated from the most part of social actors while scenarios 3 and 4 are ranked in a medium-high position from many considered stakeholders.

In synthesis, it seems correct to state that scenario 3 is the most defensible project both from a technical and from a social point of view, while the other scenarios maximize social conflict (scenarios 1 and 2) or are not well performing from a technical point of view (scenario 4).

5 Conclusions

The research proposed an integrated framework for supporting the decision making process related to the requalification of historic assets in Valle d'Aosta Region (Italy). In particular, in the study the NAIADE method has been developed for the selection of the best re-use project for the castle of Arnad.

In a decisional arena characterized by a plurality of stakeholders with different legitimate values and objectives attached to cultural heritage, the method proved to be able to consider different technical criteria and the opinions of the involved actors.

One of the main strengths of the proposed approach is the possibility of structuring the evaluation not as 'one-shot activity', rather as a social learning process where DM and stakeholders learn about the problems while they are solving them. Moreover, the method allows a common knowledge for DM, local communities and tourists to be created, thus ensuring the strengthening of the social capital.

Despite the strengths of the approach and the coherence of the obtained results, a number of future perspectives for the present study can be envisaged.

To start with, it would be interesting to explore the definition of an interaction protocol for defining actors' values and for filling in the social impact matrix in a more rigorous way.

Secondly, from the point of view of the exploitation of the results, future work could be done for exploring alternative methods, such as the use Threshold model proposed by Gamboa and Munda [13] for the aggregation of criterion scores of alternatives.

Thirdly, more research could be done in the examination of technical and social rankings proposed by the NAIADE method; in particular, it would be interesting to explore a more formal interaction among the two rankings that at the moment are compared and interpreted only from a qualitative point of view.

Finally, future research could consider the development of specific sensitivity on the technical ranking and on the credibility degrees of the coalitions in order to verify the model and the obtained results and to formulate more robust recommendations for the DM.

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