How to Support Strategic Decisions in Territorial Transformation Processes

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INTRODUCTION

Problems related to territorial planning and environmental decision-making are intrinsically complex because they involve multiple attributes which are defined by subjective elements (Marttunen and Hamalainen, 1995).

Projects, plans and programmes are subject to specific evaluation procedures, which aim at assessing the overall sustainability of the proposed solutions. In this context, mention can be made to the Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA), which are defined at the European level by the Directives 2014/52/EC and 2001/42/EC, respectively. Both EIA and SEA over time have increasingly considered not only the environmental effects of plans and projects, but also social and economic effects. In this context, it has been noticed that neither an economic reductionism nor an ecological one is possible (Munda, 2005). Since in general, economic sustainability has an ecological cost and ecological sustainability has an economic cost, an integrative evaluation framework is needed for tackling sustainability issues properly.

When speaking about sustainability in territorial planning, decision making requires consideration of trade-offs between many objectives: factors that range from the reduction of soil consumption to the optimization of the use of environmental resources, from the promotion of economic activities to the requalification of downgraded urban areas, from the endorsement of energy efficiency to the rationalization of transport systems.

To help addressing these problems, the use of Multiple Criteria Decision Analysis (MCDA) (Roy & Bouyssou, 1993; Figueira et al., 2005) has gained attention in the last years.

This paper considers the problem of sustainability assessment in territorial planning projects using the Multi Attribute Value Theory (MAVT) (Keeney & Raiffa, 1976), a particular kind of MCDA method.

Starting from a real case concerning the transformation of an urban area in the city of Torino (Italy), the aim of the paper is to explore the contribution of MAVT for planning decision making processes. In the application, several alternative projects are evaluated on the basis of different criteria and attributes, such availability of services, urban regeneration, acoustic emissions, land consumption and so on. In the result of this approach a ranking of sustainable alternative solutions is provided.

Strategic Environmental Assessment of Projects, Plans and Programmes

Assessing territorial transformation scenarios is normally addressed through the sustainable development paradigm. Sustainable development has been defined by the Brundtland Commission (Brundtland, 1987) as the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". As argued by Pope et al. (2004), the theory of sustainability assessment as currently expressed in the literature has largely evolved from work undertaken by practitioners of Environmental Impact Assessment (EIA), and more recently Strategic Environmental Assessment (SEA), which in turn has been influenced by policy analysis techniques (Sheate et al., 2001; Partidario & Coutinho, 2011).

Particularly, SEA is a policy instrument which has been developed since the 1980s as a means to influence strategic decision-making in policies, plans or programmes (PPP) of public bodies or responsible authorities (Partidario, 1999).

SEA aims at supporting Decision Makers to integrate environmental and sustainability considerations into strategic actions; moreover, the procedure is finalized to enhance environmental protection and to promote public participation in decision-making processes, thus increasing transparency of decisions (Therivel, 2004).

The SEA procedure is defined by the European Directive 42/2001 and is articulated in different subsequent phases. The first step concerns the Screening process, where it is necessary to clarify if SEA is necessary for the PPP under investigation. The second step regards the Scoping phase, which aims at explaining the environmental objectives of the PPP, the issues that should be discussed in the assessment and the methods that should be applied. The third step is related to the Environmental Assessment, where it is necessary to evaluate the magnitude of the impact, to define appropriate mitigation measures and to organize the monitoring programme. The fourth step consists in the Review process that aims at verifying that all the relevant issues, including alternatives, have been discussed in the evaluation. The fifth step is related to the Monitoring phase, which discusses the implementation of the PPP. The sixth step concerns the Consultation and Participation procedures and finally the last step is related to the Decision, where it is necessary to clarify if the SEA has been integrated into the planning process and how the evaluation procedure has been carried out in the overall decision-making process.

