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Urban Regenerations. Application of Multi Criteria Spatial Analysis for the redevelopment of the military barracks in the historic centre of Pisa

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Abstract

This study deals with the redevelopment of three abandoned army barracks located in the historic center of Pisa: a military complex, a former military district – both dating to the early 20th century – and a former monastery, which became a military property in the mid-800s. They are composed of several buildings of considerable historical-architectural importance and wide green spaces now completely inaccessible. With the aim of defining a new method of analysis and decision support which can be used for modern urban planning policies, applied to various planning problems even on different levels and compatible with the real needs of citizens and administrators, we used a GIS based Multi-Criteria-Decision-Making (MCDM) approach. Specifically, we implemented it to identify new hypothetical uses for the three abandoned military areas, considering the peculiarities of the buildings included and the urban transformations connected to them. The integrated use of the Geographic Information System with MCDM makes it possible to define different qualitative and quantitative spatial criteria and indicators, and to make the contributions explicit of the different choice options towards different criteria that define the problem. A fundamental aspect was the determination and quantification of impacts that various uses could have on the entire urban fabric: for this purpose, we used the ELECTRE 3 method – integrated and developed in a GIS environment and implemented by using a proprietary programming language. The model allowed us to obtain a classification of the three barracks for each of the six new hypothetical uses defined by involving the stakeholders. The intersection between the results obtained from the application of ELECTRE 3 and the stakeholders' preferences, makes it possible to locate the three most suitable new functions in the army barracks.

Keywords: ELECTRE 3, GIS, Multi Criteria Spatial Analysis/Evaluation, Urban Regeneration

1. Introduction

This study deals with one of the most common themes in the main Italian city centers: the redevelopment of abandoned buildings owned by the State and the Ministry of Defense. The main causes of the abandonment of these properties are to be found not only in the radical transformation of Italian defense strategies, but also in the deep economic and political crisis that has gripped the whole of Europe for over a decade. The combination of these events led to policies for the rationalization of activities and for subsequent operations aimed at reducing public debt; this includes not only actions aimed at the intelligent management of the entire capital, but also a growing sale of properties that have considerable dimensions and historical and architectural value (Storelli and Turri, 2014). The huge state capital poses a very significant issue in contemporary debate, particularly in the field of urban planning: the rethinking of methods of analysis and study for an effective reintegration of these areas into the urban fabric. With all its management problems, the phenomenon has also affected the small historic center of Pisa, which has many military areas within it composed of several buildings also of great importance and large green spaces which are currently inaccessible. The study has therefore been developed in two main parts: the first step concerned the classification and study of the phenomenon at national level and the analysis of the problem in Pisa, with particular attention to three large areas within the historical center; the second step concerned the experimentation of a new evaluation method - the Multicriteria Spatial Analysis integrated with the GIS (Ferretti, 2012).

The theme of the Urban Regeneration of these "urban voids" has to pursue not only sustainable strategic objectives for the buildings themselves but also innovative solutions to relevant problems of the historic center. In fact, the lack of specialized facilities here for students, particular groups of citizens and migrants is evident, but also the lack of public green spaces and the need to counter land consumption.

The method implemented aims to compare multiple reuse alternatives, taking into account multiple aspects, to reach a consensus on one or more alternatives useful for the realization of more democratic and transparent regeneration plans.

2. The case study

Pisa – better known as the city of the Leaning Tower – was founded in Roman Times and its oldest traces are to the north of the Arno river, the safest position for the ancient hydrological conformation of the purely marshy area (Tolaini, 1992). In the early Roman Period the first military architectures appeared, with the construction of defensive walls which were then rebuilt in the medieval period and still existing today. The historical walls constitute a physical limit of separation between the ancient city and the clearly visible twentieth-century expansion and it helps us to define the study area. Thanks to its strategic position (proximity to the sea and to two navigable rivers), the city becomes a commercial, political and military power rich in numerous civil and military buildings (Bracaloni and Dringoli, 2007). To date, eleven military areas are present in the historic center. The conditions of these areas oscillate between full activity and complete abandonment. In particular, there are three completely abandoned military areas inside the historical walls and which are analyzed in the following paragraph (Figure 1).

They count not only many buildings, but also and above all 15,000 square meters of inaccessible green areas. In the early 1960s, the first proposals of the General Urban Development Plan of the city had already addressed the transfer of military functions from the center to the suburbs. The real opportunity for transformation came only in 2001 with the birth of the "Military Barracks Project" (Fontanelli and Nigris, 2004), which was however declared unfeasible owing to the huge construction costs and the countless diatribes about the true or alleged suitability of new uses in the abandoned areas.

Figure 1. Pisa today: the center, the track of the historical walls and the military areas.
Source: Authors' elaboration.

