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A hybrid evaluation approach for designing complex urban scenarios: application for the T.I.T. area (China)

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Abstract

This paper illustrates a long-term research that aims at proposing a multi-dimensional and multi-level integrated approach for supporting strategic planning and design in the domain of urban projects. The proposed framework is based on the combined use of different tools for designing complex urban transformation processes,following the subsequent phases for the definition of the projects, from very general transformation scenarios to a more detailed preliminary project. The multi-methodological approach is organized according to subsequent steps,including SWOT analysis, stakeholders analysis and Multicriteria Analysis, taking into account both the methodology of the Analytic Hierarchy Process and the Multi Attribute Value Theory. The evaluation is applied to a real-world decision problem related to the further on-going transformations in a former industrial area in Guangzhou (China) that has been recently regenerated as the T.I.T. Creative Zone.

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*Keywords:*urban design; strategic assessment; multicriteria analysis.

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1. Introduction

Thinking about a complex interventionon industrial heritage within on-going urban developmentprocesses requires a new set of strategies that couldbe addressed only by rethinking traditional design tools.Working on different scales, comparing cases in differentcontexts, contrasting synchronic and diachronic viewsis a waythat allows to broaden the understanding and refine the available instruments.

The objective of the paper concerns an investigation of the combined use of different evaluation methods for supporting the design of complex urban regeneration processes. The proposed integrated approach is applied to a real case study located in Guangzhou (China) (Armando, Bonino &Frassoldati, 2015).

In particular, the case under examination considers the likely redevelopment of the T.I.T. area as a result of the southward expansion of the urban axis along which the newly built Central Business District of Guangzhou is organized (Frassoldati& Armando, 2015). The T.I.T. area refers to a former industrial zone dedicated to textile production. The firm was closed in 2004 and now the area is experiencing a new life as creative district in which offices, different fashion design studios and shops are located. Despite this recent regeneration, due to its location the T.I.T. area is at the centre of a governmental plan that imposes the urban axis structure on preexisting urban fabric and the development of a number of new landmarks and modern facilities. In this sense, design strategies for considering alternative futures for the T.I.T. area are needed that spans from a strictly conservative attitude towards historic buildings to total demolition and redevelopment of the area. The present research thus aims at supporting the process of re-thinking axial strategies able to valorize the T.I.T. area and more generally the urban fabric of this part of the city.

2. The integrated evaluation framework

The evaluation is basedon a multi-methodological approach for supporting strategic planning and design in the domain of urban and territorial projects (Bottero, 2015). The proposed framework is based on the combined use of different tools for designing complex urban regeneration processes, following the subsequent phases for the definition of the projects. The multi-methodological approach is organized according to subsequent steps, involving the application of different evaluation methods, namely SWOT analysis, stakeholders analysis and Multicriteria Analysis, considering both the methodology of the Analytic Hierarchy Process and the Multi Attribute Value Theory (Fig. 1).

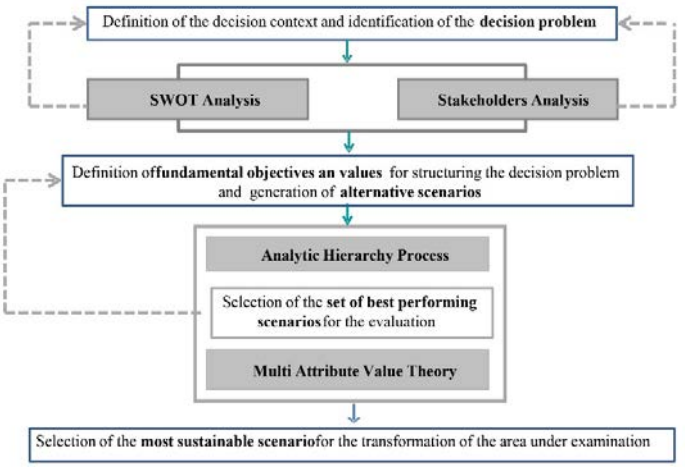

Fig. 1 The decision support process for the case under investigation

2.1. The SWOT analysis

In particular, the first phase of the procedure is related to the structuring of the decision problem in order to define the goal of the project and to identify possible alternative solutions for reaching the goal. This phase is based on the development of a SWOT analysis. The acronym SWOT stands for Strengths, Weaknesses, Opportunities and Threats and the analysis is based on a logic procedure that allows the data and information on a specific decision problem to be collected and organized.