METHODOLOGICAL BACKGROUND

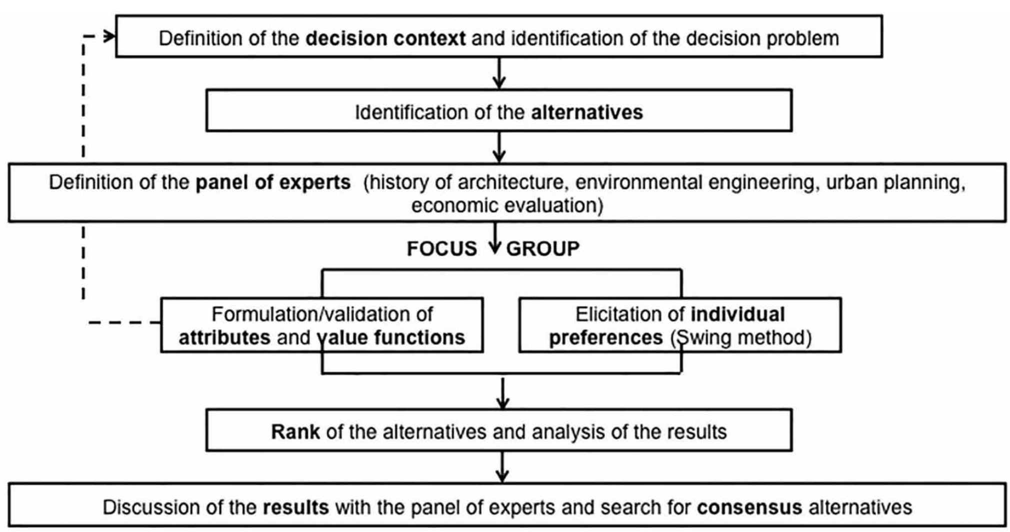
The Multi-Attribute Value Theory (MAVT) (Keeney & Raiffa, 1976) is a specific MCDA technique that can be used to address problems involving a finite and discrete set of alternative options that have to be evaluated on the basis of conflicting objectives. By being able to handle quantitative as well as qualitative data, MAVT plays a very crucial role in the field of environmental decision-making where many aspects are often intangible. Moreover, decision-making in this context is often 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 multi-perspective decision process to be followed to build a MAVT model can be described as shown in Figure 1.

In particular, the first steps are very crucial since they are concerned with the articulation of the decision context and the definition of the problem. This implies defining and structuring the fundamental objectives and related attributes.

Objectives are "statements of something that one desires to achieve" (Keeney, 1992) and they depend on the problem to be analysed, on the actors involved in the decision process, and on the environment in which the decision process takes place. The degree to which objectives are achieved is measured through a set of attributes, which may be natural (they follow directly from the definition of the objective), constructed (they specify a finite number of degrees to

Figure 1. Methodological steps for the development of a MAVT model making use of an experts' panel in territorial transformations decision processes



which objectives are met), and proxy (they are only indirectly linked to the definition of the objective) (Keeney, 1992; Beinat, 1997).

The second step consists in the identification and creation of alternative options.

The alternatives are 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 (Montibeller & Franco, 2007). Once the alternative options have been identified, it is necessary to assign scores for each alternative in terms of each attribute.

The performances of each alternative specify for each attribute the outcome of the alternative. In some cases, the performances are readily available, in some other cases they have to be computed or estimated ad hoc for the problem at hand.

The next step might consist in the definition of a panel of experts for the development of the evaluation. The use of experts' panels expands the knowledge basis 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 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 (Beinat, 1997).

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 can provide useful insights for the definition of the attributes and the subsequent preference elicitation phase. In particular, bringing together experts from different disciplines allows to perform a preliminary screening of the identified attributes and to better detail the characteristics of the relevant ones (Ferretti et al., 2014).

The following step consists in the modelling of preferences and value trade-offs and different strategies are available for this task. The holistic scaling and the decomposed scaling strategies are the most used in practice (Beinat, 1997). According to the former, an overall value judgment has to be expressed of multi-attribute profiles, which can be either the real alternatives or artificially designed profiles. Weights (i.e. scaling constants) and marginal value functions (which translate the performances of the alternatives into a value score representing the degree to which a decision objective is achieved) are then estimated through optimal fitting techniques (e.g. regression analysis or linear optimisation) and are the best representation of the assessor's judgments. According instead to the decomposed scaling technique, the multi-attribute value function is broken down into simpler sub-tasks (the marginal value functions and the weights) which are assessed separately. The aim of decomposed scaling is to construct the multi-attribute model for evaluating decision alternatives while the aim of holistic scaling is to make an inference about the underlying value functions and weights (Beinat, 1997). The case study illustrated in the present paper will follow the decomposed scaling approach.

