A Semiotic Approach to the Landscape Accounting and Assessment. An Application to the Urban-Coastal Areas

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Abstract. One of the most relevant issues of planning in the most landscape valuable locations, especially along the coastal ones, is to define the assessment support to be performed in order to balance the preservation of the main landscape aspects, and the local economic development. By referring to the case of the water front of Syracuse (Italy), this contribution aims at defining a semiotic pattern of accounting and assessment concerning the main topics of the Sustainable Development Plan currently in force. The assessment process takes into account the connection of the multiple thematic layers grouping the different functional/symbolic land units that are characterised by a semantic link, within an assessment pattern working as a syntactic field, by highlighting the inner interactions between them. In fact, the main concern of the pattern, is to outline the axiological layout of this landscape unit by making the "facts of nature" and the "narrations of culture" worth together.

Keywords: Landscape unit; semantic pattern; syntactic pattern; qualitative assessment; landscape assessment

1 Introduction

The water front of Syracuse is a unitary landscape identity comprising the Islet of Ortigia, the old town of Syracuse, and the peninsula of The Maddalena; they face each other closing the large inlet of the "Porto Grande" (big harbor) of Syracuse and represent, as a whole, the fair integration between culture and nature.

Due to this complexity and uniqueness, some concerns arise about the foreseeable, and partly in progress, structural and irreversible transformations, which the wide economic opportunities encourage. In order to arrange individual pressures (interests) and collective instances (values) of resilience (Davoudi, 2012; Folke, 2006), assessment typically supports the heuristic process of transforming observations into valuations and valuations into decisions (Blanksona and Greenb, 1991; Giuffrida, 2017). This process needs a robust approach based on a shared recognition and accounting of the landscape units (Tieskens K. F. *et al.*, 2017), in order to reduce the uncertainty of the non-structured observations (Dandy N. *et al*., 2011) Tempesta and Vecchiato, 2015; Haara A. *et al*., 2017) and especially in order to lead back to unity the cultural, physical and perceptive landscape components (Zagaria C. et al., 2017).

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The planning tools regulating the improvement processes are the Master Plan, the Detailed Ortigia's Masterplan, the Sustainable Development Plan (SDP). Some of the supposed changes of the coastline – the extension of the port area, for the mooring of two cruises at the Sant' Antonio pier, the enlargement and commercial exploitation of the Foro Italico dock, etc. – arise some concerns claiming the definition of the landscape quality in this area. As a consequence, the northern part of the old town, the one located in mainland, is expected to record a significant real estate market as well as Ortigia, due to its uniqueness from the landscape, symbolic and architectural value (Giuffrida et al. 2014; Gabrielli et al. 2016). In the Plemmirio park area no transformation is supposed, exceptforthe accessibility and accommodation.

Referring to theprescriptions of the SDP, we propose a general landscape assessment pattern referring to the identification of "*natural structures*, *technological infrastructures* and *cultural superstructures*" (Rizzo, 1999).

2 Materials. The Landscape Context and the SDP of Syracuse

The peninsula of Maddalena, located South of the city of Syracuse at the closing end of the large area of the "Porto Grande" (big harbour), is a calcareousMiocene plateau of tectonic Horst origin, extending up to 50 m above sea level, and lowering slowly toward the sea as far as the edge cliffs, with a coastline characterised by a various and discontinuous morphologic structures: from Capo Castelluccio to Punta Traversa it isfeatured by short beach strips, with a shallow and uniform sea bottom in some parts, and very deep in some other parts; from Punta Taverna point to Capo Murro di Porco cape, it is high and bevelled, with important geologic features (caves, cavities, siphons, abrasion pools, deep networks ofcarsick origin conduits), archaeology features, like the prehistoric site Grotta Pellegrina, and the bronze age Punta della Mola necropolis, anthropologic features such as the six Latomie, linked to the ancient and no longer existing Plemmyrion sub-urban district, or the extensive underground tunnels of Punta Mola, used as anti-aircraft base during the second world war, the network of the dry stone masonry walls of the local agriculture tradition, the "masserie" (old farmyards) and the Barone Beneventano del Bosco villa.