With specific reference to the context of urban projects, the aim of the analysis consisted in the definition of the possible development scenarios for the area, which derive from the valorisation of the strengths and the mitigation of the weaknesses, in the light of the opportunities and threats which could occur. Six scenarios have been thus generated as described in Table 1.

Table 1. Alternative scenarios for the evaluation

Scenarios	Description
The axis	This solution retraces the Government Plan for the design of an urban axis to continue the existing northern section. The proposal stresses the axial distribution of functions along a development that connects different water bodies in the district (perpendicular to the axis). This design offers the possibility of establishing iconic landmarks in Guangzhou's emerging central district.
Real estate development	This solution attempts to maximize the economic value of the development by organizing the urban structure according to a hierarchy of mid- and high-rise buildings. These buildings make the most of their location exploiting the view of the captivating central green core. In this solution the land management becomes crucial and overcomes others values, due to the maximization of the economical benefits.
Urban stripes	In this scenario the most important value is the interaction among clusters of clearly defined functions, such as cultural, commercial, entertainment and residential zones. Around the T.I.T. Industrial Park four museums are under construction; therefore T.I.T. becomes the core of the "cultural" stripe.
Shared voids	This scenario focuses on the open public place shared with local residents and communities. Here the community value is preserved and enhanced. Intentions of this scenario are to create opportunities daily-life encounters in shared public spaces, and to strengthen human scale against metropolitan background. In this context, the T.I.T. Industrial Park could be considered as a community itself, with chances of many events happening both inside and outside.
Green core	The "Green Core" scenario intends to create a sort of urban forest, in which the environmental effect is considered as most important, not only in the dimension of ecology, but also regarding the essential quality of urban life. Therefore, the prosperous vegetation inside T.I.T. is of highly integrated value.
Cultural Heritage	In this scenario the intention is focused mainly on the conservation of T.I.T. area as a memory of previous texture factories. The area will become a sort of fenced enclosure, as an open-air museum. All the original urban fabric will be conserved, and interventions will be made only on occasion of necessary adjustment.

2.2. Stakeholders analysis

The second phase of the proposed process consists in the development of a stakeholder analysis (Dente, 2014) aiming at identifying the actors involved in the problem, as well as their values and objectives. In the present research, the method of the stakeholders mapping (Mendelow, 1981) has been applied. In particular, the approach is based on the construction of the power/interest matrix which is represented by a grid where the power and the interest of the stakeholders are the relevant elements.

For the case under investigation, the different stakeholders have been grouped in the power/interest matrix, allowing to produce a better picture of how communication and relationships between stakeholders could affected the project and its implementation. The matrix showed a separation in the distribution of the stakeholders: on one side, the local level of social representatives, fragmented and not always fully institutionalized, and, on the other side, the planning and political institutions, from the city level to the Central State. This distribution could be one of the main reasons why the figuring of the new urban projects is carried on by a top-down strategy. This reveals both the lack of a strong representation of the local interests in the Chinese context, that could affect strategically urban projects, both the importance of the economic concerns in growing urban areas, that becomes the key element around which the local political visions are built (Lin, Li, Yang & Hu, 2014).

2.3. Analytic Hierarchy Process (AHP)

The third phase of the process consists in the development of a Multicriteria Analysis (MCA, Figueira, Greco &Ehrgott, 2005) that is a valuable and increasingly widely-used tool to aid decision-making where there is a choice to be made between competing options. It is particularly useful as a tool for sustainability assessment and urban and territorial planning, where a complex and inter-connected range of environmental, social and economic issues must be taken into consideration and where objectives are often competing, making trade-offs unavoidable (Huang,,Keisler, &Linkov, 2011).Among the different multicriteria methods, a very important role is played by the theory of the Analytic Hierarchy Process (AHP, Saaty, 1980).

