Industrial Areas and the City. Equalization and Compensation in a Value-Oriented Allocation Pattern

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Abstract. This study deals with the allocation of the firms in a large industrial area of Quarto, a town in the Naples' district subject to a "Piano di Insediamenti Industriali" – PIP (Industrial Settlement Masterplan). The main concern of the Municipality is the fair integration between environmental issues, economic development and urban identity. Therefore a structured evaluation process, based on a survey about the company profiles and their geographical location, has been carried out in order to make the plan meet the needs of the firms, and to select the best companies to settle in the planned area. A "generative" MAVT pattern has been designed to outline several layout options and to select the best ones. The model also includes equalization and compensation elements by whose means it is possible to determine the extraordinary planning permission fees for the different areas where the firms are located.

Keywords: Industrial areas · Sustainable land planning · MAVT · Equalization · Compensation

1 Introduction

Over the last years many land development projects concerning the location of production activities were made without taking into any account the local social and territorial features. This often prevented the full achievement of the objectives such proposals were aiming at, largely crippling the work of the public and private stakeholders involved in the design and realization of these projects. In Southern Italy this is confirmed by the numerous IDAs (Industrial Development Areas) that are still empty or largely incomplete because of the failure or lacking of a preventive assessment of the local needs and opportunities of integration with the territory where they have been placed [1]. This study deals with the "Piano di Insediamenti Industriali" PIP of Quarto, a town located in the Flegreo area, Naples District. PIP, which is an industrial area settlement plan, has identified in its rural territory the areas to allocate as pole of development for the enterprises of the whole district. In this area, the original agricultural use is still prevalent although it has been gradually replaced by residential and industrial uses as the result of a slow but inexorable process of urbanization. This urbanization has been a spontaneous and illegal process and, recently, has been accompanied by the construction of

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road infrastructure planned by an "extraordinary" commissioner, thanks to laws and programmes enacted after the earthquake that damaged the area in 1980. The paper proposes an innovative intervention approach centred on the features and the real needs of the connective fabric of the enterprises – that are local and from the whole Flegreo area as well – and capable of achieving an efficient process of settlement for the enterprises themselves. This approach uses a model which integrates the results of preliminary analysis, evaluation, choice and design, for selecting those firms which are more qualified in kick-start local economy while respecting cultural, environmental, and urban values.

Quarto's PIP is a tool for managing the realization of an integrated centre of research and development, according to the following purposes:

- To promote social-economic development (high level and stability of employment, quality of work) giving preference to firms that are linked to local economic networks, cooperatives owned by young people, etc.;
- To protect environmental resources by locating those innovative firms that produce low-level of pollution and use high-level of information;
- To select compatible enterprises able to activate positive synergies;
- To achieve a functional integration of industrial areas into the urban structure.

The change of land use and accessibility through planning produces the unavoidable effect of modifying the land market values, at urban level between PIP's areas and other urban areas, and at micro-territorial level among areas on which the construction of new buildings or urban infrastructures is planned. Equalization between landowners is been widely discussed and two models of equalization are been proposed: "areal" equalization, when the development rights are equals for all lots in an urban area; "extended" equalization, when the development rights are the same across the entire city. The latter model can be implemented by means of the Transferable Development Rights (TDRs) based on the idea that the development right can be separated from a specific parcel and transferred to another one. The two families of TDRs (zoning-integrative and zoning-alternative TDRs) have been in use for several decades in U.S. and Europe despite some criticism [2–5].

The PIP's drafting constitutes, therefore, the opportunity to reconfigure the flow of benefits and the equalization of wealth (rent) produced by planning. The flow of benefits is generated by natural landscapes, low cubage index, etc., and comes from the stock of local territorial resources and the cost opportunity which must be sustained by the citizens in the status quo (referring to the lost development of underused areas). The rent is a plus-value also called betterment, unearned increment or windfall profit [6]. There are two types of plus-value capture mechanism for financing public works and facilities [7]: direct by means of taxation and indirect by means of many tools such as developer obligations, infrastructure levy, impact fee or linkage, developer agreements, incentive zoning, transfer of development rights [6]. In Italy, many plans have adopted plus-value capture indirect mechanisms such as compensation, negotiation, or private-public partnership [8–11].

A multicriteria model has been elaborated to help the planning decision process realize PIP by selecting and locating the enterprises in the area; this model also includes a model of financial analysis used to base PIP's sizing on principles of equalization and

compensation, and consequently to decide which areas should be given to enterprises and which planning permission regulations should be applied. The fair integration of subjective (land owners, entrepreneurs, public) and objective (land, identity, environment) targets is the general aim of the proposed model.

2 Materials

The PIP's final draft may be considered as the conclusive phase of the design process that began many years ago with the preliminary plan, which was an intermediate confirmation of some design solutions and proposed rules, and a tool for the consultation of the potential users of the plan itself, that identify the motivation for their investment and entrepreneurial risk in the project quality and in the procedural credibility. In particular, the preliminary plan highlighted some key issues:

- The relationship with the existing Master Plan and the objective difficulty in interpreting its choices and provisions;
- The demand analysis and the pre-qualification of firms to be located;
- The implementation procedure that, proposing a tool alternative to expropriation, introduced some basic choices subsequently adopted in the final draft.

PIP comprises a mostly flat area of 50 hectares at the Southwest base of the hills surrounding the Quarto's valley (Fig. 1). In this local context, the main infrastructures, such as the historical railway and the road system, are instrumental for defining the geographical references and the most important boundaries of the PIP's area. The North side of the planned area is delimited by the Circumflegreo railway and the Quarto's channel (the latter covered by infrastructures built after the earthquake); the East side is delimited by the Railway Naples-Rome; the South side is delimited by via Grotta del Sole (which defines the border with the Pozzuoli municipality); the West side is delimited by Via Spinelli.

