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Application of the Analytic Network Process and the Multi-modal framework to an urban upgrading case study

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ABSTRACT

Multicriteria analysis is often used in planning for evaluating alternative development options against a set of evaluation criteria. In the context of sustainable development, the definition of these criteria is quite controversial because of the complex and fuzzy nature of this emerging topic. Decision making for sustainable (re)development at urban planning level requires an understanding of the multiple issues implied in the problem. The Multi-modal framework (MMF) developed by Brandon & Lombardi (2005) has proved to be able to help decision makers to handle the multiplicity of the issues embodied in the concept of urban sustainability, guiding the selection of appropriate criteria for evaluating alternatives solutions. This paper will apply this framework to an Italian urban (re)development problem by using the Analytic Network Process (ANP), a most advanced network version of the Analytic Hierarchy Process (Saaty, 2006). The ANP is the first mathematical theory that makes possible to systematically deal with all kinds of dependencies and feedback. It requires a network structure to represent the problem, as well as pair-wise comparison to establish relations within the structure. The MMF will be used to structure the problem for decision toward a more sustainable built environment.

Key words: Analytic Network Process (ANP); Multi-Criteria analysis; Multi-modal framework; Sustainable Built Environment.

1. INTRODUCTION

One of the major challenges for political and technical actors (planners, designers and urban authorities) is to devise strategies and policies, urban plans and projects that can guide cities and other aspects of the built environment along a more sustainable development path. At present, there is a lack of a decision support framework, system or tool which is both comprehensive and holistic to harmonise the different aspects of sustainable development in planning and design.

Devising strategies and regeneration processes for the sustainable development of cities and districts is difficult nor just because the nature of a city is complex, but also because the concept is ambiguous, multi-dimensional and generally not easy to understand outside the single issue of environmental protection.

There is a serious lack of understanding regarding the complex dynamic interactions and feedback effects of socio-economic-technological activities and the earth's ability to sustain itself. For example the impact of social organisation on the built environment and subsequently its ability to be sustainable is not well understood (Curwell et al., 2005).

Decision-making for sustainable development in the built environment requires new approaches which are able to integrate and synthesise all the dimensions of an urban system (or a building) and different point of views, in a holistic manner (Lombardi and Brandon, 2002).

Adequately evaluating planning and design solutions, taking into account their multidimensional consequences in the built and natural environment, requires a multi-scale, transdisciplinary, and pluralistic approach, able to integrate and synthesise the many different perspectives that can be taken, using all the information available, both soft and hard .

Multicriteria analysis (MCA) takes into account all the aspects and values involved in a decision making process. Compared with cost-benefit analysis, in MCA the measure of benefits are not related to the concept of 'willing to pay' but to the 'goal achievement level', which involves the evaluation of performance against a number of criteria. Both performance and criteria can only be defined by a value-based judgement; they are not empirically verifiable. Indeed, the term performance must be a goal-oriented-behaviour, i.e. a behaviour rendered meaningful by the existence of a criterion that specifies when a goal has been attained (Muller and Patassini, 2005; Munda, 2004).

By taking into account different point of views and a weighting of the criteria to be used in the evaluation of alternative options, MCA methods provide the possibility to realise a meaningful and pluralistic evaluation of planning proposals, synthesising all the contributions of the different experts and the point of views of the actors involved (stockholders and decision makers).

Because of these features, the approach has been successfully applied to urban planning and design for evaluating alternative options, assessing their impacts on all the built and natural environment and the institutional, socio-economical context (see, in Italy, the following regulations and laws: Dpcm 116/1997; DPR 554/99; L.144/99; CIPE/99; NUVV, 2001).

In this field, the most applied MCA methods are of a "discrete" type since they are able to manage a limited number of alternatives, corresponding to few projects, and multiple indicators, quantitative and qualitative in nature. Decision-makers can express their views, assigning individual preferences to the various criteria of evaluation. Therefore, discussion and negotiations should be encouraged where exponents of different groups of opinion, political currents and lobbies, as well as the promoters and executors of the proposed actions, may be represented.