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 (Belton & Stewart, 2002) as it is represented in Equation (1):

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

where V(a) is the overall value of alternative a, $v_i(a_i)$ is the single attribute value function reflecting alternative a's performance on attribute i, and w_i is the weight assigned to reflect the 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 further discussed with the Decision Makers and stakeholders.

APPLICATION

Description of the Area and Presentation of the Alternatives

The case study that has been considered for the present application refers to the transformation of an urban area in the city of Torino (Italy). The area is located in a strategic zone of the city, close to the train station, the University campus and the most important executive headquarters buildings (Figure 2).

In spite of its strategic position and intrinsic value, the area represents nowadays an urban void and different transformation projects are under consideration. It has to be noticed that the evaluation procedure illustrated in the present paper was based on the SEA procedure, which has accompanied the formation of the land-use plan since the preliminary phases related to the definition of the strategy to be followed (Mondini, 2013). The three main alternative scenarios for the area are represented in Table 1.

The Decision Support Process

The decision support process that we decided to follow in the present application can be structured according to subsequent phases.

Figure 2. The area under examination

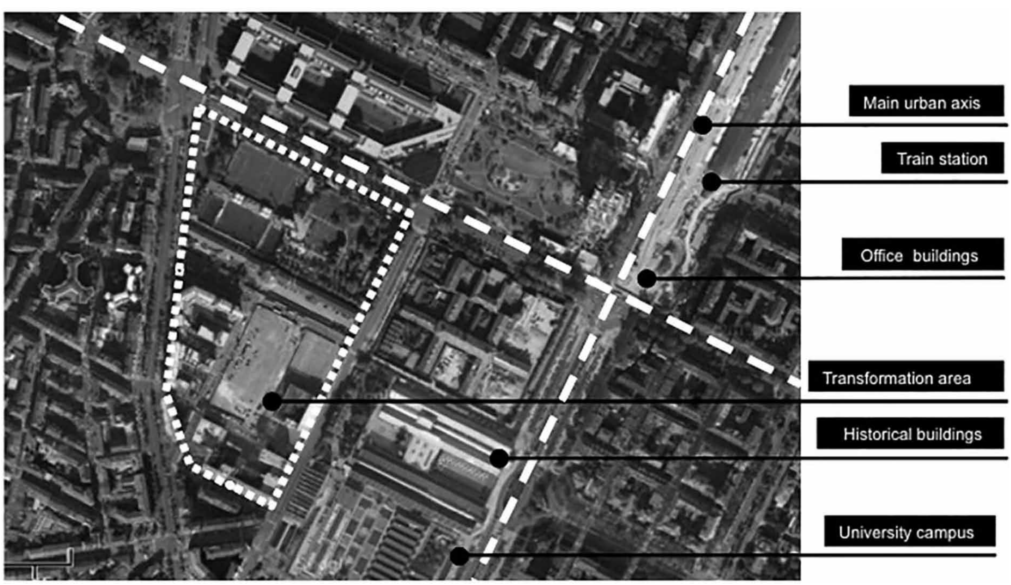


Table 1. Alternative scenarios for the transformation of the area

Scenario	Description
1. Conference centre	Following the recent trends of business tourism flows in the city of Torino, the main idea for the area is the construction of a large conference centre that now is missing. This scenario also includes the construction of different services, such as a luxury hotel, new commercial areas and university residences.
2. Conference centre and shopping mall	This scenario underpins the main ideas of the scenario 1 but it includes the construction of a shopping mall for providing commercial services to the area.
3. Urban park	This scenario considers to relocate the construction of the conference centre in another part of the city while the area under examination will be transformed in an urban park.

In particular, phase I of the proposed process consisted in the development of a stakeholder analysis (Dente, 2014) aiming at identifying the actors involved in the problem, as well as their values and objectives. Phase I informed phase II of the process as the system of identified objectives was used for the development of a Multicriteria Decision Analysis (MCDA, Figueira et al., 2005) aiming at the selection of the best scenario for the transformation of an urban area in Italy.