Fig. 1. Modelled view of Quarto's PIP

The approved Master Plan allocates most part of the territory comprised in the triangle delimited by the former Quarto's channel, the railway Napoli-Roma and Via Grotta del Sole, to the industrial-handicraft use. The plan also identifies several areas with different functions: Da (existing industrial area), Db (industrial area to be planned),

Dc (areas for research, programming, testing, and industrial facilities), and Dd (areas for small firms and handicraft).

PIP can be also considered as an urban redevelopment project that uses the envisaged new constructions and public spaces to give order to the unregulated spontaneity of the buildings realized in that area. PIP pursues a set of objectives that can be grouped into five classes of needs (that are themselves divided into some classes of requirements) on which the Implementing Technical Standards (ITS) are based (Fig. 2). The classes of needs are: security, usability, environmental quality, morphological quality and management. The evaluation process that supports the executive project of PIP comprises the following steps:

- Selection model of the firms basing on the specific features of the companies currently settled or to be settled, and the requirements of environmental, social and economic qualification;
- Assessment model of private and public costs and revenues of the investment property for new buildings;
- Equalization and compensation model that guarantees a transparent participation and redistribution of revenues and costs between public and private stakeholders involved in the transformation process of the areas.

Functions	Development			Building area			Green void area			Covered area			Built-up area		
	Sect 1	Sect 2	Sect 3	Sect 1	Sect 2	Sect 3	Sect 1	Sect 2	Sect 3	Sect 1	Sect 2	Sect 3	Sect 1	Sect 2	Sect 3
Existing buildings															
Crop fields		34.000	14.000		34.000	14.000					5.100			5.100	
Agric. outbuildings												2.100			2.100
Factories/crafts		47.130	104.619	22.542	47.130	104.619	9.017	18.852	41.847	9.017	18.852	41.847	10.820	22.622	50.217
Advanced tertiary		47.130	104.619	22.542	47.130	104.619	451	943	2.092	1.127	2.356	5.231	2.254	2.356	5.231
Tertiary service		47.130	104.619	22.542	47.130	104.619	451	943	2.092	1.127	2.356	5.231	2.254	2.356	5.231
Public facilities		2.409	10.553	3.045	2.409	10.553	1.066	1.204	3.693	913	723	3.166	913	1.445	6.332
Public green		1.579	15.955	17.254	1.579	15.955									
Sport equipment			8.658			8.658									
Publi voids															
Driveways	520														
Pedestrian/cycle	115														
Squares		228	4.434	409	228	4.434									
Parking lots		3.981	8.275	2.503	3.981	8.275									

Fig. 2. Synthesis of the main quantities of PIP (by cubage ratio equal to 2 cm/sqm; cover ratio equal to 0,3–0,4 sqm/sqm).

3 Methods and Procedures

3.1 Objectives, Data Sources, Information

In the perspective of the actual feasibility of PIP and its adequacy to the stakeholders' expectations, an innovative solution is proposed, and it is based on the integration between knowledge, assessment and design through a continuous and constant feedback between all the different skills involved.

The innovations introduced in the process can be summarized as follows:

- Analysis: study of the PIP's end-user, by means of the call for the preliminary qualification of the enterprises aimed at the knowledge of the real demand of localization.

- Assessment: identification of the economic (private and public conveniences) and financial (ability to sustain current and future costs) conditions suitable for establishing a consortium of firms and a consortium of landowners as well. These consortiums may become unitary interlocutors able to dialog with the municipality to create the conditions to have access to the lots and to apply equalization and compensatory processes to make development and urbanization harmonious.
- Design: dimensioning of lots and public works on the basis of the demand for industrial land use.

In particular, the analysis of the demand for localization in suitable areas by the firms of the Flegreo territory is divided into two phases: the first one is developed through a sample field survey; the second one is carried out by launching a call for the preliminary qualification of some firms that could be potentially located. The references for this qualification process are related to the production layout and the used spaces, and the management and organization profile as well, in order to know the demand for space, the best organization of space itself, and the demand for facilities for local firms. Information from various sources (such as ISTAT, Chamber of Commerce, trade associations, consortia) and from a specific questionnaire is collected in a sheet for each of the 94 companies that have been consulted. The collected data concern: Company name; Localization; Type of entrepreneur; Type of activity; Company size; Availability to form consortia; Availability to relocate; Typology of the production process; Standard working hours; Settlement model (lot geometry and aggregation scheme); spatial organization (surfaces, volumes and functions); Agglomeration economies; environmental monitoring capability; Location with respect to the city centre and to the residential fabric; Compliance with environmental standards; Job security; Geography of activities, processing and equipment; Innovation; Development programs; Liquidity (assets and liabilities in the last three years); Financial autonomy (net assets, fixed assets). For new enterprises it is also specified: Project validity; Type of initiative; Potential markets; Employment impact; Environmental impact; Cover expenditure.

The detailed data are translated into scores and made available for the development in the multidimensional model for analysis and assessment. The model, that could be also linked to a Gis-Spreadsheets model [12], incorporates economic aspects in order to activate equalization and compensatory mechanisms by means of which the externalities due to the development process may be internalized. The most important aspect of this integration is the correspondence between the extraordinary planning permission fees and the profile of those enterprises considered the most suitable ones for being located in a certain area. The more an area is suitable for receiving activities that have the greatest impacts and the highest profits, the higher the fees (and vice versa). The need for efficiency, transparency and simplicity of the process of allocation of the areas to firms, and for integration of quantitative-monetary and qualitative assessments, requires the implementation of a multi-criteria evaluation model of MAVT type.

