Multidimensional Approaches to Evaluate Urban Planning Scenarios

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Abstract. The evaluation of urban planning practices may be thought as a way to represent and communicate a project or a plan as an object open to judgment as well as an opportunity for capacity building. An urban plan is therefore defined as neither right nor wrong due merely to the results it may generate but, above all, to the capacities that it is able of constructing and implementing in settled, involved communities. In this paper, this approach guides the analysis of a Plan for the community services of a medium sized city in the south of Italy, driven by some urban planning scenarios evaluated by a multicriteria assessment. The paper is introduced by the description of the objectives of the work, followed by an account of the methodological aspects founding the study. In the third section the case study is described in its principal aspects and finally some conclusions are made in the last section highlighting first results and future research development.

Keywords: Multidimensional approaches, multicriteria methods, scenarios, urban planning.

1 Introduction

The main objective of contemporary urban and regional planning is to build strategic models to favour improvement processes based on the principles of sustainable development.

This results in an attempt to build models that are able to re-combines environmental protection and conservation of land and resources with the needs of socio-economic development.

In this context, planning's methods, programming and implementation of strategies and interventions take the utmost importance in order to transmit re-sources in their integrity for future generations.

Protecting non-reproducible natural resources and promoting the fundamental re-generation of the reproducible ones, planners and public administrations are called today to ensure the fulfilment of the needs of the population and to answer the asking of residence, equipment and services improving at the same time the production system.

Activation of housing policies, improving the efficiency and quality of the existing infrastructure combined with the reduction of land use within the urban areas and the

B. Murgante et al. (Eds.): ICCSA 2013, Part IV, LNCS 7974, pp. 556–571, 2013.

protection of existing environmental systems, are considered essential condition for improving the current levels of well being.

The urban areas development and the improvement of life quality of their inhabitants, therefore, are the result of a complex set of interactions between population, resources and territory and consequence of a balanced use of overhead capital in general [1].

So, the core of the sustainability challenge can be described as the problem of representing and analyzing the interactions, behavior and emergent properties of combined natural and social systems, and of providing decision makers with appropriate guidelines regarding the effects of various forms of behavior or policy intervention. [2].

The purpose of this study is to identify a possible approach to the construction of medium and long term design alternatives for regeneration and development of urban areas.

In the second section, the work will focus on methodological aspects trying to highlight procedures for the achievement of sustainability that combines economic benefits, quality of life, environmental features and social issues.

Section 3 is devoted to the case study of the Plan for the community services of the City of Monopoly (Italy) as a real case of sustainable land use planning.

In particular, the experiments conducted wanted to assess which of the possible development scenarios proposed by stakeholders during the elaboration of the plan are consistent with the objectives of sustainable development in the area.

Finally, in section 4 the paper analyses the results, and reflect about possible methodological developments of urban plans.

2 Methodological Aspects

As mentioned above and already known in the planning literature, sustainability is a multi-attribute welfare concept [3] and presupposes a self-organizing or self-adjusting concept with a dynamic meaning over time and space [2] [4].

The process of construction of plans and, consequently, of strategies of sustainable development is, therefore, of high complexity since it requires consideration of the different perspectives and viewpoints of different stakeholders [5].

The existence of different actors, different stakeholders, implies that each of them is looking to pursue their future according to their objective [6] and, therefore, a wide range of possible future scenarios can be created and they can be subject to possible re -negotiations in order to make them real.

Circumstances of this kind are particularly evident in the case of construction plans with the help of methods of bottom-up in which all stakeholders have the opportunity to make concrete proposals for development to the planners and Public Administration.

There is, therefore, the need to equip the makers of instruments able to evaluate and understand what possible alternatives to consider, what would be the possible changes in environmental, social and economic contexts.

It should also be noted that all forms of decision-making necessarily have some temporal dimension, whether it is the timescale over to which policy will act, the timing of policy review and reformulation, the use of projections of economic, social and demographic trends, and so on. In this sense governance always embodies some form of future decision-making. [7]

The evaluation of possible scenarios of future development is, therefore, an important step in the construction of the plan.

As pointed out by Slaughter in his reflection on Future Studies, the aim is to broadly explore, understand and cope with the long-term forces of change, to 'maintain and create high quality forward views and to apply to Both These short and long-term decision -making [8] [7].