Although there have been many regeneration proposals over time, some also defined by citizens through participatory planning paths, since then the barracks have been completely abandoned. Therefore, in order to tackle the problem, we used a decision aid approach based on the application of a Method of Multi Criteria Spatial Analysis, which allowed the breaking down and analyzing of the highly complex reality of the urban scale in all its parts. In particular a high level of complexity is related to such problems such as the adaptive reuse of existing buildings and the choice of the new function in abandoned areas, (Noorzalifah and Alauddin, 2016), or the lack of facilities and their allocation in residential districts (Vilutienė and Zavadskas, 2003). With the aim to reach the consensus over a reuse scenario for each alternative, we divided the research into three distinct phases. A first phase, concerning the analysis of the status of the areas and the regulatory framework, made it possible to understand who the main stakeholders were and to define new hypothetical compatible uses. The second phase consisted in the application of the Multi Criteria Spatial Analysis and, finally, the third phase is the delicate one of the application of the ELECTRE Method (Roy, 1968) and consists in defining a software that applies computational steps leading to the construction of rankings for the various project. Starting from the analysis of the performance of each alternative with respect to the criteria identified, we were able get a classification of the various scenarios consistent with the results of the study and suitable for solving the problem.

2.1 Problem analysis

The study areas, hereafter renamed "ALTERNATIVE" (Figure 2), are specifically:

ALTERNATIVE 1: "Vito Artale" barrack, a complex of post-unitary buildings that still includes an entire block of the historic district of Cathedral Square;

ALTERNATIVE 2: The former "Monastery of San Vito", formerly the headquarters of the Finance Police, definitively abandoned in 2007 and located on Lungarno;

ALTERNATIVE 3: The former Military District "Curtatone and Montanara", abandoned since 1994 and equipped with one of the largest green lungs in the entire historic center.

Figure 2. The three alternatives. From top to bottom: the "Vito Artale" barrack, the former "Monastery of San Vito", the military district "Curtatone and Montanara".
Source: Google Earth.

Over the years, great interest has been shown in the areas mentioned. The most concrete redevelopment and re-use proposals were put forward mainly by a group of 5 stakeholders: the Municipal Administration, the University of Pisa, a limited company controlled in part by the Ministry of Economy and in part by private subjects like banks (Real Estate Fund for Housing), citizens and many local associations.

To identify a series of hypotheses of new uses (Goal Functions) to be located in the barracks themselves, each stakeholder was interviewed directly and with various methods of investigation. For citizens and local associations we made a specific questionnaire involving about 400 people, while for the other stakeholders, interviews were made with the competent offices. The uses resulting from these interviews and compatible with the intended use and regulations established by the urban planning instruments of the historic center, can be summarized in: Museum Centre, Service Centre for the district, Private Housing, Student Residence, Tourist Structure and Music Centre / Conservatory. For each of these new uses and for each barracks we made meta-projects and, in this phase, we evaluated the possibility of inserting the main functional units of the goal functions thus avoiding a profound transformation of the buildings and the areas. Six meta-projects for each of the barracks were therefore elaborated. For each one we took into consideration the historical and architectural features as well as, where present, the archaeological, hydrogeological and landscape constraints. With the aim of creating a more detailed and comprehensive framework, in addition to the characteristics of the buildings, we proceeded with the construction of maps containing much information about the entire historic center; to do this, we inserted into the study the "spatial" component through the use of the Geographical Information System (GIS). The use of this tool allows the immediate visualization of many characteristics of the territory, such as the distribution of services, the connections and constraints. Through its main operations of geo-processing, it allows us to obtain very useful territorial information that cannot be obtained effectively by very old maps which could be missing a lot of updated information such as land use, properties, green areas, the infrastructure network, etc. In so doing, we managed to evaluate the complex system of relationships that the activities establish between themselves and the territorial morphological system. The operational tool used is a desktop GIS dedicated to digital cartographic representation and allows the processing and manipulation of geo-referenced geometric data placed in relational databases. The data processed by the study of the problem and the use of the GIS software allowed us to obtain a lot of information on the current state of the historic city and gave a solid framework on which to be able to make an even more careful analysis oriented towards the resolution of the problem and the design of more awareness oriented recovery plans.

2.2 Application of Multi Criteria Spatial Analysis

To deal with the problems related to territorial governance and planning, we decided to intersect the elaborations of a Multi Criteria Decision Method (MCDM) with a Geographical Information System (GIS).

MCDM offers a methodology to support the decision makers in defining policies dealing with very high complex urban or territorial systems (Gerdes and Spero, 2013). MCDM consists of a set of techniques that aim to comparatively assess alternative projects or heterogeneous measures (Bevilacqua et al., 2017).

The current objective of this research is to develop tools to allow public participation with a view to guaranteeing access and equity (Casini et al., 2016). This is how the Spatial Multi Criteria Analysis was born and it is one of the most interesting developments in analysis and evaluation in the field of territorial transformation. To apply the Spatial Multi Criteria Analysis, it is necessary to break down the object of the analysis into simple factors (the criteria), which describe it exhaustively, and that can be analyzed separately (Cappellano et al., 2005). The criteria can be qualitative,

quantitative and/or spatial (Malczewki, 2006) and they are therefore the measurable aspect of the judgment to which the alternatives are subjected. They can be subdivided into further sub-criteria that better represent certain aspects. For each of the goal functions of the study we have defined a set of four criteria in which a finite number of sub-criteria converge; specifically, we considered 18 sub-criteria (Figure 3).