3.2 The MAVT Approach to Select and Allocate the Enterprises in a Sustainable Way

MCDA is a field of research which is concerned with the structured evaluation and support of decision problems with multiple criteria and uncertainty [13]. They are considered as explicitly subjective decision analytic technique in which value judgements are obtained and modelled through multi-attribute value and utility functions [14]. The distinction between value and utility functions is that the former incorporate no notion of risk attitude and thus apply in conditions in which there is no or, more likely, negligible uncertainty. The latter explicitly acknowledge risk and are suited to decision making under uncertainty, but require more information from the decision makers. The multi-attribute value theory (MAVT) (MultiAttribute Value Theory) [13–16] provides methods to structure and analyse decision problems by means of attribute trees (also called value trees) and to elicit the relative importance of criteria in this setting. In an attribute tree, the overall goal or objective is divided hierarchically into lower level objectives (also called criteria) and measurable attributes (also called lowest level or leaf criteria). A decision alternative x is evaluated on each attribute, i, by means of a value function $v_i(x)$. Under the assumption of mutual preferential independence of attribute, the standard additive aggregation rule can be used [14]. Them the overall value of an alternative x is evaluated as:

$$V(x) = \sum_{i=1}^{n} w_i v_i(x) \tag{1}$$

where n is the number of attribute, w_i is the weight of attribute i and $v_i(x)$ is the rating of an alternative x with respect to attribute i. The sum of the weights is normalized to one and the component value functions $v_i(x)$ have values between 0 and 1. The weights w_i indicate the relative importance of attribute i changing from its worst level to its best level, compared with the changes in the other attributes [14, 15].

It should be stressed, however, that for a justified implementation of the additive model some requirements of MAVT concerning the problem under investigation should be held, especially the preferential independence requirements [14, 15]. MAVT relies on the assumption that the decision-maker is rational, preferring more value to less value, and that the decision-maker has perfect knowledge, and is consistent in his judgments.

MAVT can be used to address problems that involve a finite and discrete set of alternative options that have to be evaluated on the basis of conflicting objectives. For any given objective, one or more different attributes or criteria, which typically have different measurement scales, are used to measure the performance in relation to that objective [14]. MAVT can handle quantitative as well as qualitative data. If quantitative data are not available, expert judgments can be used to estimate the impacts on a qualitative scale. The intention of MAVT is to construct a means of associating a real number with each alternative, in order to produce a preference order on the alternatives consistent with the decision maker value judgments. This function is used to transform the evaluation of each alternative option on considered attributes into one single value. The alternative with the best value is then pointed out as the best [17]. Following this reasoning,

it becomes clear that MAVT aggregates the options' performance across all the criteria to form an overall assessment and is thus a compensatory technique [18].

The process to be followed to build a MAVT model consists of the following five fundamental steps [19]:

1. defining and structuring the fundamental objectives and related attributes;
2. identifying alternative options;
3. assessing the scores for each alternative in terms of each criterion;
4. modeling preferences and value trade-offs: elicitation of value functions associated with objectives and attributes and assessment of their weights;
5. ranking of the alternatives: a total score is calculated for each alternative by applying a value function to all criteria scores.

In the development of a MAVT model is importance to express the perceived values on the impact that the options under consideration can have. The perceived values can be used to measure the relative worthiness of each impact of options. The preferences can be modeling by constructing a value function, that is a mathematical representation of human judgments on the considered options. The value functions are an analytical description of the value system of the individuals involved in the decision and aim at capturing the human judgments involved in the evaluation of alternatives. In particular, a value function translates the performances of the alternatives into a value score, which represents the degree to which a decision objective (or multiple decision objectives) is achieved. The value is a dimensionless score: a value of 1 indicates the best available performance and a high objective achievement, while a value of 0 indicates the worst performance and a low objective achievement. The decision makers don't express their preferences and values by using a similar dimensionless score from 1 at 0, and then the value functions have to be estimated through a specially designed interviewing process for them. A focused interviewing process to extract the preferences and values of decision makers can be used to identify the relevant judgments for the decision. The generated relevant judgments can be organized and represented analytically in to support the MAVT model. In this regard, the generating process of the values functions can be considered as an approximate representation of human judgments that have been identified in the interviewing process.

In literature many approaches define the value functions [20]: direct rating technique [15]; curve fitting; bisection; standard differences; parameter estimation; semantic judgment. About the weighting criteria, the literature proposes many different methods. It has been generally agreed that the meaning and the validity of these criteria weights are crucial in order to avoid improper use of MCDM models and the procedures for deriving criteria weights should not be independent of the manner they are used [21–23].

In the MAVT approach, the weights in the additive model are scaling constants, which allow marginal value functions to take on values in the same interval. Weights or scaling constants can be estimated using several techniques. There are two broad categories of weights, namely numerical estimation and indifference weights [15]. Ranking, direct rating, ratio estimation and swing weights belong to the numerical assessment category while the trade-off method comes under the indifference judgment

category. This study uses the direct technique rating for the determination of the value functions and the swing-weights technique for the weights.