It is clear that in order to analyse the problem in all its complexity, as is now well known in the literature, it is necessary the integrated use of different methodologies to support decision makers in strategic development.

In particular, we refer to:

• Scenario Planning: Widely employed a methodology for supporting strategic decision making, employs the use of imaginary future scenarios to help decision makers think about the main Uncertainties they face, and devise strategies to cope with Those Uncertainties [9] [10].

• Multi-criteria Decision Analysis: methodology designed for Evaluating options taking into account decision-makers' multiple and conflictive Often, Objectives [9] [11] [12].

Both methodologies are configured as decision support tools and their use lets you identify and understand threats and opportunities of design alternatives in relation to environmental, economic and social problems to which each of them tries to answer.

In particular, the scenario analysis is a scientific approach based on the intention to design and judge possible future images as a frame of reference for current future-oriented decision-making. [13]

Scenarios need to be able to integrate planning about the uses and impacts associated with different interest groups for a given landscape [14]: when the scenarios are identified, it is the task of the decision maker to choose the design criteria in relation to the objectives that you have chosen and, on their bases, to evaluate the coherence and the admissibility of the proposed project.

The multi-criteria methods are now a wide application in the evaluation of environmental issues and related planning and land use as Such methods are capable of dealing with the multiple dimensions of evaluating problems (e.g. social, cultural ecological, technological, institutional, etc..) and give attention to two interest con-flicts among stakeholders involved. [1]

In particular, in the case study in question examined in the next section we chose to use the AHP method [15]: the method provides that the pair of criteria decision maker is asked to Which degree is a criterion of more December Importance than the others. By means of These comparisons the method defines the relative position of each one criteria in relation to all other criteria. Finally by using an eigenvalue matrix technique, quantitative weights can be assigned to the criteria. [1]

The weights assigned to the criteria and the construction of the correlation matrix permit, therefore, decision-makers to evaluate each future scenario planning in relation to the general objectives of the planning, allowing you to understand of what scenarios are more consistent with the development objectives.

3 The Plan for the Community Services in the City of "Monopoli"

3.1 Case Study Area

Monopoli (40°57′17″N 17°10′24″E) is medium size city of the Apulia Region in the South of Italy.

The municipality is developed along the Adriatic coast 43 km south of Bari, the capital of Apulia Region, and it has a surface area of about 156 sqkm , a population of 49,558 inhabitants and a density of 317 inhabitants per sqkm.

The territory is constituted by a flat coast characterized by the presence of Monumental Olives beyond which develops the Murgia hill until a height of about 410 meters above sea level.

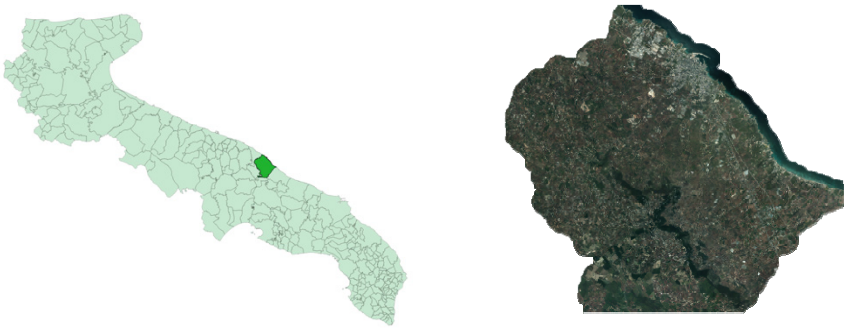


Fig. 1. The city of Monopoli in the Apulia Region in the South of Italy (source: elaboration on ISTAT Census data 2001. Ortophoto download from www.sit.puglia.it).

3.2 About Urban Planning in Case Study Area

The City Council of the municipality of Monopoli with a resolution of 22 October 2010 approved the new General Urban Plan with the following objectives:

- to provide for sustainable development of the territory and protect the environment;
- to reduce the consumption of soil, to reduce the impact of infrastructure, to protect the Monumental Olives etc.;
- to guarantee the satisfaction of requirements of the population and demand for public services and facilities;

- to improve the accessibility of the city by focusing on the strengthening of the existing road network;
- to intervene on housing policies in order to create new social and public housing.