Many archaeological finds have been discovered here, and they are safeguarded in the Paolo Orsi museum in Syracuse. In the area between Punta Castelluccio point and Caladelle Rive Bianche bay some phenomena of erosion and collapsing of the cliff occurred, with rock crops sliding to the sea, and the danger of further subsidence.

The central and southern areas of the peninsula are characterised by an intense holiday homes and farmyards building activity; moreover, it has a footpath and road network on dirt or stone ground, that may be redeveloped for tourism or leisure purpose (fig. 1). The SIC called "Saline di Siracusa e fiume Ciane" – ITA 090006 is located South of the estuary of the rivers Anapo and Ciane; the one called "Capo Murro di Porco, Penisola della Maddalena e Grotta Pellegrino" - ITA090008 (79/409/CEE e 92/43/CEE directives) is located in the eastern side of the Maddalena peninsula; here, the Natural Reserve of Plemmirio (1435 ha) was established by Decree of the Ministry of the Environment on 15/09/2004.

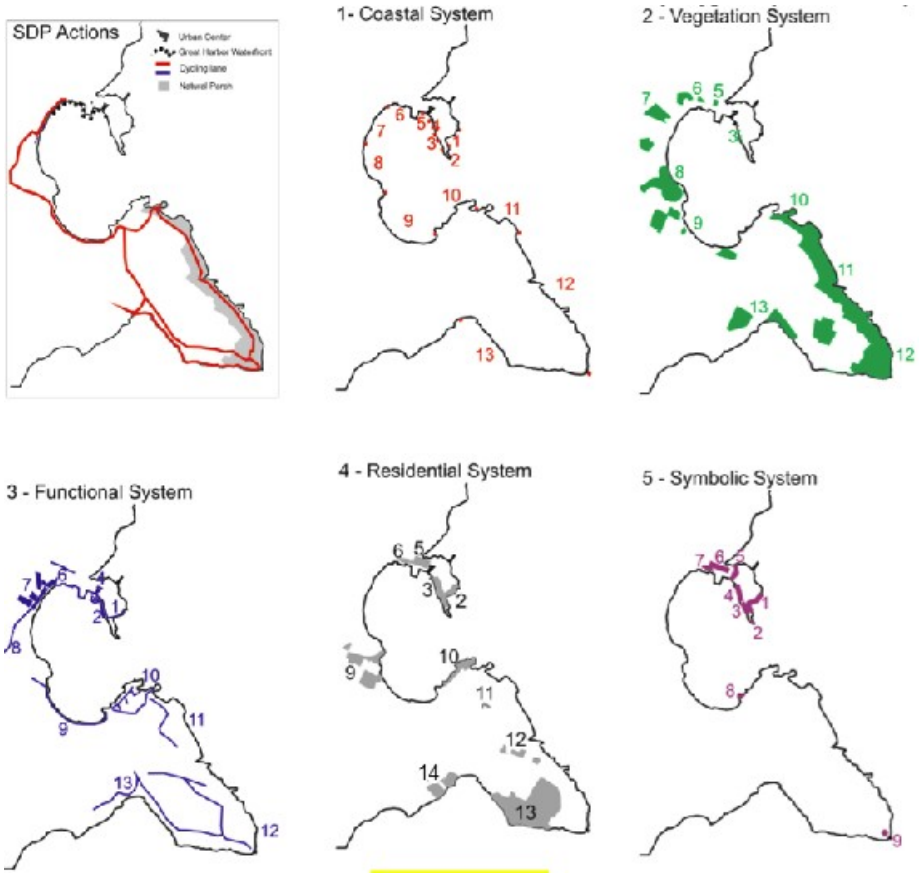

Fig. 1. Landscape systems and landscape units.