3.3 Equalization and Compensation

PIP's profitability and financial sustainability are appraised from the point of view of: equalization of advantages gained by the PIP's lots - it is achieved establishing that the increasing differential rent should be fairly redistributed among all landowners -; compensation of territorial and environmental costs sustained by the citizens due to the development projects, transferring to the municipality a part of the gained over-profit converted in extraordinary permission fees. Consequently the quantitative and qualitative PIP's profile is based on the possibility of producing wealth to be transferred and redistributed on the base of contribution from involved stakeholders that are:

- The Municipality, with regard to its capacity to provide a framework;
- Landowners, with regard to willingness to make land available at the price fixed by Consortium;
- Enterprises, with regard to their capacity to create real wealth by their participation to a unitary district.

To undertake such an action, it is assumed that PIP could be implemented by a Consortium of landowners (supported and facilitated by the Municipality) for the unitary management of the areas that will be partly transformed and partly transferring to the Municipality for the construction of public works. Each landowner participates in the Consortium's profits according to the value (quantity and quality) of its land involved in the development project.

The Consortium has the faculty to: bargain over the price for the use of the areas by enterprises to be located, with respect to the objectives of maximization of rent and protection and development of property; dispose of a significant share of lands, also by hire purchase with or without option to buy; contribute to the protection of environmental values by means of a more direct control of the land use.

As the economic surplus over the total cost depends on both the size of the transformed area and the permitted cubage ratio, these two quantities can be assumed as the core of the negotiation, and as a tool for supporting the development of the area from both a private and a public perspective. Extraordinary permission fees are therefore calculated by balancing technical feasibility and private profitability through a fair return of the resources provided by the entrepreneurs. The permission fees are supposed to be paid in advance – in cash or by the realization of public facilities – when the use value of the areas becomes effective and the state of affairs is actually modified, or are quantified in terms of future management of public facilities by discounting the cash flow. Consequently, they constitute one of the anticipated revenues from financial capital that are taken into account in the model. The size of the extraordinary permission fees results from the integration of feasibility and fairness. Feasibility concerns the appropriate income for each asset; fairness depends on the self-financing ratio of the plan, which is the quota of public cost covered by the extraordinary permission fees.

The PIP's area is divided in three sectors, and for each of them a public (Municipality) and private (the landowners' consortium) financial feasibility analysis has been carried out comparing total costs, revenues, ordinary and extraordinary permission fees, and profits [24]. Given the demand for PIP areas as a result of the demand analysis, a specific application of the "transformation value" (extraction method) has been carried out starting from the basic formula (2) where the extraordinary permission fees are expressed. The normal profit can be assumed as a quota of the total investment (3) and the normal global profit rate as the sum of the weighted average cost of the capital paid in advance and the premium for risk and organization (4), so that the permission fees can be easily calculated (5). Furthermore, as required by the equalization process, for each sector the appropriate cubage rate is calculated (6).

$$v_t = v_f - k - f^* - \pi \tag{2}$$

$$\pi = r(v_t + k + f^*) \tag{3}$$

$$r = \left[\left(w + r'\right)\left(1 + w + r'\right)^n - 1\right] \Big/ \left(w + r'\right) \tag{4}$$

$$f^* = \left\{v_f - \left[\left(v_t + k\right)(1 + r)\right]\right\} \Big/ (1 + r) \tag{5}$$

$$i_f = \left[v_t \bar{h}(1 + r)\right] \Big/ s_f \left[\bar{p} - \bar{k}(1 + r)\right] \tag{6}$$

Where: v_t is the current real estate value of the total private developable area comprised in the sector; v_f is the value of the private property at the end of the development process; k is the building cost including ordinary permission fees; f^* indicates the extraordinary permission fees; r is the global profit rate for each loan term; w is the weighted average cost of capital; r' is the annual profit rate for the promoter's risk and organization; n is the loan term (years); i_f is the cubage ratio; $\overline{h}$ is the weighed average height of the buildings included in the sector; s_f is the area where the development is permitted; $\bar{p}$ is the weighted average market price of the buildings included in the sector; $\bar{k}$ is the weighted average unit cost of the buildings included in the sector.

4 Applications and Results

4.1 The Allocation of the Areas to the Firms

The decision maker's overall aim is to achieve the best PIP layout from the perspectives of economic development, environmental sustainability, land and urban identity. As a consequence, the firms have been selected according to economic, environmental and urban features, while the areas have been allocated to them by applying the evaluation model shown in Fig. 3.

Criteria	Sub-criteria	Indicators
Economy	Market	Market strength
		Innovation attitude
	Capital	Liquidity
		Financial independence
Environment	Natural environment	Adaptability to environmental regulation
		Accessibility to the urban scale
	Artificial environment	Compatibility of location 1
		Compatibility of location 2
	Human environment	Impact on employment
		Health and safety at work
Social system	Participation	Permission fees
	Agglomeration	Size of the requested area
	Landscape	Volume of buildings

Fig. 3. Evaluation model for allocating areas to firms

Figure 4 presents the results of the assessment and allocation process, and the comparison between two different modes of allocating the areas according to: profile of each sector; characteristics of the selected firms; criterion for the selection of the firms (a score-threshold that is explained below).

The features of the three sectors are outlined by three different weight lists; the 94 firms can be selected by means of their physical size (left) or overall quality based on their attributes (right); the sum of the requested settlement areas must be smaller than the permitted area within each sector (first three columns of the two parts). The coloured cells indicate where the firm is located (sector 1, 2 or 3) and the two blocks of the table show the comparison between the two different selection modes.

The other three groups of columns report the quality scores from the three perspectives (economy, environment, social system) and for each sector. The shade of the cells allows us to compare the values in the cells of the same column (the darker, the higher), so that the table provides an overall diagram of the position and qualification of the firms.