In order to support the management of the General Urban Plan by the relevant offices, the Public Administration of the City of Monopoli, in accordance with the pro-visions of the regional legislation, has decided to adopt a Plan of Public Facilities able *to ensure provision of public facilities, services and public spaces for public use, appropriate in quantity, quality, usability and accessibility, to the needs of the population permanently or temporarily resident in the municipal area, in the time period of the plan. The Plan of Public Facilities must still ensure the minimum allocation surfaces, binding, reserved for public spaces or collective activities, for public parks or parking for residential and productive areas (art. 3, 4 e 5 del DIM 1444/68* [16].

In particular, the Plan of Public Facilities is coherent with the orientations expressed by the City Council both for new community services to be carried, for existing ones to be reorganized, and for the technical guidelines that the relevant offices will follow for the evaluation and approval of the private Executive Town Planning and for the training of the public initiative ones.

In the case of the Municipality of Monopoli, the Plan of Public Facilities has done the first quantitative control of the requirements for the different types of services in synergy with the General Urban Plan and with the national law provisions. This check was conducted both in the public facilities at the neighborhood and city level, both in terms of the other necessary public services and, finally, with regard to infrastructure and network services.

Finally, the Plan provides for the location of new facilities, also including the Social housing and their planning, which means to give political and administrative indications based on the information gathered during the construction of the cognitive frameworks. In particular, the final proposal of the Plan of Public Facilities was based on the actual conditions of the feasibility of planning and on public and private resources that can be activated over a period of validity of the General Urban Plan.

Then, the Plan of Public Facilities is composed by an analytical part and a programmatic one in order to target the supply of project of public services and the reorganization of existing ones towards a better functional and locational framework.

The objective of the Plan is to build a new structure of the Public City based on improving the quality of services and on finding new public areas, to be implemented according with the parameters of feasibility, priority, and gradually increase of facilities. Moreover, the aim is the regeneration of the city and meeting the needs of users, both resident and city users and temporary users (such as tourists) or occasional ones.

In particular, the construction of the knowledge framework and the comparison with the stakeholders in the Focus Group activities, designed to promote participation in the formation of the Plan of Services, showed four types of facilities that we con-sider essential for the development of the city of Monopoli:

- new green areas;
- new parking areas, mostly small / medium sized widespread in areas close to the central area;
- new urban polarities for mainly residential areas, both urban and rural, productive or port areas for touristic uses;
- areas for Social Housing.

In addition, the planning of public facilities necessary for the contemporary society, can no longer be satisfied with some abstract and timeless hypotheses but must check the real financial resources of the Public Administration as generally expressed in the Triennial Program of Public Works. Figure 2 illustrates the Structural Strategic Scheme of the Plan of Public Facilities of Monopoli which shows the framework of strengthening of the system both in the consolidated city and in the new transformation areas. In particular, a significant role is played by the environmental heritage existing in the city of Monopoly that is con-figured as green infrastructures "coming inside" the city and which can give it a new meaning in terms of environmental quality and capability to respond to natural areas within the existing fabric, in response to the demands of the population.