In this second phase, we started from the definition of the decision context and the identification of the real alternatives.

The next phase consisted in the definition of a panel of experts for the development of the evaluation. The use of experts' panels expands the knowledge basis and may serve to avoid the possible bias which characterizes the situation with a single expert. In our case, particular attention was dedicated to the panel composition in order to have it balanced (Ferretti et al, 2014). Therefore, we involved an historian, an expert in environmental engineering, a urban planner and an expert in the field of economic evaluation. In particular, we used decomposed scaling as explained by Beinat (1997) and thus marginal value functions and weights were assessed separately. The overall value model was then built by combining these parts through the additive combination.

With specific reference to the assessment of the scaling constants for all the attributes, we chose the Swing Weight approach because the discussion oriented towards value ranges seemed very promising in the context of urban projects. In particular, for the lower levels of the hierarchy (i.e. the attributes level), the evaluation has been performed by individual experts in their proper field of expertise; in this case, the experts have been involved in the compilation of a specific questionnaire which is based of the Swing method approach. For the higher levels of the hierarchy (i.e., the criteria level), a focus group has been organized in order to allow a discussion among the three experts to be carried on and a common set of weights to be found.

It is important to highlight that it has been an iterative process and that the discussion with the experts during the focus group provided useful insights for the definition of the attributes and their value functions. In particular, bringing together experts from different disciplines allowed to perform a preliminary screening of the proposed attributes and to better detail the characteristics of the relevant ones.

Development of a Stakeholders Analysis for the Definition of Objectives and Values

In public policy making the actors and their behaviors represent the core of any possible theoretical model (Dente, 2014; Boerboom and Ferretti, 2014). The actors are those individuals or organizations that make the actions able to influence the decisional outcomes and that do it because they pursue goals regarding the problem and its possible solution, or regarding their relations with other actors (Dente, 2014). The first, essential, step of a decision process to support public policies formulation thus consists in the identification of the actors and of their objectives (Dente, 2014).

Stakeholders are a specific subset of the actors, defined as those who can affect the realization of organizational goals or that can be affected by the realization of organizational goals (Liu & Du, 2014). Stakeholder analysis plays a very important role in strategic planning and sustainability assessment procedures since it allows to identify conflicting interest at an early stage of the process.

From a practical point of view, stakeholders' analysis is based on the identification and classification of stakeholder groups. Indeed, stakeholders have access to and can mobilize different types of resources (i.e. political, economic, legal and cognitive resources), they can be grouped into different categories (i.e. political actors, bureaucratic actors, special interests, general interests and experts) and they can have different roles (i.e. promoter, director, opposer, ally, mediator, gatekeeper and filter) (Dente, 2014).

In decision-making processes, stakeholders' analysis is thus a continuous and iterative procedure which involves the following subsequent steps:

1. Identification of all the relevant actors;
2. Documentation of actors' needs;
3. Analysis and assessment of actors influence/interest;
4. Management of actors' expectations;
5. Design of actions;
6. Revision of the status and repetition of the procedure.

The final aim of the analysis is to develop a strategic view of the human and institutional landscape, the relationships between the different actors and the issues they care about most.

Different techniques are available to analyze stakeholders and actors but, in the field of urban development projects, it is of particular importance to classify the different stakeholders based on the categories mentioned above (i.e. types of resources mobilized, type of actors, and type of roles).

To this end, Table 2 surveys the most relevant stakeholders for the decision problem under investigation, with specific reference to the level, the type of actors and the nature of the resources at stake.

The analysis shown in Table 2 generated knowledge about the actors involved in the process and their associated objectives and thus allowed to better structure the decision making process aiming at identifying the best performing solution for the area under analysis.