The selection by size allocates the smaller firms in Sector 1, the medium ones in Sector 2 and the larger ones in Sector 3, according to the sizes of the sectors themselves. The selection by attributes is carried out establishing, for each group of attributes, a score-threshold above which firms are allowed, and below which they are rejected; this type of selection allows the decision makers to assign the firms to the sectors to which they are best suited.

The pattern allows many in-depth analyses useful to assess the overall profile of the strategies that can be generated by changing the weights recursively, in order to identify the best overall layout, fitting tactic (valuation of a single firm) and strategic (valuation of the overall layout of each sector) approaches as well.

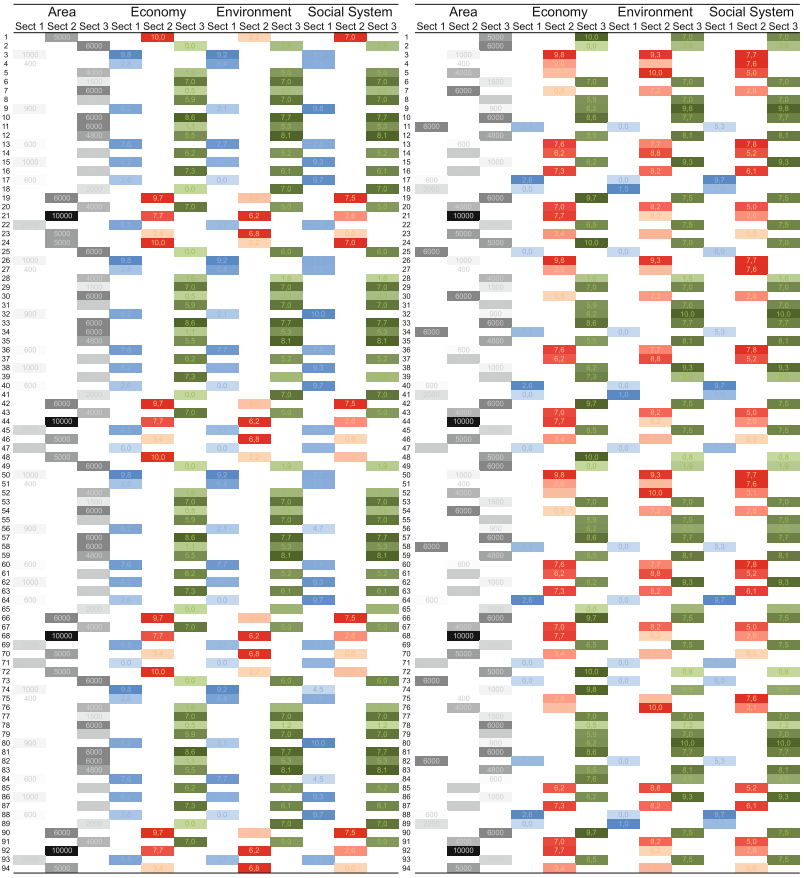

Fig. 4. Allocation of the areas of each sector by volumes (left) and attributes (right)

4.2 Results of the Equalization and Compensation Process

The calculation of the extraordinary fees requested for planning permissions in the different PIP's areas is carried out counterbalancing revenues and costs, both private and public, as shown in the summary tables (Fig. 5).

The costs included in the private budget are: cost of construction; cost for the landscaping of the external areas, general expenses, taxes (VAT), cost opportunity of the existing areas and buildings (expressed by their current market price); ordinary permission fees (Article 3 of Law 10/1977); extraordinary permission fees that are equal to potential extra-profits. The private revenues consist of the increases of the real estate value involved in the PIP's transformation process, and the capital value of flows of income coming from the possible private management of public works. The entrepreneur's profit (Consortium of landowners) constitutes the condition for the PIP's feasibility, comprises the remuneration for the anticipations, for the organization of the process, and for business risk, and is diversified relating to the profit rate of equity

	Private Balance Sheet				Public Balance Sheet			
Sector 1	Costs	Land and existing buildings	€	747.830	Costs	Construction	€	2.795.060
		Construction	€	11.291.810		Other costs	€	279.400
		Other costs	€	1.128.970		*total costs*	€	*3.074.460*
		Ordinary permission fee	€	240.150				
		Extraordinary permission fee	€	406.970				
		total costs	€	*13.815.730*				
	Revenues	Real estate market values	€	17.127.780	Revenues	Ordinary permission fee	€	240.150
		Management of public works	€	-		Extraordinary permission fee	€	406.970
	Profit	24%	€	3.312.040		*total revenues*	€	*647.120*
	Indexes	**Net value**	**€**	**3.312.040**	**Indexes**	**Net value**	**-€**	**2.427.340**
		Extraordinary permission fee (equal to extra-profit)	**€**	**406.970**		**% public costs financied**		**21,0%**
Sector 2	Costs	Land and existing buildings	€	1.062.870	Costs	Construction	€	3.140.570
		Construction	€	21.588.930		Other costs	€	314.010
		Other costs	€	2.158.790		*total costs*	€	*3.454.580*
		Ordinary permission fee	€	385.280				
		Extraordinary permission fee	€	1.117.100				
		total costs	€	*26.312.970*				
	Revenues	Real estate market values	€	32.689.140	Revenues	Ordinary permission fee	€	385.280
		Management of public works	€	-		Extraordinary permission fee	€	1.117.100
	Profit	24%	€	6.376.180		*total revenues*	€	*1.502.380*
	Indexes	**Net value**	**€**	**6.376.180**	**Indexes**	**Net value**	**-€**	**1.952.200**
		Extraordinary permission fee (equal to extra-profit)	**€**	**1.117.100**		**% public costs financied**		**43,5%**
Sector 3	Costs	Land and existing buildings	€	2.371.050	Costs	Construction	€	12.250.870
		Construction	€	41.804.600		Other costs	€	1.225.040
		Other costs	€	4.180.720		*total costs*	€	*13.475.910*
		Ordinary permission fee	€	855.770				
		Extraordinary permission fee	€	2.045.690				
		total costs	€	*51.257.830*				
	Revenues	Real estate market values	€	63.621.810	Revenues	Ordinary permission fee	€	855.770
		Management of public works	€	-		Extraordinary permission fee	€	2.045.690
	Profit	24%	€	12.363.980		*total revenues*	€	*2.901.460*
	Indexes	**Net value**	**€**	**12.363.980**	**Indexes**	**Net value**	**-€**	**10.574.450**
		Extraordinary permission fee (equal to extra-profit)	**€**	**2.045.690**		**% public costs financied**		**21,5%**
Total	**Indexes**	**Net value**	**€**	**22.052.200**	**Indexes**	**Net value**	**-€**	**14.953.990**
		Extraordinary permission fee (equal to extra-profit)	**€**	**3.569.760**		**% public costs financied**		**25,2%**