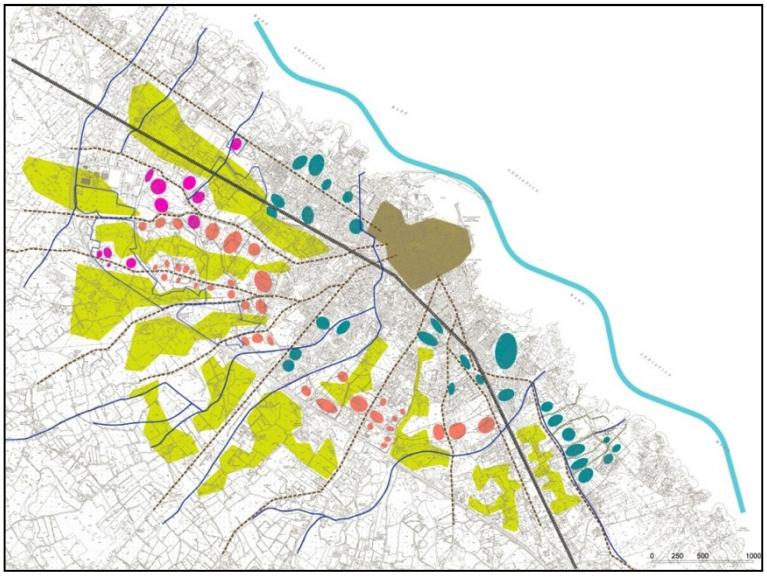


Fig. 2. Structural Strategic Scheme of the Plan of Public Facilities of Monopoli

3.3 Evaluating Futures Development

The preparation of the Plan of Public Facilities has been accompanied by a partici-patory process open to the citizens and articulated for Focus Group in order to enable appropriate information and involvement of all stakeholders on the objectives and actions contained in the plan. The Public Administration chose to collect, by public notice, expressions of interest from private citizens and economic operators with respect

to the forecasts of land use under the General Urban Plan, useful for the formation of Plan of Public Facilities. As a result of the Notice for submission of expressions of interest concerning with the formation of the Plan of Public Facilities issued in May 2011, the City Administration received 16 project proposed by private citizens. Table 1 shows the list of expressions of interest received by the date of July 2011.

Table 1. list of expressions of interest proposed by private citizens

N°	Object
1	Project proposal for the implementation of a new context for public facilities at Belvedere Area
2	Preliminary project of a tensile structure
3	Project of construction of six buildings for residential accommodation and nearby areas
4	Proposal of division of urban context
5	Accommodation of a private area in the area of Capitolo to be used as public parking, square and small tourist accommodation with parking
6	Request of redefinition of an area labelled as "contexts for new public services"
7	Project for an urban area
8	Proposal of division of urban context
9	Proposal for realization of an urban park
10	Feasibility study of the project for the organization of the areas near the Lodge of the Snake
11	Construction of public parking facilities or public parks and free transfer of part of the area
12	Project proposal for the urban planning area designated to the urban consolidated contexts and context for new public services
13	Implementation of public interventions on areas for public facilities
14	Project proposal for Social Housing
15	Plan of the arrangement of the areas near the hospital
15bis	Project for the area between via Roman Traiana and via Procaccia

The objective of this case study, therefore, is to identify and evaluate possible strategic development through the use of a Multicriteria Analysis and, in particular, define which of the expressions of interest received are actually achievable not only with reference to their economic feasibility as included in the Triennial Program of Public Works as well as referring to:

- needs of the population;
- evaluation of the environmental impacts from the implementation of the proposed public facilities within the expressions of interest;
- accessibility to the community.

Finally, we will proceed to a comparison of the results obtained from the present work and the choices that the Public Administration of the City of Monopoli made after

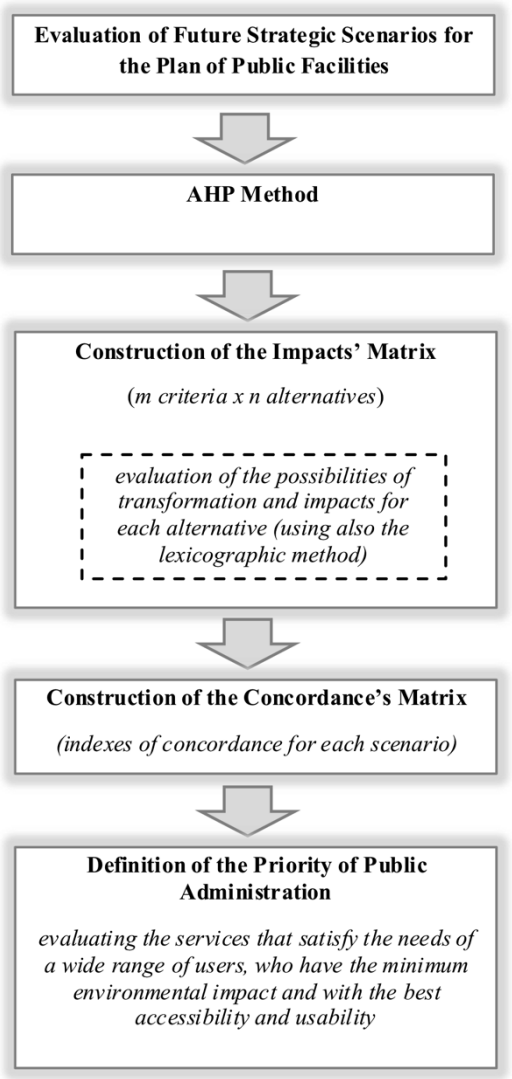


Fig. 3. Methodological scheme to clarify the main steps followed in the evaluation process

analysis of the submitted projects, verifying its priorities and its consistency with the Triennial Program of public Works, elaborated by each Municipality to program its public works.