Structuring the Decision Problem

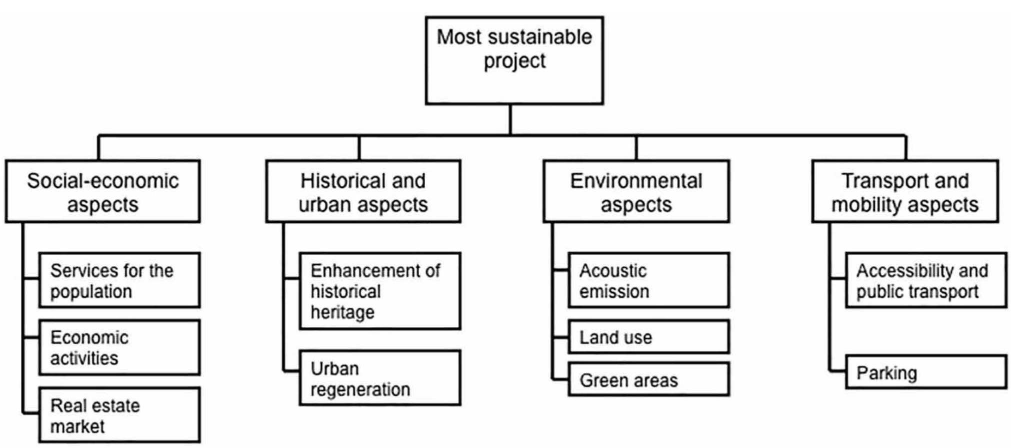
The aforementioned decision environment represents a complex system where the presence of interrelated elements and conflicting aspects suggests the use of a Multiple Criteria Decision Analysis that is able to provide a rational base for the systematic analysis of the alternative scenarios.

A set of measurable attributes has been identified for the evaluation of the alternatives and it has been organized according to the value tree approach (Figure 3). In this case we used a top down approach for structuring the value tree meaning that we started from eliciting the ultimate

Table 2. Most relevant stakeholders for the transformation of the urban area in Turin

Stakeholder	Level	Type of Actor	Resources
Piedmont Region	Regional	Political/ Bureaucratic	Political/ Legal
Cultural and historical heritage department	Regional	Bureaucratic	Cognitive/Legal
Turin Province	Provincial	Political/ Bureaucratic	Political/ Legal
Turin Municipality	Local	Political/Bureaucratic	Political/Legal
Turin Urban Centre	Local	Special interest	Cognitive
Environmental associations	Local	General interest	Cognitive
Bureau of Commerce	Local	General interest	Cognitive/ Economic
Developers	International /National/Local	Special interest	Economic
Citizens	Local	Special interest	Cognitive/ Economic
Economic activities	Local	Special interest	Economic
Tourists/ visitors	Local	Special interest	Cognitive/ Economic
Architects and planners	International /National/Local	Experts	Cognitive

Figure 3. The value tree for the decision problem under analysis



objective and climbed down, asking how this objective could be achieved and thus looking for attributes.

The main objective of our model is to determine the sustainability of the transformation scenarios for the area. To this end, 4 attributes have been considered that represent the main aspects of the decision problem. The first attribute refers to socio-economic elements of the area and takes into account the availability of services for the population, the presence of economic activities and the trends in real estate market. The second attribute considers the historical and urban factors, including the enhancement of the cultural heritage in the area and the urban requalification operations. The third attribute takes into account the environmental quality, considering the acoustic emission, the land consumption and the presence of green areas. Finally, the fourth attribute is related to transport and mobility aspects and considers the accessibility to the area by means of public transport and the creation of parking.

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. Table 3 describes the attributes used in the evaluation and the related value functions.

According to their performance, the three alternatives were evaluated with reference to each attribute and the evaluation is illustrated in Table 4.

Weighting and Aggregation

Once the alternatives have been evaluated, it is necessary to define the importance of the different attributes of the decision problem. In this case the Swing method has been used which explicitly incorporates the attribute ranges in the elicitation question. In particular, the method asks to value each improvement from the lowest to the highest level of each attribute (Montibeller & Franco, 2007) by using a reference state in which all attributes are at their worst level and asking the interviewee to assign points (e.g. in the range 0-100) to states in which one attribute at a time moves to the best state. The weights are then proportional to these values.

In this study the evaluation has been performed by a panel of experts with expertise in the field of hystory of architecture, environmental engineering, urban planning and economic evaluation, as previously described. As an example, Figure 4 shows the questionnaire they had to answer with reference to the first level attributes.