With reference to the multi-criteria analysis, a very important role is played by the Analytic Hierarchy Process – AHP and by its generalization to feedback networks, the Analytic Network Process –ANP (Saaty, 2006). In fact, many decision problems can not be structured hierarchically because they involve the interaction and dependence of higher-level elements on lower-level elements. Not only does the importance of the criteria determine the importance of the alternatives as in a hierarchy, but also the importance of the alternatives themselves determines the importance of the criteria.

The ANP requires a network structure to represent the problem, as well as pairwise comparison to establish relations within the structure. There are two possible modelling approaches to ANP: the BOCR (Benefits, Costs, Opportunities, Risks) approach, suggested by Saaty (Saaty and Vargas, 2006), which allows to simplify the problem structuring by classifying issues into traditional categories of cost and benefit; and a free-modelling approach, which is not supported by any guide or pre-determined structure. The first approach is often inadequate because it fall into reductionism; while the second one is often difficult to be applied in complex decision making problems.

This paper will show a different problem structuring approach which is able to explain complexity without falling into reductionism and/or subjectivism. This approach refers to the Multi-modal framework (MMF) developed by Brandon & Lombardi (2005) which has proved to be able to help decision makers to handle the multiplicity of the issues embodied in the concept of urban sustainability, guiding the selection of appropriate criteria for evaluating alternatives solutions. An application of this framework to an Italian urban (re)development problem will be provided.

The paper is structured as follow. Section 2 synthetically describes both the ANP and the MMF from a theoretical viewpoint. Section 3 introduces the case study problem and illustrates the application of this ANP-MMF to the case-study. Finally, section 4 provide some final remarks and research perspectives.

2. THE METHODOLOGICAL APPROACH

2.1 Analytic Network Process

The Analytic Network Process (ANP) is a multicriteria technique that supports the decision making process and that makes possible for us to deal systematically with all kinds of dependencies and feedback. The ANP extends the AHP to cases of dependence and feedback and generalizes on the supermatrix approach introduced with the Analytic Network Process (AHP). The ANP model consists of the control hierarchies, clusters, elements, interrelationship between clusters, and interrelationship between elements. The ANP allows interactions and feedback within and between clusters and provides a process to derive ratio scales priorities from the elements .

Taking into consideration the very high number of operations involved in the analysis, the general ANP network can be subdivided in different control nodes, i.e. “benefits”, “opportunities”, “costs” and “risks”. This structure, named BOCR (Saaty and Vargas, 2006), allows to simplify the modelling of the decision problem by making a top-level network and four subnets control criteria. On the other side, it presents a number of limitations, especially when it is applied to problems related to sustainability because it forces the analysis to a hierarchical classification of positive and negative issues. For this reason, in this paper, a new problem structuring will be adopted which allow the development of a more holistic and integrated model for sustainability decision making problem (see para 2.2).

In general, an ANP process requires the following four steps:

- *Step I: Developing the structure of the decision model*

Firstly, we have to identify the goal or objective of the decision process . This goal will be further decomposed into clusters and elements, criteria and alternatives. Secondly, we have to identify all the relationships between the different parts of the network, in terms of dependence and feed-back.

- *Step II: Pairwise comparison and relative weight estimation*

The determination of relative weights in ANP is based on the pairwise comparison as in the standard AHP (Saaty, 1980, 2000). Pairwise comparisons give to the user a basis to reveal his/her preference by comparing two elements. Furthermore, the user has the option of expressing preferences between the two as equally preferred, weakly preferred, strongly preferred, or absolutely preferred, which would be translated into pairwise weights of 1, 3, 5, 7 and 9, respectively, with 2, 4, 6 and 8 as intermediate values. Pairwise comparisons of the elements at each level are conducted with respect to their relative importance towards control criterions or clusters. Pairwise comparisons are performed in two levels, the level of elements and the level of clusters. The methodology takes as input the above comparisons and produces the relative weights of elements as output using the "eigenvalue" method.

In addition, the method includes consistency checks for input matrices, named ‘consistency ratio’ (R.C.).