According with literature [15], we have provided for the construction of a matrix of impact m x n (Table 2) characterized by:

m criteria ie the elements of judgment that contribute to the evaluation of alternative

n alternatives ie expressions of interest covered by the evaluation and selection;

The m criteria chosen for the evaluation of expressions of interest are:

- Priority
- Users
- Environmental Evaluation
- Accessibility and Usability Evaluation

The *n alternatives* are the expressions of interest received on 29 July 2011 and reported in Table 2.

Table 2. Matrix of impact

		CRITERIA			
		Priority	**Users**	**Environmental Evaluation**	**Accessibility and Usability Evaluation**
ALTERNATIVES OF PROJECT - SCENARIOS	**1**	high	high	medium	high
	2	medium	high	low	high
	3	low	low	high	medium
	5	low	low	medium	medium
	6	medium	high	medium	high
	7	high	low	medium	medium
	9	low	high	high	high
	10	high	high	medium	high
	11	low	high	low	medium
	12	high	high	low	high
	13	low	high	medium	low
	14	medium	medium	high	low
	15	high	high	low	medium
	15 bis	high	high	high	high

Expressions of interest 4 and 8 are excluded because they do not include the creation of a public service, while the project proposals 15 and 15bis, as on areas connected to each other, were analyzed separately, but assessed in a unified way.

While for priority and users we have been able to assess the impact to give in a direct manner for each alternative, this was not possible with regard to the environmental impact evaluation of the works to be carried out and the evaluation of accessibility and usability.

These main criteria are in fact dependent on specific criteria that need to be evaluated individually. In particular, the environmental impact evaluation is closely related to the geology of the site, in the presence of restrictions, levels of the naturality and urban morphology, that is the level of urbanization in the area of intervention. For the evaluation of the accessibility and usability and impacts generated by them is necessary to refer to the dimension of the work, that is the identification of the parameters of geometric and physical nature characterizing the work such as to ensure the functionality, reliability and safety; the ability to satisfy the needs of the population; the presence of access roads and to their characteristics and the presence of parking.

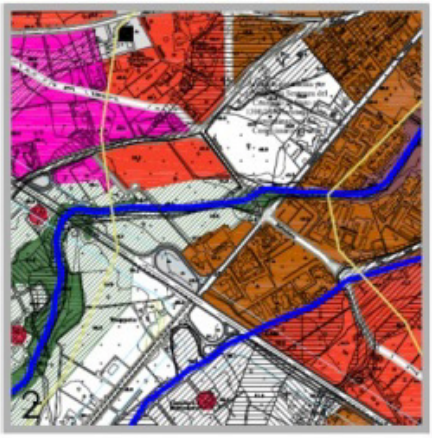
For the environmental impact and the accessibility and usability evaluation we used a simplified version of the lexicographic method.

Following the identification of the specific criteria it was possible to construct matrices useful for the evaluation of impacts and for each area covered by manifestations of interest.

The impacts are measured with an adimensional scale with values from 1 to 9 that is by a low impact (equal to 1) to a high impact (equal to 9). The method involves the pairwise comparison between the specific criteria and the final impact is given by the sum of the components resulting from the matrix having as criteria the sum two by two of the reference criteria. For each expressions of interest, we have built the lexicographic matrices and scenarios were evaluated with reference to the potential uses achievable under the provisions of the implementing technical rules of the General Urban Plan.