The overall set of weights resulting from the elicitation procedure is shown in Table 5. The single attribute value functions have then been aggregated using the obtained set of weights and additive assumptions to calculate the total value of the specific alternatives. In particular, the global weight has been calculated for each attribute through the following equation: global weight = normalized weight of attribute x normalized weight of criterion. The calculation developed in the case under investigation provides the final priorities represented in Table 5.

From the obtained priority list it is possible to notice that scenario 2 and scenario 1 have very similar performances and that their overall scores thus present negligible differences. In any case, scenario 2 is slightly preferred to scenario 1 and scenario 3 represents the least preferred option. These results highlight the need to further investigate the alternatives by developing a sensitivity analysis on both the weights of the attributes and the original scores of the alternatives.

After obtaining a ranking of the alternatives and despite the coherence obtained in the results, it was considered useful to perform a sensitivity analysis on the final outcome of the model. The sensitivity analysis is concerned with a “what if” kind of question to see if the final answer is stable when the inputs are changed. It is of special interest to see whether these changes modify the order of the alternatives.

Table 3. Elicitation of value functions for each attribute

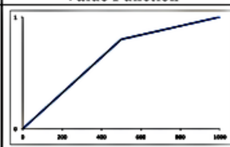
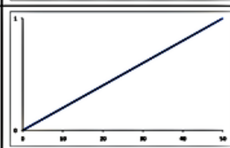
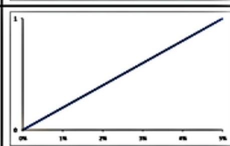
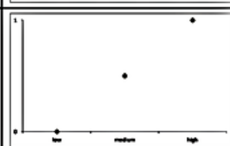
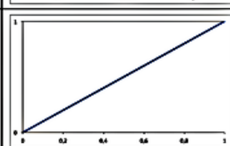
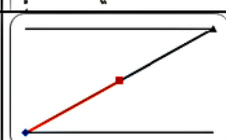
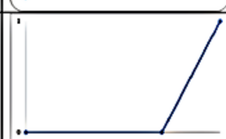
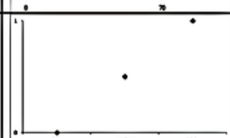
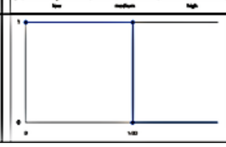
Indicator	Description	Value Function
1.1 Services for the population	Surface of commercial activities considered in the project (m^2)	
1.2 Economic activities	Number of jobs created by the project (n.)	
1.3 Real estate	Increase in real estate quotations of the zone (%)	
2.1 Enhancement of cultural heritage	Levels of enhancement (low, medium and high)	
2.2 Urban regeneration	Diversity index $H' = -\sum_{j=1}^{s} p_j \, log p_j$ where s is the total number of species and p_j is proportion of s made up of the jth species	
3.1 Acoustic emission	Noise level in the area under analysis after the project implementation	
3.2 Land use	Area subject to land reclamation measures (%)	
3.3 Green areas	Area left as green public area (%)	
4.1 Accessibility and public transport	Levels of accessibility (low, medium and high)	
4.2 Parking	Number of parking slots to be constructed (n.)	

Table 4. Evaluation of the alternatives

Indicators	Scenario 1	Scenario 2	Scenario 3
1.1	0,8	1	0
1.2	0,8	1	0
1.3	0,6	1	0
2.1	1	1	0
2.2	0,69	0,71	0
3.1	1	0	1
3.2	1	1	0,5
3.3	0	0	1
4.1	0,5	1	0
4.2	1	0	1

In the present study the sensitivity analysis has been performed with regards to the weights of the attributes. Particularly, the weight of one attribute at a time has been increased until 70% while the weights of the other three attributes have been maintained equal to 10%. The evaluation model has been run considering the new weights and the final priorities of the alternatives have been recalculated. Figure 5 represents the results of the performed sensitivity analysis. As it is possible to see, scenario 2 has the best performances in the considered sensitivity sets of weights while scenario 3 ranks worst in the most part of the sets. In this sense, it is possible to affirm that the model is quite stable and the rank is preserved in the most part of considered cases.