The urban and monumental scenario of Ortigia and Maniace Castle – that is the architectural background in front of which the natural contest of Plemmirio increase its landscape value – works as counterpoint to the naturalistic dimension of the Maddalena. A heterogeneous set of landscape units in conflict is located alongside the coastline between them: the Pantanelli industrial area progressive dismantling, extending from the seaplane base to the estuary area of Ciane and Anapo rivers; the Anapo-Ciane Oriented Natural Reserve, comprising the EU interest site of the "Pantanidelle Saline" South of the estuary of the two rivers; the southern part of the gulf (via Lido Saraceno – via La Maddalena), dotted by sprawling cottages, extending along the system of promontories and small bays between Punta Faro and Punta Castelluccio, where large hotel is located. The eastern coastline of the peninsula, extending from Punta Mola to Capo Murro di Porco, is preserved free of constructions in an average 350-meter width belt.

The Strategic Sustainable Plan (SSP) (2006) includes five Strategic Projects:

SP 4: Urban Center and the Research and Environmental Education Centre within the former Enel buildings to be renovated;

SP 5: improvement of the Pantanelli water front, supposing the removal of some inappropriate buildings, roads, pavements, furniture and street lighting;

SP 6-7: cycling lanes, the first from Ortigiato the Anapo-Ciane Reserve; from Anapo-Ciane Reserve to the Maddalena peninsula.

SP 8: Maddalena Natural Park, a 236 hectare area extending from Castelluccio Cape to Milocca Cape, including the CommunitarianInterestSite ITA A090008 "Capo Murro di Porco, Penisola Maddalena e Grotta Pellegrino".

3 Methods

As a landscape unity, this area works as a semantic chain, i.e. a set of semantic units (signs) interpreting each other, so that the modification in significance of a single item affects the significance of the most similar or close ones.

This textual structure is characterised by tensions due to the typically consonant or dissonant, constructive or destructive, convergent or divergent signs. These tensions can be assessed by referring to many criteria of *structural* (natural), *infrastructural* (technological), *super-structural*(cultural) type.

The proposed model establishes:

- semantic relations, defining the internal consistency of signifier (LU) and significance(valuation)based on causal or intentional correspondences;
- syntactic relations, defining the external consistency of LUs, based on motivational and conventional correspondences.

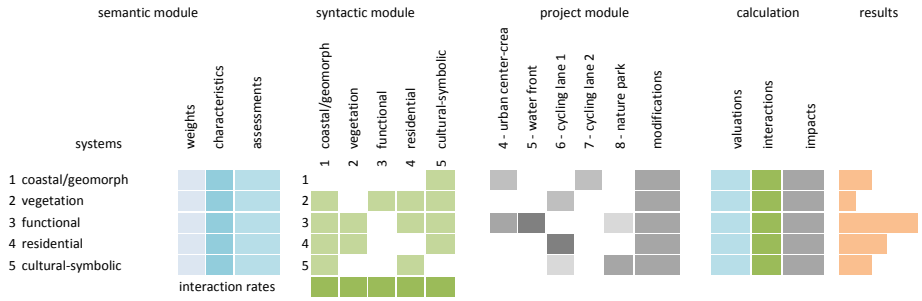

Fig. 2. General valuation pattern scheme

The pattern works as a set of impact coaxial matrixes composed of the Lus in rows and some blocks of columns: the syntactic and semantic modules, the set of actions, and the calculations-results one. The semantic module associates a value to each LU according to the well-known method of the value functions. The syntactic module

links the signs to each other, individuating the (positive/negative) interactions between the values of the Lus.