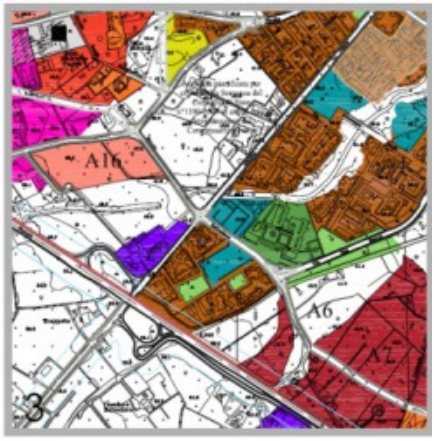
As an example, we show the environmental impact assessment of the expression of interest 1 about the *Project proposal for the implementation of a new context for public facilities in an environmental value zone named "Belvedere Area"* (Figure 3 e 4).

a)

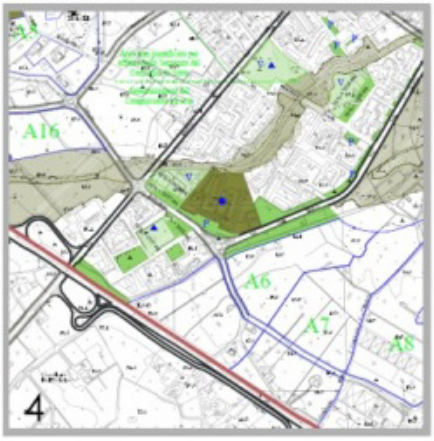


b)

Fig. 4. Localization of the expression of interest n. 1 (a); General Urban Plan - Structural Part (b)



c)



d)

Fig. 5. General Urban Plan (c) - Programmatic Part; Plan of Public Facilities (d)

The images shown in Figures 3 and 4 illustrate the localization of the expression of interest 1: the analysis of the places has allowed to understand the characteristics of the entire area subject to evaluation (morphology and geology), presence of important environmental assets, settlement context within which it is located, population density, access and use, quality of infrastructure.

These characters are the basis of the construction of the matrix of impacts.

In addition, for each expression of interest we have taken into account the possibilities of transformation required by the General Urban Plan. In this case we have taken into account the following assumptions in destination of use by assessing the impacts:

- Hypothesis n.1: realization of a Residential Area
- Hypothesis n.2: realization of a Public Facilities

As a result the phase of analysis, for each hypothesis, we have constructed the matrices of impact in order to understand which of the two possible destinations, based on the characters of the object of analysis and its peculiarities, was more impactful.

Table 3 shows how the environmental impact of hypothesis of residential area realization is much greater than that produced by the hypothesis of creating an area to be allocated to green spaces.

Table 3. Example of evaluation of environmental impact

Hypothesis n.1: Residencial Area

GEOLOGY \ RESTRICTIONS	low	medium	high
high			
medium			
low			X

ON THE NATURE \ MORFOLOGY	low	medium	high
high			x
medium	x		X
low			

GEOLOGY \ RESTRICTIONS	low	medium	high
high	5	7	9
medium	3	5	7
low	1	3	5

ON THE NATURE \ MORFOLOGY	low	medium	high
high	7	8	9
medium	4	5	6
low	1	2	3

RESTRICTIONS + GEOLOGY \ ON THE NATURE + MORFOLOGY	low	medium	high
high	7 8 9		
medium	4 5 6		
low	1 2 3	4 5 6	7 8 9

RESTRICTIONS + GEOLOGY \ ON THE NATURE + MORFOLOGY	low	medium	high
high	3	4	5
medium	2	3	**4**
low	1	2	**3**

Hypothesis n.1: Residencial Area ***Matrix of Environmental Impact*** **I = 4+3 =7**

Hypothesis n.2: Public Facilities

GEOLOGY \ RESTRICTIONS	low	medium	high
high			
medium			
low	X		

ON THE NATURE \ MORFOLOGY	low	medium	high
high			
medium			
low	X		

GEOLOGY \ RESTRICTIONS	low	medium	high
high	5	7	9
medium	3	5	7
low	1	3	5

ON THE NATURE \ MORFOLOGY	low	medium	high
high	5	7	9
medium	3	5	7
low	1	3	5

RESTRICTIONS + GEOLOGY \ ON THE NATURE + MORFOLOGY	low	medium	high
high	7 8 9		
medium	4 5 6		
low	1 2 3	4 5 6	7 8 9

RESTRICTIONS + GEOLOGY \ ON THE NATURE + MORFOLOGY	low	medium	high
high	3	4	5
medium	2	3	4
low	**1**	2	3

Hypothesis n.2: Public Facilities ***Matrix of Environmental Impact*** **I = 1+1 = 2**

In the same way, we have evaluated the impact of accessibility and usability for all expressions of interest considered. The analysis come to the following diagrams summary of environmental impacts and the accessibility and usability (Figures 5 and 6). the population.