CONCLUSION

The contribution illustrates the application of the MAVT approach in the context of the transformation of a large urban portion of the city of Torino (Italy). The results of the analysis have highlighted that the best scenario for the transformation of the area under analysis is the scenario 2, which aims at increasing the commercial function of the area under examination.

Decision-making in urban and territorial projects is usually complex because of heterogeneous stakeholder interests, multiple objectives, long planning and implementation processes, and uncertain outcomes (Bottero et al., 2013). In this context, the results of the performed analysis show that MAVT is efficient in representing the real problems of a territorial system.

As reported by Huang et al. (2011), decision making in planning process requires consideration of trade-off between socio-political, economic and environmental impacts and MCDA emerged as a formal methodology to face available technical information and stakeholders' values. In the performed application we found that the evaluation addresses the requirement coming from the SEA European legislation because it effectively involves bringing together social, economic and environmental concerns and the formulation of options. The proposed approach seems to constitute a real integrated decision support tool able to both generate and compare alternative options, thus aiding strategic thinking about the likely environmental, social and economic consequences of current and possible future trends and the consequences of making particular policy choices (Schetke et al., 2012).

Figure 4. Questionnaire for the elicitation of the Swing weights for the higher level of the hierarchy

Elicitation tool: *Swing method*

Objective:	Interviewer	Interviewed	Date
Which is the most important attribute with reference to the sustainability assessment of the project?			

Hypothetical alternative No. 1

☺	**Socio-economic aspects** Surface of commercial activities:1000 m^2, number of jobs: 50, real estate: 5%				Score 100
☹	↑	**Historical and urban aspects** Enhancement of cultural heritage low, urban regeneration 0	**Environmental aspects** Acoustic emission high, land reclamation 0%, green areas 50%	**Transport and mobility** accessibility low, parking slots >500	

Hypothetical alternative No. 2

☺		**Historical and urban aspects** Enhancement of cultural heritage high, urban regeneration 1			Score 65
☹	**Socio-economic aspects** Surface of commercial activities:0 m^2, number of jobs: 0, real estate: 0%	↑	**Environmental aspects** Acoustic emission high, land reclamation 0%, green areas 50%	**Transport and mobility** accessibility low, parking slots >500	

Hypothetical alternative No. 3

☺			**Environmental aspects** Acoustic emission low, land reclamation 100%, green areas 100%		Score 90
☹	**Socio-economic aspects** Surface of commercial activities:0 m^2, number of jobs: 0, real estate: 0%	**Historical and urban aspects** Enhancement of cultural heritage low, urban regeneration 0	↑	**Transport and mobility** accessibility low, parking slots >500	

Hypothetical alternative No. 4

☺				**Transport and mobility** accessibility high, parking slots 0	Score 80
☹	**Socio-economic aspects** Surface of commercial activities:0 m^2, number of jobs: 0, real estate: 0%	**Historical and urban aspects** Enhancement of cultural heritage low, urban regeneration 0	**Environmental aspects** Acoustic emission high, land reclamation 0%, green areas 50%	↑	

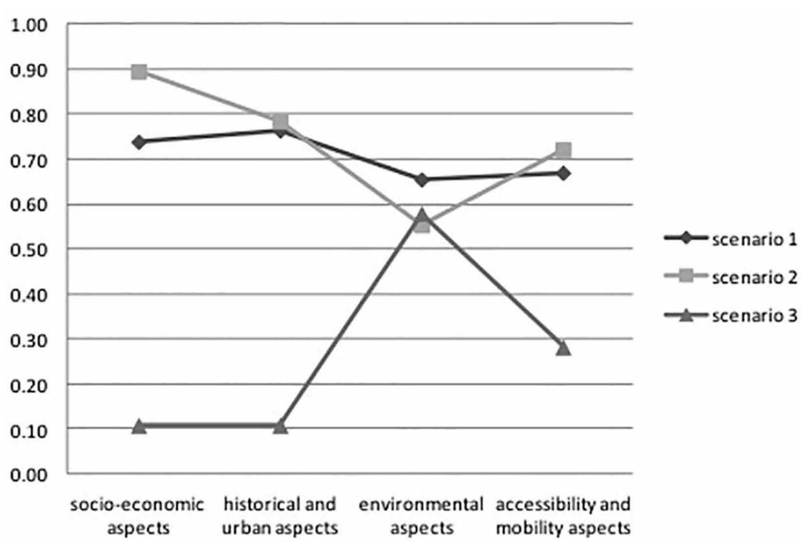
Worse hypothetical alternative

☺					Score 0
☹	**Socio-economic aspects** Surface of commercial activities:0 m^2, number of jobs: 0, real estate: 0%	**Historical and urban aspects** Enhancement of cultural heritage low, urban regeneration 0	**Environmental aspects** Acoustic emission high, land reclamation 0%, green areas 50%	**Transport and mobility** accessibility low, parking slots >500	