The model is composed of the vector of the valuations the 52 Lus: an impact matrix with 15 columns (5 actions x 3 impact types) and 52 rows; an interactive matrix with 52x52 elements that quantifies the influences between the Lus (fig. 2)

3.1 Semantic Module

The semantic module defines the relation between the LUs as described by their characters (indicators) and their values. The module:

- identifies the Lus as potential impact bearers (*extension*E, *importance*I, *700dentifies*) grouped in five systems (Blackstone and Greenb, 1991): 1. *Coastal-geomorphologic*, 2. *Vegetation*, 3. *Functional*, 4. *Residential*, 5. *Cultural*(Davoudi, 2012; Folke 2006; Gunderson et al. 2010);
- attributesof a weighing system w, where w_{E_i}, w_{I_i} and w_{R_i} are the weights of $LU_i - th$, for E, I, andR criteria and such that $\sum_k^{E,I,R} w_k = 1$;
- 700dentifies value for each $LU_i - th$function of E_{LU_i}, I_{LU_i} and R_{LU_i}in a dimensionless scale ranging from 1 to 5;
- defines "the level of axiological participation" for $LU_i - th$, namely p_i, where$p_i = E_{LU_i} w_{E_i} + I_{LU_i} w_{I_i} + R_{LU_i} w_{R_i}$;
- characterises of Lus in regarding its belonging to the natural structuresS_N, to the technological infrastructures $I_T$and to the cultural superstructures and SS_C;
- identifies of a weighing system t , where $t_{S_{N_i}}$, $t_{I_{T_i}}$ and $t_{SS_{C_i}}$ are the weights of $LU_i - th$, forS_N, I_T and SS_Ccriteriaand such that $\sum_s^{S_N I_T SS_C} t_s = 1$;
- identifies a value for each$u_i - th$function of S_{N_i}, I_{T_i} and SS_{C_i}in a dimensionless scale ranging from 1 to 5;
- evaluates$V_i$the value for each Lus by the formula$V_i = \sum_{i=1}^{n} u_i p_i t_i$, and where n is their number. This value is modified by the actions included in the plan, as explained in paragraph 5.2.

3.2 Syntactic Modul

The syntactic module formalises the horizontal relations, (communication), binding between themselves several signs, LUs, representing the axiological interactions activated by the foreseen modifications. It is the last passage of the whole valuation, and reanalyses the judgments assigned to the single components, considering their complementarity with all the others; therefore, it provides a different valuation according to the type of connection and the entity assigned to it. It is articulated in three activities, the first organizational, the second instrumental, the third of verification.

Individuation of the interactions. The organizational activity consists of the description of the interactions between the landscape units, starting from their aggregations in systems (Weinstoerffer andGirardin, 2000) in one double entry matrix where the LUs are put in line and in column. The cells contain a-dimensional

scores, x_{ij} (from 0 to 2), that quantify the syntactic connections between the different systems by means of the description of the interactions between each LUs component of one system and those of another one. When there is no interaction the coefficient will be 1, if the i unit has a positive impact on the j unit the multiplier will be > 1, and in the opposite case it will be < 1.

Connection with the semantic model. The instrumental activity consists in the definition and choice of the most suitable algorithm to take into account the relations described by the coefficients. In the present case the model of the Interactive Matrix proposed by F. Rizzo (1989, 2003) was chosen. In this case the connection between the system of the interactions and the values placed on the main diagonal of the matrix, $x_{ij}(i = j)$, called levels of action of the criteria, is provided $by\ v_j = \prod_j x_{ij}$, where v_j is the "total level of action of the criterion", and therefore, in this case, the semantic value of the landscape unit, which is influenced by the interactions with all the other ones.

Analysis of sensitivity and of scenario. The verification activity includes: analyses of sensitivity, concerning the variation of the interactions, performed through a multiplier that modifies them, in order to individuate the LUs that are more influenced by the system effect; scenario analyses, consisting in the implementation of the different "axiological strategies" through the variation of the λ_j weights associated to the different landscape units and integrating those calculated in the semantic analysis. The λ_j weights have a higher project intentionality, and are utilised in the phase of choice between options, participating in the calculation of the "total assessment level", $V = \sum_j v_j \lambda_j$.