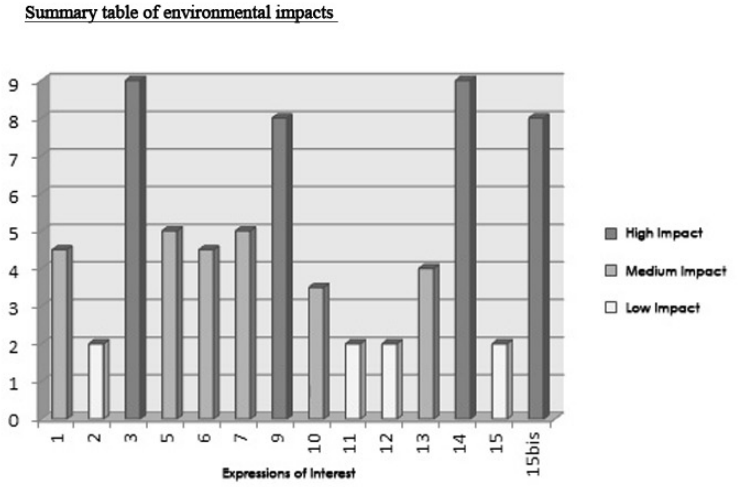


Fig. 6. Summary tables of environmental impacts

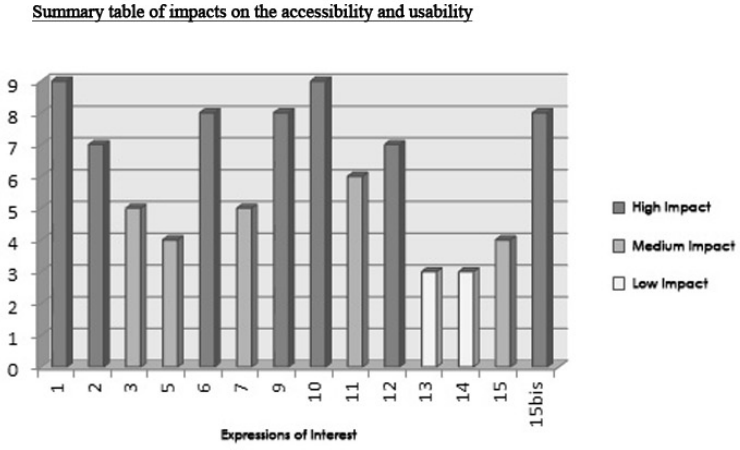


Fig. 7. Summary tables of accessibility and usability

On the basis of the results obtained integrated by the use of expert knowledge, it has been possible to construct the matrix general impacts (Table 3). Subsequently, the matrix was normalized with the assignment of the weights and the hierarchical definition of importance among the criteria as shown in Table 4.

Finally, according with literature [15], the pairwise comparison between the possible scenarios has allowed the construction of the matrix of concordance and the definition of indexes of concordance in relation to each event of interest analyzed (Table 4).

Table 4. Table of weights and the hierarchical definition of importance

		CRITERIA			
		Priority	**Users**	**Environmental Evaluation**	**Accessibility and Usability Evaluation**
ALTERNATIVES OF PROJECT - SCENARIOS	**1**	3	3	2	1
	2	2	3	3	1
	3	1	1	1	2
	5	1	1	2	2
	6	2	3	2	1
	7	3	1	2	2
	9	1	3	1	1
	10	3	3	2	1
	11	1	3	3	2
	12	3	3	3	1
	13	1	3	2	3
	14	2	2	1	3
	15	3	3	3	2
	15 bis	3	3	1	1
		25% MIN	*15% MIN*	*30% MIN*	*30% MIN*

Legenda **low = 1** **medium = 2** **high = 3**

Table 5. Table of matrix of concordance and the definition of indexes of concordance