Fig. 5. Summary tables of private and public balance by sector

(including areas and buildings conferred to the Consortium) and capital of debt; the profit rate is the WACC.

In the public budget the costs comprise: potential indemnity of expropriation; costs for the landscaping of the areas; costs of construction; general expenses and taxes. The public revenues are ordinary and extraordinary permission fees.

Public and private budgets are made for each area for the status quo and for a basic project, which has invariant and variable (morphogenetic) features [25], assuming a mix of functions and uses.

Once a profit rate is determined, the budgets allow the calculation of the possible entity of the extra-profits. If the budget has a deficit, the morphogenetic features of the project are changed modifying cubature and land use according to cubature limits,

	Green areas		Parking lots		Public facilities		Urban infrastructures	
	Total costs	% financied	Total costs	% financied	Total costs	% financied	Total costs	% financied
Sector 1	€ 785.010	83%	€ 495.800	0%	€ 754.030	0%	€ 1.038.080	0%
Sector 2	€ 108.460	100%	€ 790.180	100%	€ 1.322.130	46%	€ 1.234.330	0%
Sector 3	€ 2.448.010	100%	€ 1.647.500	28%	€ 5.804.980	0%	€ 3.579.050	0%
Total	€ *3.341.480*	*96%*	€ *2.933.480*	*42%*	€ *7.881.140*	*8%*	€ *5.851.460*	*0%*

Fig. 6. Public works financed by means of extraordinary permission fees

planning standards, morphological quality, and historical or environmental constrains. The process of adjustment of the features of a project is iterative and stops when the private budget provides those extra-profits that, turned into extraordinary permission fees, can finance significant quotas of public works (Figs. 6 and 7).

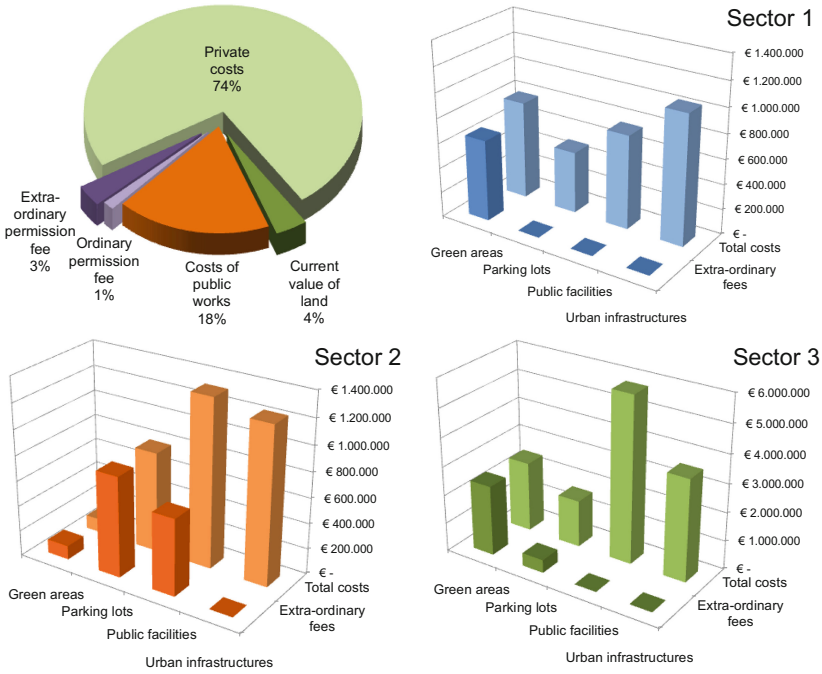

Fig. 7. Public works financed by means of extraordinary permission fees

5 Discussions and Conclusions

Evaluation of the Strategies. Combining the procedures of selection (by volume or attributes) and the preference systems by criteria it is possible to verify the best allocation of the areas to the enterprises, which is the best location of the enterprises in the three sectors as well. The exemplification in Fig. 8 synthesizes the evaluation of the two formerly explained layouts, and shows the weights of the criteria by each sector (bar histograms) and the general evaluation of each sector from the point of view of the three fundamental criteria (economy, environment, and social system).