3.3 Regulatory Aspects

The synthesis of the two modules converging to the proposed model (SSM), fulfils in the framework of the European and national legislation, as follows:

- according to the European Landscape Convention (ELC) (2000), art. 131 of L.D. no. 42, Italian Code of Cultural Heritage and Landscape (2004), art. 1a of L. no 9. (2006); art. 3 of L. D. no. 157 (2006); art. 2.1.a) of L.D. no. 63 (2008) the SSM:
    1. defines a landscape complex as a semantic field, i.e. a set of signs linked to each other by consistent and resilient communicative relations;
    2. evaluates the landscape complex by integrating the *signification*-*value* of the individual (natural/human) items that make up it, within an internal and external *communication*-*values* system;
    3. allows us to: a) appreciate the value of the different combinations of LUs; b) identify the differences between the individual evaluations; c) provide the valuation of the landscape complex as a whole;
- according to the ELC (2000)and the L. n. 9/2006, the SSM:
    1. supports public administrators in implementing general principles, strategies and guidelines by means of scenario analysis (art. 1.b);
    2. supports valuators in outlining sustainable development patterns inasmuch as it allows them to recognise the most sensitive and resilient items that can be differently affected by the actions (art. 1e);

3. supports decision making in identifying strategies for an efficient land government by integrating the values of the single items(ib.);
4. takes into account natural, rural, urban and peri-urban spaces, terrestrial landscapes, inland and marine waters – typically: 1. Coastal-geomorphologic systems, 2. Vegetation, 3. Functional areas, 4. Residential settlements, 5. Cultural/symbolic units – by distinguishing the LUs as exceptional, of daily life and degraded (art. 2):
5. promotes the conservation, management and planning of landscapes (art. 3);
6. promotes global objectives according to the principle of subsidiarity, taking into account the European Charter of Local Self-Government (art. 4)
7. promotes the legal recognition of the landscape as an essential component of the context of people's lives, an expression of the diversity of their common cultural and natural heritage, and the foundation of their identity (art. 5a);
8. supports the analysis and implementation of policies for protection, management and landscape planning through the adoption of the specific measures referred to in art. 6 of the ELC (art. 5b);
9. supports the integration of the landscape into the planning land, urban, cultural, environmental, agricultural, social and economic policies (art. 5d);
10. fosters the implementation of: Awareness, Education, Identification and Evaluation, Landscape Quality Objectives, Application (art. 6).

4 Implementation and Results

4.1 Semantic Module

The value map given by the semantic analysis highlights a heterogeneous framework of the landscape disunity due to the juxtaposition of excellence and decay. The valuation model highlights the highest quality areas and the criticalities, their absolute or intrinsic value, and the relative or extrinsic value they acquire by the different records of weighing and scoring.

	landscape units												
systems	1	2	3	4	5	6	7	8	9	10	11	12	13
coastal	3,3	3,4	2,4	2,2	1,5	0,9	1,1	2,3	2,0	4,3	4,2	3,5	2,3
vegetation	0,0	0,0	2,2	0,0	2,2	1,7	0,9	4,1	1,0	1,6	1,2	0,6	0,6
functional	3,2	4,1	4,1	2,6	2,6	2,0	1,0	1,0	1,3	1,5	0,7	0,4	0,4
residential	2,2	3,7	4,4	4,4	3,7	1,2	1,2	1,2	1,6	2,3	1,0	1,0	1,6
symbolic	0,0	4,7	2,6	3,7	3,4	0,9	0,9	3,8	1,2	1,2	1,2	1,2	1,2