		ALTERNATIVES OF PROJECT - SCENARIOS														**Ic**
		1	**2**	**3**	**5**	**6**	**7**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**15bis**	
ALTERNATIVES OF PROJECT - SCENARIOS	**1**		30	30	30	0	30	0	0	60	30	30	30	60	0	**25,38**
	2	25		30	30	0	55	0	25	30	25	30	30	55	25	**27,69**
	3	70	70		30	70	55	15	40	45	70	75	70	70	40	**55,38**
	5	40	70	0		40	25	15	50	45	70	45	70	70	40	**44,62**
	6	25	30	30	30		55	0	25	60	55	30	30	85	25	**36,92**
	7	15	45	0	0	15		15	25	45	45	45	45	45	15	**27,31**
	9	55	55	30	60	55	85		55	60	55	60	55	85	25	**56,54**
	10	0	30	30	30	0	30	0		60	30	30	30	60	0	**25,38**
	11	25	25	0	0	25	25	0	25		25	30	55	25	25	**21,92**
	12	0	0	30	30	0	30	0	0	30		30	30	30	0	**16,15**
	13	25	55	0	0	25	55	0	25	30	55		25	55	25	**28,85**
	14	70	45	0	30	45	55	15	70	45	70	55		70	40	**46,92**
	15	0	0	0	0	0	0	0	0	0	0	30	30		0	**4,62**
	15 bis	30	30	30	60	60	60	0	30	60	30	60	30	60		**41,54**

In this way, it was possible to determine which of the scenarios analyzed are more responsive to the sustainability objectives of the Plan of Public Facilities.

On the basis of the matrix and by the indices of concordance, the services that satisfy the needs of a wide range of users, who are found to be little impacting by a environmental point of view and with good evaluations of accessibility and usability, characterized by an index of concordance less than 28.265 are:

- Hypothesis n. 12 - Ic = 16,5
- Hypothesis n.11 - Ic = 21,92
- Hypothesis n.15tot (medium value between 15 e 15bis) - Ic = 23,07
- Hypothesis n.1 - Ic = 25,38
- Hypothesis n.10 - Ic = 25,38

- Hypothesis n.7 - Ic = 27,3
- Hypothesis n.2 - Ic = 27,69

Then, among the sixteen expressions of interest received by the municipality of Monopoli, only seven respond to the objectives that the Plan has set.

Among these, the expression of interest n. 1 and 2 are already present in the Triennial Program of Public Works 2011-2013 and therefore readily realizable and the proposals n. 7, 10, 12 and 15 may be included in the Triennial Program of Public Works 2012-2014. Finally, to include the expression of interest n. 11 among the feasible interventions, Public Administration will be required to produce a planning change of the General Urban Plan.

The multicriteria evaluation carried out leads to results consistent with the decisions of the Public Administration of the Municipality of Monopoli.

4 Conclusions

An analysis of the term evaluation as a cognitive process and author of social experiences shows, however, its importance and meaning, not just as a set of verdicts at the conclusion of a process, but, rather, the building of sense between participants, increasing a self-reflective learning process, finding unexpected significances in actions and building networks (of people, actions and thoughts).

This occurs when assessment compares to a chance for the acknowledgment on the part of participants of having worked together with one another, appreciated the involvement, and recognized their own commitment, possible struggles, as well as dangerous points and difficulties.

In this perspective evaluation may be considered not only in terms of a final outcome or an administrative procedure, intended to validate, or otherwise, participatory activities but, rather, as a working method, a "process of gradual learning" which makes sense, even when developed through small steps or partial experimentation. [17], [18], [19], [20].

The purpose of evaluation is, in fact, not simply, or solely, making judgments of eligibility but increasing, within the decision-making process, an awareness of choices made.

Evaluation is, in this sense, shown as an original item of a learning process and, therefore, becomes a critical research task producing improved consciousness and responsibility in terms of alternatives available to choose [21], particularly in the case of social and institutional interaction that is both concrete and constant.

Following Bernardo Secchi [22], the concept of scenario is quite different from that of prediction. Building scenarios is quite different from making predictions. The forecast is based on the certainty that the future performance of certain variables may be known in advance. The belief that we can pre-view, that is to see in advance, is the daughter of rationalist visions world and deductive practices associated with them [23].

The certainty of pre-diction is on the idea of having reliable data and appropriate tools. That's why scenarios appear more effective to describe a fast changing world as the contemporary.

In this case of study multicriteria evaluation methods offer a simple and qualitative way to assess different scenarios and to clarify alternatives and choices to stakeholders and inhabitants [24].

It's not the only possible way to support decision but in the contemporary planning process it seems a useful compromise between quantitative and complicated instruments and simple designed scenarios.

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