- *Step III: Supermatrix*

The relative weights mentioned above are then put into a initial supermatrix that represents the interrelationships of elements in the system. The eigenvector obtained from cluster level comparison with respect to the control criterion is multiplied to the initial supermatrix as cluster weights. This operation leads to a weighted supermatrix of values.

- *Step IV: calculation of global priority vectors and weights*

In the final step, the weighted supermatrix is raised to limiting power to get the final priority vectors, as illustrated in equation (1):

$$\lim_{k \to \infty} W^k \qquad (1)$$

2.2 Multi-modal framework

The Multi-modal framework (MMF) developed by Brandon & Lombardi (2005) is based on the ‘Theory of the Cosmonomic Idea of Reality’ developed by the Dutch Philosopher Herman Dooyeweerd (1958). This theory attempts to integrate all of the aspects of the universe in a meaningful form to help explain structure and relationships in a holistic way (de Raadt, 1997; Lombardi and Basden, 1997).
The theory is complex but broadly the “Cosmonomic Idea of Reality” proposes a list of dimensions of reality, named “modalities”, which can be useful for understanding the ‘functioning’ of a complex system or an entity, such as the built environment, a local community, etc. These dimensions, each of which has a kernel meaning (in brackets), are the followings: Quantitative (amount), Spatial (continuous extension), Kinematics (movement), Physical (energy), Biotic (life functions), Sensitive (sense, emotion), Analytical (distinction), Historical-technological-cultural (formative power), Communicative (symbolic meaning), Social (social intercourse), Economic (frugality), Aesthetic (harmony), Juridical (what is due), Ethical (self-giving love), Credal (faith, vision, commitment).
The fifteen modalities are not placed in an arbitrary order, but the earlier modalities serve as foundation for the later. Indeed, for instance, the economic modality is dependent on the social, the social on the communicative, the communicative on the historical, and so on. In other words, the fifteen modalities are nested within each other and each modality affects and informs those above. This interrelation between the modalities (dependency relation) defines their position in the list. It is important in understanding and modelling sustainability as it recognizes that economy is nested in

the society and both are determined by the environment. This interpretation is coherent with most of the authoritative and reliable theories on the matter (Daily and Cob, 1989; Costanza, 1993; Hart, 2002).
The list of modalities and their meaning in the context of sustainable development, as identified by Brandon and Lombardi (2005), is provided in Table 1. The first column of the same table re-groups them into the three main internationally recognized dimensions of sustainability, also defined as three different types of 'capitals' (Hurt, 2002), which are related to the physical environment, the human environment and the economic-institutional environment.
According to Brandon and Lombardi (2005), "this framework is useful, not only because it recognises different levels of information but also because it suggests an integration of the key aspects to provide a continuum for harmony and decision making. The proposed framework aims at guiding designers and planners, official public developers and decision makers through the process of understanding and evaluating sustainable development in planning and design on the basis of a new holistic structure which acts as a prompt and check list".
In the next section, the framework will be used for structuring the decision making problem in a ANP multicriteria evaluation process.

3. APPLICATION OF THE MMF/ANP TO THE CASE STUDY

The case study is related to a urban renewal intervention in a small Italian town (about 50.000 inhabitants), in the metropolitan area of Turin.
The area includes historical buildings (see Fig.1) which need re-furbishing and re-using, with a total floor surface of about 2000 mitre squares.

Figure 1. The historical buildings named “Laboratori Arti e Mestieri”

3.1 Identification of the alternatives

The Municipality, with the support of a group of experts from Polytechnic of Turin, has developed a number of different scenarios for the regeneration of the area, which can be synthesized in the following four alternative hypotheses of urban reuse:

A. *“Do nothing”*

This solution means there will be no consequences from new constructions or reuse, but, at the same time, this could lead to an urban decay, particularly serious in the field of cultural heritage.

B. Services for companies

This solution aims to provide support to small and medium companies and is encouraged by recent regional strategic development directions.

C. Cultural and recreation centre

This scenario involves a mix of urban services and activities related to leisure, fitness and museum, which is also able to give an investment return.