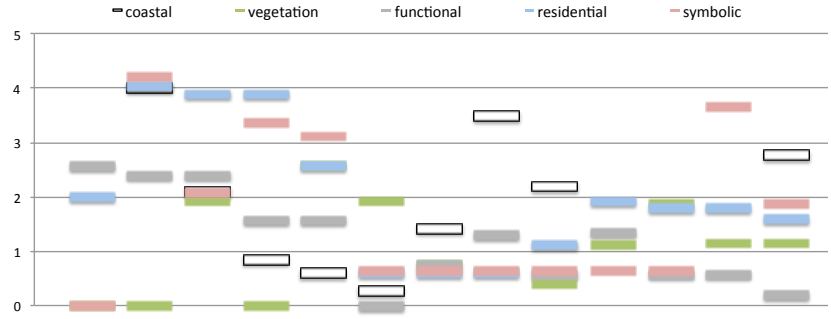

Fig. 3. The value map: graphical/numerical representation

The map represents the prevalence of the cultural features in Ortigia, of the functional and environmental disvalues in the industrial and harbor area, the building parasitism of the zone underlying the salines, the seizure of the highest quality area, the system of inlets between Punta Castelluccio and Punta Mola; the latter closes the large inlet of Porto Grande harbor, and faces Maniac Castle, claiming the function of natural counterweight. Compared to this wound to the potential best combination of the whole unity, the Reserve of Plemmirio, despite being appropriate and even necessary, becomes a mere alibi. The value map partly indicates the forms of axiological non-congruity of the different systems compared, and the conflicts of the different, sometimes divergent development lines as well. A graphical/numerical representation of it (fig. 3) may be attempted, indicating with a different colour for each of the five systems the value (*y axis*) of each landscape unit (*x axis*) (Trovato and Giuffrida, 2014).

4.2 Syntactic Module

The results of the interactions' analysis highlight the value system of the landscape complex, and allow us to assess the difference between the valuations of the single elements and those of their combinations in unities (Giuffrida*et al*., 2016). Among the examples of LUs integration, the one between ManiaceCastle and Punta Castelluccio-Punta Mola is the most significant: considered separately they assume respectively the residential and symbolic functions, while in the syntactic context of the territorial unity they acquire the maximum landscape tension (geographical, historic and symbolic), at the top of the constructive opposition "nature *vs* culture".

As a consequence the building activity on Punta Castelluccio turns out incongruous, as it attenuates this opposition. In a context in tension even punctual modifications can break the semantic chain compromising the significance of the

context (Naselli et al. 2014). The comparison of the two assessments without project, no-interaction (*Vninp*) and with-interaction (*Vwinp*) is shown in fig. 4, where all the landscape units are displayed in the *x-axis*, and the valuations in the *y-axis*.