When the selection is made by volumes (on top), the features of the enterprises that are located in the three sectors provide a global value lower than the one obtained by selecting the enterprises by attributes (at the bottom), where the global value for the sectors 2 and 3 is significantly higher, while we observe a slight lowering of the value of the sector 1. This difference of evaluation depends on the system of weights that, as shown in the second procedure of selection (diagrams at the bottom), allows to fully

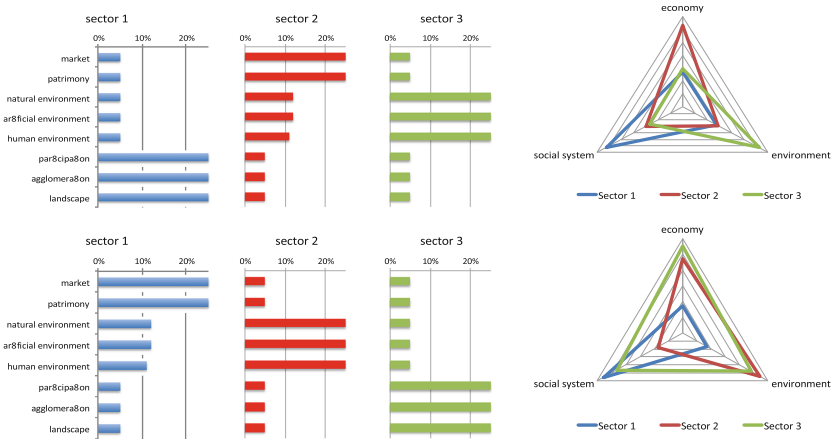

Fig. 8. Weight of criteria and global evaluation by sector and by layout (Color figure online)

appreciate the environmental performances of the enterprises located in the sector 2 and the social-systemic performances of the ones located in the sector 3.

Sensitivity Analysis. The process can be reiterated until the solution that maximises the total value is achieved. Figures 9 shows 10 iterations that allow the individuation of the best arrangement modifying the weights and the thresholds for selecting the firms.

strategy	weights									valuations									settled firms			total value	treshold 1	treshold 2
	economy			environment			social-system			economy			environment			social-system								
	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3			
1	25%	5%	5%	12%	25%	5%	5%	5%	25%	1,0	6,6	5,9	0,2	8,7	5,7	7,1	5,8	5,7	30	40	118	5,2	1,5	4,5
2	25%	12%	10%	5%	20%	5%	12%	5%	22%	0,4	6,6	5,7	0,3	8,7	6,1	6,2	6,1	6,0	22	40	126	5,1	1,2	4,5
3	5%	25%	5%	5%	12%	25%	25%	5%	5%	0,1	8,0	4,5	0,0	6,7	6,0	5,5	5,9	6,0	12	54	122	4,8	1,5	4,5
4	7%	19%	8%	12%	14%	16%	18%	8%	12%	0,1	7,4	5,6	0,4	7,9	5,9	6,3	5,3	5,9	22	42	124	5,0	1,5	4,2
5	19%	8%	7%	14%	16%	12%	8%	12%	18%	0,7	7,3	6,0	0,2	8,5	5,6	7,1	5,4	5,8	30	40	118	5,2	1,5	4,0
6	8%	7%	19%	16%	12%	14%	12%	18%	8%	0,4	7,6	5,7	0,2	8,5	5,7	7,1	6,4	5,6	30	36	122	5,2	1,5	3,5
7	10%	21%	8%	8%	12%	16%	19%	8%	12%	0,2	7,1	5,3	0,0	7,7	6,4	5,9	6,7	5,7	16	50	122	5,0	1,5	4,2
8	21%	8%	10%	12%	16%	8%	8%	12%	19%	0,8	7,7	5,7	0,1	8,6	5,6	7,4	5,4	5,9	30	40	118	5,2	1,5	4,2
9	8%	10%	21%	16%	8%	12%	12%	19%	8%	0,4	6,8	5,2	0,2	7,2	5,0	7,1	7,2	5,4	30	68	90	4,9	1,5	3,0
10	13%	13%	13%	13%	13%	13%	13%	13%	13%	0,2	6,7	5,5	0,3	7,8	6,0	6,2	5,9	6,0	22	56	110	4,9	1,5	3,5

Fig. 9. Valuation of different strategies

The iterations indicate a set of strategies (1, 5, 6 and 8) that maximize the total value. The procedure can be repeated until the configuration that maximizes the total value is achieved. The graphs in Fig. 10 show the partial values and, more generally, the strong prevalence of the values of the sectors 2 and 3 in each iteration. In this regard, the different dimension of the areas affects the selection model, because the sector 1 is much smaller than the other ones and, therefore, it is less likely that firms with an elevated score can be selected. This constitutes a limit of the proposed model and represents a new starting point for further study.

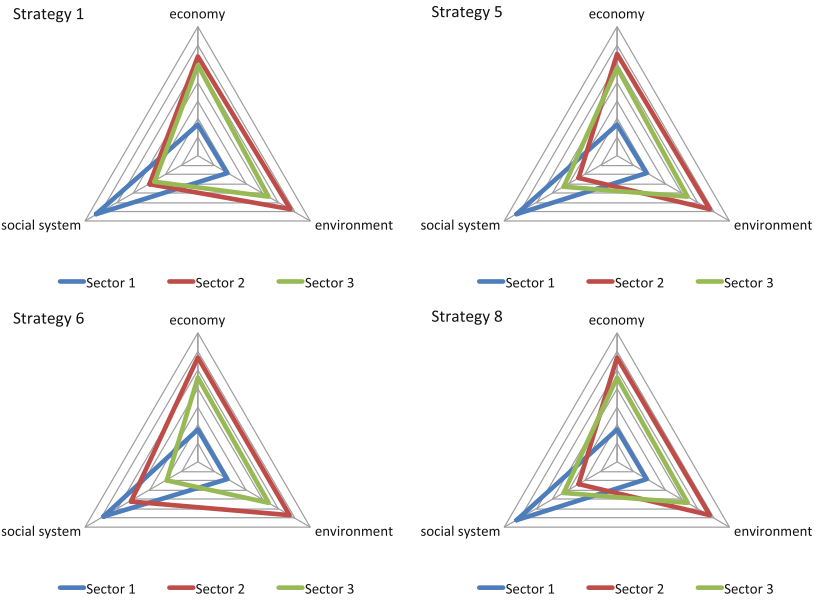

Fig. 10. Strategies that best maximize the total value (Color figure online)