Table 5. Overall evaluation of the alternatives

Indicators	Standardized Scores of the Alternatives			Weights of the Attributes	Weights of the Criteria	Global Weights of Attributes	Priorities of the Alternatives		
	1	2	3				1	2	3
1.1	0,8	1	0	0,42	0,3	0,13	0,10	0,13	0,00
1.2	0,8	1	0	0,38	0,3	0,11	0,09	0,11	0,00
1.3	0,6	1	0	0,2	0,3	0,06	0,04	0,06	0,00
2.1	1	1	0	0,36	0,19	0,07	0,07	0,07	0,00
2.2	0,69	0,71	0	0,64	0,19	0,12	0,08	0,09	0,00
3.1	1	0	1	0,19	0,27	0,05	0,05	0,00	0,05
3.2	1	1	0,5	0,43	0,27	0,12	0,12	0,12	0,06
3.3	0	0	1	0,38	0,27	0,10	0,00	0,00	0,10
4.1	0,5	1	0	0,71	0,24	0,17	0,09	0,17	0,00
4.2	1	0	1	0,29	0,24	0,07	0,07	0,00	0,07
Final priorities							0,70	0,74	0,28

Figure 5. Sensitivity analysis for the case under examination



From the results of the present application, it is possible to highlight that MAVT approach has many strengths. First, MAVT helps in structuring the decision by classifying the problem in various objectives, criteria to measure the objectives and alternative options to solve the problem. MAVT also allows qualitative and quantitative information to be taken into account in the evaluation. Secondly, MAVT enhances the understanding of the policy problem by forcing the Decision Makers to compose a value function that represents their preferences. Thirdly, MAVT offers the possibility of reasoning about the problem by clarifying the strengths and weaknesses of the different alternative policies. Furthermore, MAVT strongly supports the decision-making process because it permits to clearly visualize and communicate the intermediate and final results. Finally, in the construction of the decision tree MAVT can incorporate the diverse views of stakeholder groups, considering the development of alternative options/solutions for the problem and the composition of the value functions. For these reasons, MAVT has been applied to many real-world decisions, in both the private and public sectors (Munda, 1995).

Moreover, the discussion oriented towards values rather than towards alternatives during both the value function construction and the level of trade-offs elicitation facilitated a better understanding of the problem and of the relationships among the considered aspects.

As a future development of the work, it would be interesting to consider uncertainty of predictions and risk attitude of DMs switching values functions to utility functions, thus developing a Multi Attribute Utility Theory model (Keeney & Raiffa, 1976). This is very important in public decisions and territorial transformation processes where complex problems arise and the outcomes cannot be predicted precisely.

Secondly, mention should be made to the fact that MAVT aggregates the options' performance across all the attributes to form an overall assessment and is thus a compensatory technique. This means that the method does allow compensation of a weak performance of one attribute by a good performance of another attribute. It is interesting to notice that the compensatory approach is crucial in the field of "strong" sustainability assessment where the principle of substitution cannot be applied; in fact, according to the "strong sustainability paradigm" a good performance in one area (for example, the economic dimension) is not compensated by a poor performance in another area (for example, the environmental dimension). In this sense it would be interesting to investigate the existence of interactions among the evaluation criteria by means of the Non Additive Measures approach (Giove et al., 2010).

Thirdly, given the spatial nature of the decision problem under consideration, it would be of scientific interest to investigate the possibility of integrating the MAVT approach with Geographic Information Systems in order to develop a Multicriteria Spatial Decision Support System (MCSDSS) that will enable multi-purpose planning (Malczewski, 1999).

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