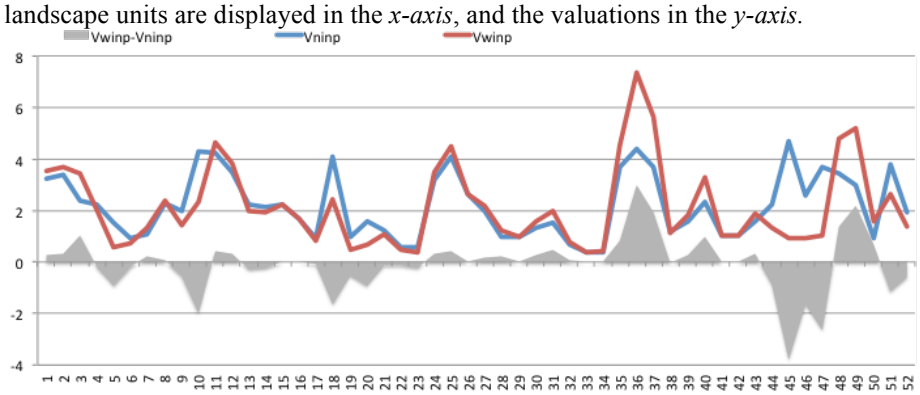

Fig. 4. Comparison of the with-interaction and no-interaction assessments

The graph highlights in grey the effect of the interactions as difference in terms of landscape value: in a positive sense, an advantage of the residential and symbolic-cultural system of the less fine areas, (47-50) that anyway are beneficiaries of a favourable context; in a negative sense a disadvantage: of the natural, geomorphologic and vegetation system, due to the urbanization of the coastline area comprised between the seaplane base at the estuary of Anapo-Ciane rivers, and the streets Sacramento-Maddalena (4-6; 9-11; 18-23); of the symbolic-cultural system of the monumental southern area of Ortigia, as a consequence of the building activity and of the seizure of the naturalistic system comprised between Punta Faro and Punta Castelluccio from public use.

The sensitivity analyses concern the variation of Total Action Degree (TAD) as effect of the variation of the weights in order to select the most influential criteria, while the analyses of scenario concern the TAD variation regarding the modulation of strategies, that value from time to time the natural structures, the technological infrastructures and the cultural superstructures. The results are reported in fig. 5.

	ext	imp	res	TAD	elasticity		NS	TI	CS		elasticity
1	0,3	0,0	0,7	100,25		1	1,0	0,0	2,0	108,14	
2	0,3	0,2	0,5	101,10		2	1,0	0,5	1,5	104,36	min -3,5%
3	0,3	0,3	0,3	101,95	0,85%	3	1,0	1,0	1,0	101,95	med -6,4%
4	0,3	0,5	0,2	102,79		4	1,0	1,5	0,5	100,92	max 0,3%
5	0,3	0,7	0,0	103,64		5	1,0	2,0	0,0	101,27	
6	0,7	0,3	0,0	97,81		6	2,0	1,0	0,0	101,16	
7	0,5	0,3	0,2	99,88		7	1,5	1,0	0,5	100,69	min -0,5%
8	0,3	0,3	0,3	101,95	2,12%	8	1,0	1,0	1,0	101,95	med 8,4%
9	0,2	0,3	0,5	104,01		9	0,5	1,0	1,5	104,93	max 4,5%
10	0,0	0,3	0,7	106,08		10	0,0	1,0	2,0	109,63	
11	0,0	0,7	0,3	107,77		11	0,0	2,0	1,0	103,43	
12	0,2	0,5	0,3	104,86		12	0,5	1,5	1,0	102,52	min -0,9%
13	0,3	0,3	0,3	101,95	-2,70%	13	1,0	1,0	1,0	101,95	med -1,5%
14	0,5	0,2	0,3	99,03		14	1,5	0,5	1,0	101,72	max 0,1%
15	0,7	0,0	0,3	96,12		15	2,0	0,0	1,0	101,84	

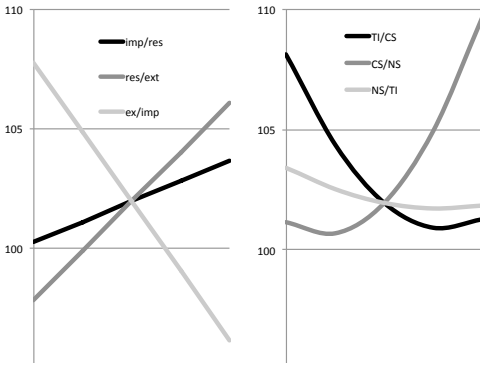

Fig. 5. Syntactic assessment module: results and sensitiveness analysis

5 Application, Results and Discussion

The implementation of the five projects, articulated in the different actions that turn out relevant for the modification of the landscape value, produces the impacts represented in the graph of fig. 6 that highlights the different characteristics of the 52 landscape unities as above described.

The modifications of the different actions on the landscape units are represented, in terms of percentage value variation, by three viewpoints, the one of the impact intensity, the one of the impact reversibility (or duration), and the one of the impact ramification (space-time extension of the indirect forecasted or expected effects).