Following the AHP methodology, the problem under examination has been divided into several sub-problems that were organized according to hierarchical levels, where each level denotes a set of criteria or attributes related to each sub-problem. In particular, the evaluation criteria for the development of the model represent the most important aspects for the decision problem under investigation, namely economic elements, environmental impacts, identity characters, services and policies aspects. The bottom level contained the six scenarios generated in the first phase of the evaluation process (Fig. 2). The development of the AHP permitted to compare the different elements, with the importance of individual factors being relative to achieve the best performing scenario for the transformation, and the priority list of the considered alternatives to be reached. A crucial step in the development of the AHP evaluation consisted in the definition of the weights to be used in the model. In the present application a focus group was organized with experts in the field of urban design, economic evaluation, urban sociology and architecture. During the focus group the experts were asked to respond to a series of pairwise comparisons in which two elements at a time are compared in terms of their contribution to their specific upper-level criteria. The set of weights of the evaluation criteria resulting from the focus group can be described as follows: economic elements have 14,3% of importance, environmental impacts 43,4%, identity characters 31,6%, services 6,8% and policies aspects 3,8%. The results of the evaluation show that the best performing scenarios is the “Green core” project (0,272 in the priority vector), followed by “Urban stripes” (0,217), “The axis” (0,153), “Real estate development” (0,126), “Heritage” (0,119) and finally “Shared voids” (0,113).

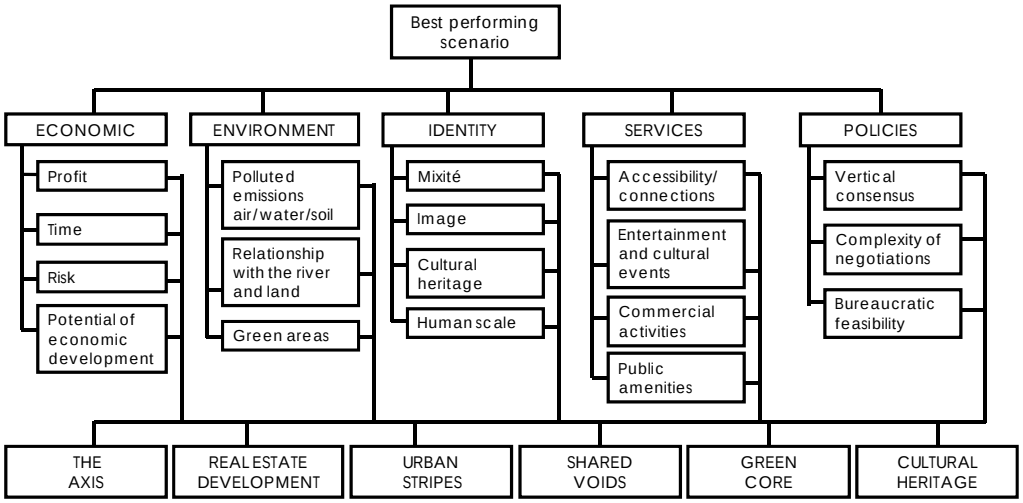

Fig. 2 The structuring of the decision problem for the application of the AHP

After obtaining a ranking of the alternatives and despite the coherence obtained in the results, it was considered useful to perform a sensitivity analysis on the final outcome of the AHP model. The sensitivity analysis is concerned with a “what if” kind of question to see if the final answer is stable when the inputs are changed. It is of special interest to see whether these changes modify the order of the alternatives. In the present study the stability of the solution has been studied with regards to the weights of the general criteria. Particularly, the One-at-a-Time (OAT)

approach has been used meaning that the weight of one criterion at a time has been increased to 40%while the weights of the other four criteria have been maintained equal to 15%. The evaluation model has been run considering the new weights and the final priorities of the alternatives have been recalculated. The outcomes of this analysis allowed to select three scenarios, namely "The axis", "Urban stripes" and "Green core" which resulted to be the best performing options (Fig. 3).