D. “City of Health”

This solution is linked to the Piedmont Region’s decision to concentrate hospitals and health structures in a area close to the one under study, in order to serve the whole Turin’s metropolitan area. This decision would have influenced the use of the buildings.

3.2 Identification of the evaluation criteria

For evaluating the most preferable scenario, a number of criteria have been identified. This identification has been guided by the MMF which has provided the structure for understanding the decision problem (Lombardi, 2006). The list of criteria and their specific meaning are reported in Table 1.

Table 1: The multimodal framework applied to the case - study

Sustainable development	**Multi-modal aspects**	**Specific meaning with regard to the case study**
PHYSICAL ENVIRONM. CAPITAL	Numerical	Potential users. Bigger is the potential users number, more sustainable is the project.
	Spatial	Construction works. This means less green destination. Smaller is the construction work, more sustainable is the project.
	Kinematic	Accessibility. Higher is the accessibility level, more sustainable is the project.
	Physical	Environmental quality level. Lower is the resources and

		energy consumption , more sustainable is the project.
	Biological	Quantity of air and water pollution. Lower is the quantity of pollution, more sustainable is the project.
HUMAN CULTURAL CAPITAL	Sensitive	Level of comfort. Higher is the comfort level, more sustainable is the project.
	Analytical	Level of knowledge and analyses supporting the project. Higher is this level, more sustainable is the project.
	Formative	ICT use. Bigger is the ICT use, more sustainable is the project.
	Communicati ve	Cultural symbol. Bigger is the ability of the project to communicate cultural symbols, more it is sustainable.
	Social	Favourable conditions for social relationships. How much the project provide favourable conditions for social intercourse?
ECONOMICAL INSTITUTION. CAPITAL	Economic	Economical efficiency. Higher is the economical efficiency, more sustainable is the project.
	Esthetical	Harmony with the context, from a morphological view-point. More harmonic is the urban renewal, more it is sustainable.
	Juridical	Respect of norms and regulations (e.g. in Master Plan). Less changes are required at administrative level, more sustainable is the project.
	Ethical	Attention to disables, children and old people. More attention is paid to all citizens' needs, more sustainable is the project.
	Credal	Local Community expectations, coherence with Public Authority's development strategies. More coherent with expectations is the project, more sustainable it is .

3.3 ANP application and results

The ANP application has been developed following the methodological steps illustrated in paragraph 2.1[1].

The network model is shown in Figure 2. This is formed by four clusters: the Alternatives' cluster and the three clusters corresponding to the dimensions of sustainable development, i.e. Physical/Environmental, Human/Cultural and Economical/Institution. The network structure and the links among clusters and nodes have been built on the base of the following hypotheses:

- According to MMF, there is a dependency between the aspects. On the top of this model there is the Credal modality. This is connected with all the previous

[1] The specific software used is available on: http://www.superdecisions.com/.

ones and allows the weighting of each modality in this “spiral” sustainability model;

- In order to evaluate the impacts of the four transformation scenarios against the identified sustainability criteria, each node of the network (i.e. each modality or aspect of sustainability) is connected with the cluster of alternatives .

In this case study, each cluster has not been evaluated *per se*, but each node has been assessed with regard to the top level of the spiral model (i.e. the creedal node). For instance, with reference to the elements of the Physical/Environmental cluster, it has been asked to the participants of decision making (in this case, the experts involved in the design process): “what element is more important between new construction *(Spatial)* and environmental quality (*Physical)*, with regard to Local Community expectations, and how much?”. Their judgement, measured on a 9-point-scale, have been then reported in pair comparison matrices, such as the one illustrated in Table 2.

Table 2. Example of Pairwise Matrix related to the Physical/Environmental elements

	Numerical	Spatial	Kinematic	Physical	Biological
Numerical	1	5	2	1/5	1/7
Spatial	1/5	1	1/3	1/5	1/7
Kinematic	1/2	3	1	1/5	1/6
Physical	5	5	5	1	½
Biological	7	7	6	2	1

This assessment process has been developed for all the elements in the identified clusters and their priorities vectors have been derived. Subsequently, the normalized eigenvector of each matrix has been extracted and a supermatrix of paired comparisons and its normalisation by cluster, has been developed in accordance to the ANP procedure described in para 2.1. A working example is provided in the technical appendix with reference to the Physical/Environmental cluster (see Tables A.1, A.2 and A.3).