The combination of these assessments gives the value of the impact for each landscape unit, calculated by taking into account the interactions (I_{ni_i}) or not (I_{wi_i}): $I_{ni_i} = V_{niwp_i} - V_{ninp_i}$; $I_{wi_i} = V_{wiwp_i} - V_{winp_i}$

Due to the types of action, the total impact on each landscape unit is mostly positive. The main impact concerns the actions supposed for: the area of the Urban Center, which some positive effects are expected from, all over the S. Antonio neighborhood, especially in terms of real estate increase in value; the area of Plemmirio Natural Park, where both naturalistic and cultural interventions and initiatives are envisaged. Although positive, the impacts, due to the small dimension of the interventions, are irrelevant, and a comparison between with and without project statuses is scarcely significant.

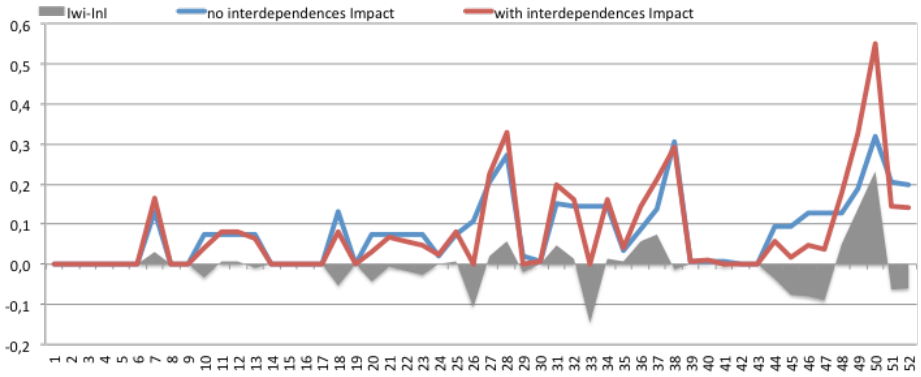

Fig. 6. Impact for each landscape unit, calculated with and without interaction

The difference between "with-interaction impact" and "no interaction impact" valuations highlights: the negative effects of the Pantanelli industrial area on the nearest Ciane-Anapo CIA area (18), the negative effect of the enhancement of the Darsena area (26); the modifications needed by the improvement of some naturalistic areas of the Park (33); the impact of the modification of the waterfront in the area of the Foro Italico; the effect of an improvement of tourism on some natural areas (45-47). The valuation of these areas is higher if interactions are not considered.

6 Conclusions

The proposed model works as a platform for an analysis finalised to orientate "landscape regeneration strategies", identifying, on the one hand, their most sensitive elements, that are influenced negatively by the interactions, on the other hand the most capable ones, that are influenced positively by the latter.

Basing on the performed valuation, we deduce that the actions envisaged by the planning tools don't deal in depth and extensively as necessary with this territorial complex in its most peculiar aspect, the landscape one, and propose instead punctual and linear interventions with a scarce engaging capacity, considering the inertia of a territory whose invasive human settlements would demand, in some of its large areas, consistent reconversion actions. As a consequence, relevant criticalities persist:

- the large Pantanelli area, apart from the semantic poverty and the syntactic strangeness to the context, arises physical, environmental and functional necrosis;
- the increasing pressure of the large scale harbor activities in the area of S. Antonio pier and Foro Italico;
- the building aggression in the part of the coastline suitable for bathing.

In the articulation of the valuation path, the semantic analysis allowed to start a reflection on landscape in terms of value instead of elements, while the syntactic analysis allowed, in extensive sense, to reason on the landscape in terms of relations, and to consider it, therefore, as form instead of image of the territory.

Despite operating in the folds and shadows of a structural information incompleteness, the model allowed to keep the process of attribution of the value judgment in a general level useful to compare heterogeneous territorial aspects, and to perceive the coalescence to an aim: the landscape as substance of the value of the inhabited territory.

Acknowledgments. The paper must be equally attributed to these authors.

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