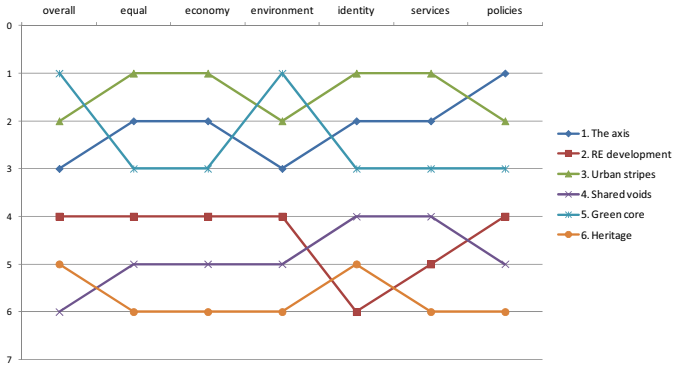

Fig. 3 Sensitivity analysis for the AHP model

2.4. Multi Attribute Value Theory

These three scenarios have been further investigated by means of the Multi Attribute Value Theory (MAVT, Keeney &Raiffa, 1976) in order to better differentiate their performance and to obtain more stable results.

For the present study, the application of the MAVT model was intended to examine in details the three best performing scenarios resulting from the AHP evaluation, with particular attention to their morphological and structural performances. In this sense, a set of measurable attributes has been defined for the evaluation of the three scenarios, as represented in Table 2.

Table 2 Evaluation criteria for the MAVT model

Criteria	Attribute	Description
Structure	Path hierarchy	Length of bike or pedestrian path/ total length of the mobility network [km/km]
	External connection	No. of intersections between the project and the surrounding vertical axes [no.]
	Inner connectivity	Surface of the max pedestrian surface without interruptions [m^2]
Density	Impact	Volumeof demolished buildings/volume of existing buildings [m^3/m^3]
	Occupancy	Gross Floor Area of the project / territorial surface of the transformation [m^2/m^2]
Public spaces	Private/public spaces	Surface of public/semi-public areas/territorial surface of the transformation [m^2/m^2]
	Mixed functions	No. of different functions along the project [no.]

According to the MAVT methodology, each attribute is described by a value function which allows to scale the attributes between 0 and 1 in order to compare non-commensurable items. As an example, Figure 3 represents the value function related to the attribute "Path hierarchy".

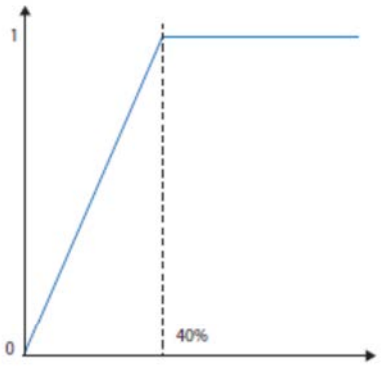

Fig. 4 Example of elicitation of value function for the MAVT model

Once the alternatives have been evaluated, it is necessary to define the importance of the different attributes of the decision problem. In this case the Swing method has been used which explicitly incorporates the attribute ranges in the elicitation question. The single attribute value functions have then been aggregated using the obtained set of weights and additive assumptions to calculate the total value of the three alternatives. Form the calculations, the scenario "Urban stripes" had the highest priority (0,63), followed by the scenario "Green core" (0,59) and the scenario "The axis" (0,58). The results were verified by means of a sensitivity analysis. Also in this case, the OAT approach has been used meaning that the weight of one attribute at a time has been increased to 60% while keeping all the others equal to 20%. The final results showed that the scenario "Urban stripes" had the best performances in all the considered sensitivity sets of weights, thus confirming the results of the evaluation model.

3. Conclusion

The study illustrates a hybrid evaluation model for supporting the design of complex urban transformation scenarios for the T.I.T. area in Guangzhou (China). From the results of the model, the scenarios "Urban stripes" that forecasts interaction among clusters of clearly defined functions resulted as the most suitable for the transformation.On the basis of the evaluation, the final design visualization consisted in re-thinking the winning solution by mixing the three best performing scenarios into a single optimized design proposal that minimizes weakness and maximizes potentials of each of them.

The proposed model resulted to be suitable for the analysis of decision problems in the domain of urban design processes, including environmental, social, cultural, urban, economic and morphological elements. The method is able to support the Decision Makers, as well as planners and designers, in handling heterogeneous information, qualitative and quantitative, monetary and non-monetary, expressed on ordinal or cardinal scales, and it can give a real contribution in the strategic decision phase, where detailed information about project performances are needed. It is also interesting to notice that the proposed approach is structured according to an iterative process as it was delineated by a series of tasks, issues and feedback loops that have formed and influences the design projects during the evaluation.

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