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References

1. Martinico, F.: Il Territorio dell'industria. Nuove strategie di pianificazione delle aree industriali in Europa. Gangemi, Roma (2001)
2. Chiodelli, F., Moroni, S.: Zoning-integrative and zoning-alternative transferable development rights: compensation, equity, efficiency. Land Use Policy **52**, 422–429 (2016)
3. Woodbury, S.: Transfer of development rights: a new tool for planner. J. Am. Plan. Assoc. **41**(1), 3–14 (1973)
4. Henger, R., Bizer, K.: Tradable planning permits for land-use control in Germany. Land Use Policy **27**, 843–852 (2010)
5. Camagni, R.: Perequazione urbanistica "estesa", rendita e finanziarizzazione immobiliare: un conflitto con l'equità e la qualità territoriale. Scienze Regionali **13**(2), 29–44 (2014)
6. Alterman, R.: Can the 'unearned increment' in land values be harnessed to supply affordable housing? In: Financing Affordable Housing and Infrastructure in Cities: Towards Innovative Land and Property Taxation, pp. 17–18. UN Habitat, Varsaw (2010)
7. Camagni, R.: Il finanziamento della città pubblica: la cattura dei plusvalori fondiari e il modello perequativo.: In: Curti, F. (ed.) Urbanistica e fiscalità locale, pp. 321–342. Maggioli, Ravenna (1999)

8. Micelli, E.: Development rights markets to manage Urban plans in Italy. Urban Stud. **39**(1), 141–154 (2002)
9. Stanghellini, S. (ed.): Il negoziato pubblico-privato nei progetti urbani. DEI, Roma (2012)
10. Calabrò, F., Della Spina, L.: The public-private partnerships in buildings regeneration: a model appraisal of the benefits and for land value capture. In: 5nd International Engineering Conference 2014 (KKU-IENC 2014). Advanced Materials Research, vols. 931–932, pp. 555–559. Trans Tech Publications, Switzerland (2014)
11. Nesticò, A., Galante, M.: An estimate model for the equalisation of real estate tax: a case study. Int. J. Bus. Intell. Data Min. **10**(1), 19–32 (2015)
12. Giuffrida, S., Gagliano, F.: Sketching smart and fair cities WebGIS and Spread sheets in a code. In: Murgante, B., et al. (eds.) ICCSA 2014, Part III. LNCS, vol. 8581, pp. 284–299. Springer, Heidelberg (2014)
13. Belton, V., Stewart, T.J.: Multiple Criteria Decision Analysis: An Integrated Approach. Kluwer Academic Press, Boston (2002)
14. Keeney, R., Raiffa, H.: Decisions with Multiple Objectives: Preferences and Value Trade-offs. Wiley, New York (1976)
15. Von Winterfeldt, D.W., Edwards, W.: Decision Analysis and Behavioral Research. Cambridge University Press, Cambridge (1986)
16. Greco, S., Ehrgott, M., Figueira, J.: Multiple Criteria Decision Analysis: State of the Art Surveys, vol. 78. Springer, New York (2005)
17. Herwijnen, M.V.: Spatial Decision Support for Environmental Management. Vrije Universiteit, Amsterdam (1999)
18. Trovato, M.R., Giuffrida, S.: The choice problem of the urban performances to support the Pachino's redevelopment plan. Int. J. Bus. Intell. Data Min. **9**(4), 330–355 (2014)
19. Montibeller, G., Yoshizaki, H.: A framework for locating logistic facilities with multi-criteria decision analysis. In: Takahashi, R.H., Deb, K., Wanner, E.F., Greco, S. (eds.) EMO 2011. LNCS, vol. 6576, pp. 505–519. Springer, Heidelberg (2011)
20. Beinat, E.: Value Functions for Environmental Management. Kluwer Academic Publishers, Dordrecht (1997)
21. Roy, B., Mousseau, V.: A theoretical framework for analysing the notion of relative importance of criteria. J. Multi-Criteria Decis. Anal. **5**, 145–159 (1996)
22. Choo, E.U., Bertram, S., Wedley, W.: Interpretation of criteria weights in multicriteria decision making. Comput. Ind. Eng. **37**, 527–541 (1999)
23. Poyhonen, M., Hamalainen, R.P.: On the convergence of multi-attribute weighting methods. Eur. J. Oper. Res. **129**, 569–585 (2001)
24. Trovato, M.R., Giuffrida, S.: The choice problem of the urban performances to support the Pachino's redevelopment plan. Int. J. Bus. Intell. Data Min. **9**(4), 330–355 (2014)
25. Napoli, G.: Financial sustainability and morphogenesis of Urban transformation project. In: Gervasi, O., et al. (eds.) ICCSA 2015. LNCS, vol. 9157, pp. 178–193. Springer, Heidelberg (2015)