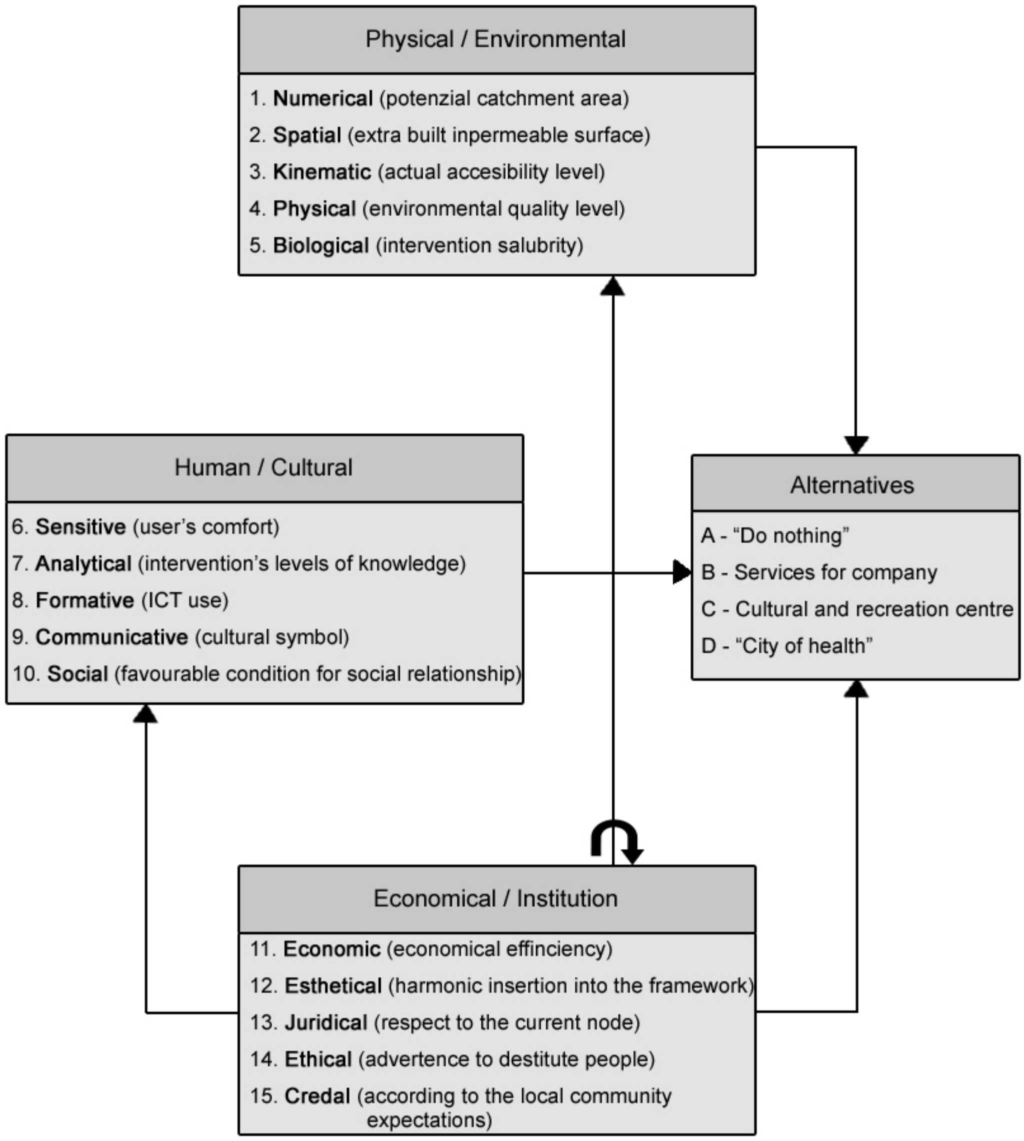

Figure 2: The network applied to the case study

At the end of the process, the limit matrix gives the final global priorities for all the network elements, including the alternatives. has been obtained (see Table A.3 in the appendix). These results show that the Cultural and Recreation Centre is the urban scenario that, compared with the others, is better able to meet all the sustainability criteria, obtaining the highest percentage (43%). The second best choice is the "Services for Companies" scenario and, almost equal, the "Do nothing" alternative (17%); while the worst alternative is the "City of Health" (15%). These results are in line with the transformation strategies of the City which are reflected in the high priorities give to the followings:

- *Social (social intercourses)*. The City aims to create 'social attraction points' in order to increase citizens' "sense of belonging" to their urban environment and to contrast emigration of population;
- *Biological (healthy)*, the City wishes to preserve the urban environmental quality;
- *Credal (Local Community Expectations)*, this is the main objective and the top of this sustainability model.

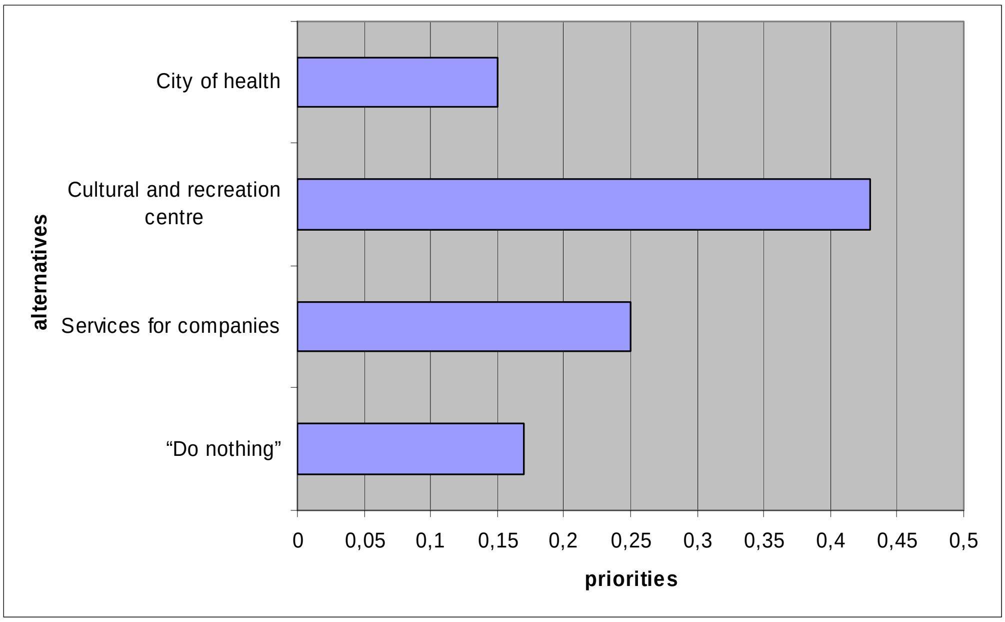

Figure 3: Normalized ranking of Alternatives Priorities

4. CONCLUSION AND NEXT STEPS

In this study, a new approach for evaluating alternative solutions in the field of urban sustainability has been developed, using the Multimodal Framework (MMF) for guiding and structuring an Analytic Network Process (ANP). This application of MMF and ANP has been supported by a real world study case, related to a renewal intervention in the metropolitan area of Turin (Italy).

The MMF has proved to be a useful approach to decision making problems in the field of urban transformation because it allows the identification of specific criteria and it is able to consider all the most relevant dimensions of sustainability. The ANP

methodology is a robust multi-attribute decision-making technique for synthesizing criteria and elements governing urban transformation. It allows to structure any kind of decision problem with different relationships and interdependencies or feedback. Therefore, it requires evident knowledge of sustainable design development. For this reason, this study adopted the MMF for supporting this understanding.
This study represents the first application of the ANP in Italy and one of the first example of ANP application in the field of urban transformation at international level.

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Technical appendix

Table A.1: Normalized Eigenvector of Physical/Environmental cluster

	Normalized Eigen vector'
Numerical	**0,11**
Spatial	**0,04**
Kinematic	**0,07**
Physical	**0,31**
Biological	**0,47**

The above normalised weights of the Physical/Environmental elements are then reported in the unweighted supermatrix of elements in Table A.2. (see in bold), in correspondence to the credal element (15th modality).

Table A.2. The Unweighted Supermatrix

		ALTERNATIVES				ECONOMICAL INSTITUTION					PHYSICAL ENVIRONMENTAL					HUMAN CULTURAL				
		A	B	C	D	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10
ALTERNATIVEs	A	0,00	0,00	0,00	0,00	0,04	0,04	0,48	0,04	0,05	0,04	0,50	0,54	0,50	0,29	0,04	0,15	0,04	0,04	0,05
	B	0,00	0,00	0,00	0,00	0,42	0,22	0,08	0,09	0,28	0,12	0,14	0,28	0,21	0,39	0,32	0,21	0,22	0,21	0,15
	C	0,00	0,00	0,00	0,00	0,42	0,66	0,17	0,19	0,58	0,62	0,29	0,14	0,24	0,27	0,32	0,56	0,22	0,67	0,68
	D	0,00	0,00	0,00	0,00	0,11	0,08	0,27	0,68	0,09	0,21	0,06	0,04	0,05	0,05	0,32	0,08	0,53	0,08	0,12
ECONOMICAL INSTITUTION.	11	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,27	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	12	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,14	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	13	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,04	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	14	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,14	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	15	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,41	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
PHYSICAL ENVIRONMENTAL	1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**0,11**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	2	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**0,04**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	3	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**0,07**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	4	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**0,31**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	5	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**0,47**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HUMAN CULTURAL	6	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,11	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	7	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,05	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	8	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,15	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	9	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,21	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,48	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Table A.3. The Weighted Supermatrix

		ALTERNATIVES				ECONOMICAL INSTITUTION					PHYSICAL ENVIRONMENTAL					HUMAN CULTURAL				
		A	**B**	**C**	**D**	**11**	**12**	**13**	**14**	**15**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
ALTERNATIVEs	**A**	0,00	0,00	0,00	0,00	0,04	0,04	0,48	0,04	0,01	0,04	0,50	0,54	0,50	0,29	0,04	0,15	0,04	0,04	0,05
	B	0,00	0,00	0,00	0,00	0,42	0,22	0,08	0,09	0,07	0,12	0,14	0,28	0,21	0,39	0,32	0,21	0,22	0,21	0,15
	C	0,00	0,00	0,00	0,00	0,42	0,66	0,17	0,19	0,14	0,62	0,29	0,14	0,24	0,27	0,32	0,56	0,22	0,67	0,68
	D	0,00	0,00	0,00	0,00	0,11	0,08	0,27	0,68	0,02	0,21	0,06	0,04	0,05	0,05	0,32	0,08	0,53	0,08	0,12
ECONOMICAL INSTITUTION.	**11**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,07	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	12	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	13	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	14	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,04	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	15	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
PHYSICAL ENVIRONMENTAL	**1**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**0,03**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	2	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**0,01**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	3	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**0,02**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	4	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**0,08**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	5	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**0,12**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HUMAN CULTURAL	**6**	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	7	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	8	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,04	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	9	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,05	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,12	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Table A.4 Limiting priorities

ALTERNATIVEs	"Do nothing"	0,1504
	Services for companies	0,2223
	Cultural and recreation centre	0,3838
	City of health	0,1406
PHYSICAL ENVIRONMENTAL	Numerical	0,0037
	Spatial	0,0013
	Kinematic	0,0025
	Physical	0,0105
	Biological	0,0163
HUMAN CULTURAL	Sensitive	0,0038
	Analytical	0,0016
	Formative	0,0005
	Communicative	0,0073
	Social	0,0164
ECONOMICAL INSTITUTION.	Economic	0,0091
	Esthetical	0,0047
	Juridical	0,0013
	Ethical	0,0049
	Credal	0,0141