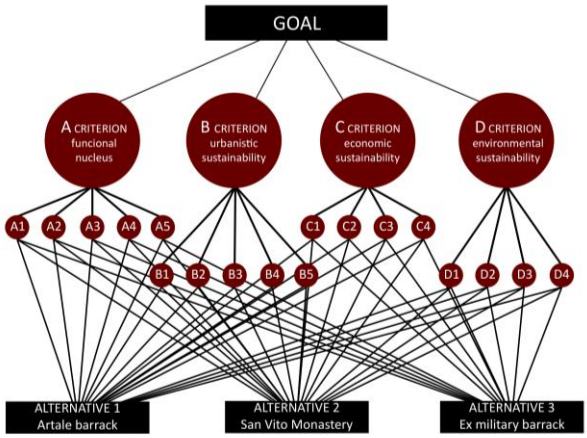

Figure 3. Structure of the Spatial Multicriteria Analysis: GOAL FUNCTION - CRITERIA - SUBCRITERIA and ALTERNATIVE.
Source: Authors' elaboration.

2.2.1 Criterion A: functional feasibility

This criterion aims to evaluate the compatibility of alternatives with the selected goal functions. This was possible only after a thorough study of the design characteristics of the various hypotheses. The same criterion has been divided for each goal function into five sub-criteria (A1, A2, A3, A4, A5) that identify in an overall way the possibility of being able to distribute the functions of each goal in the three alternatives. The most important characteristics are, therefore, the heights of the rooms, the accessibility, the availability of usable square footage, the presence of services and premises for the equipment and the possibility of breaking down the architectural barriers. Naturally, the sub criteria of this family vary according to the function that we must evaluate; in the quantification of the sub-criteria, the regulatory provisions concerning the intended use and the possibility of recovery of historical areas are binding.

2.2.2 Criterion B: urban sustainability

The theme of sustainability of the interventions is the basis of the three other families of criteria. To ensure sustainable development, we must consider three inseparable dimensions: the economic dimension, the environmental dimension and the social dimension. Territorial planning has implications in all three dimensions, and therefore each choice must meet certain requirements for each of them. The sub-criteria defined therefore concern the coherence with the urban planning forecasts (B1) and with the functions present in the area of influence (B3), relations with other services (B2), accessibility and mobility (B4) and finally, the level of livability of the neighborhood (B5).

2.2.3 Criterion C: economic sustainability

With the same aim of sustainability, through the identification of four other sub-criteria, we also assessed the economic dimension. In this case, the definition of the criteria aims at evaluating, in the first instance and for each location, the pros and cons of choosing one Goal Function over another.

We have identified four sub-criteria that consider not only the quality of the intervention in relation to its uniqueness (C1), but also the costs for the development of feasibility studies (C2), for interventions on an urban scale (C3) and the preventive restoration of places (C4).

2.2.4 Environmental sustainability

The last sub-criteria family refers to environmental sustainability, a very important aspect for the strategic policies of the Tuscany Region. The data reported by ISPRA (in the last 50 years Italy has consumed about seven square meters per second of land) highlight the situation of our country, where in very short time the consumption of soil will lead to the complete saturation of urban areas (ISPRA, 2017). One of

the actions that must absolutely be undertaken is that of the reuse and reconversion of abandoned buildings and areas, paying close attention to their eco-sustainable performance (Legambiente, 2016). In this sense, the sub-criteria identified refer to the environmental impact (D1) and the maximization of the green areas in the historical centers (D4), the energy efficiency (D2) and to the preservation of the historical vocation (D3).

2.3 Assigning weights to criteria and sub-criteria and choosing of the indicators

To assign an order of relative importance to the set of criteria and sub-criteria, it was necessary to assign them a "RELATIVE WEIGHT", i.e. a numeric dimensionless value, which sets the priority assigned to the various aspects of the problem; for this reason, it never has an absolute value, but only a relative one.

There are many weight assignment techniques, but the one used in this work was the Pairs Comparison Method, also called the SAATY's Method of Eigenvalues (Saaty, 1988).

This method involves comparing of the criteria and sub-criteria in pairs, related by their performance. This comparison is associated with a number chosen on a linear scale, called Saaty's Scale (Table 1).

DOMINANCE INTENSITY	DEFINITION
1	indifference
3	moderate preference
5	strong preference
7	very strong preference
9	extreme preference
2,4,6,8	intermediate preference judgments
reciprocals (1/2, 1/3, …)	to measure the degree of dominance of A_j to A_i

Table 1. Saaty's linear scale. Source: Saaty, 1980.

The result is a positive, diagonal and symmetrical matrix from which, through the calculation of the Maximum Eigenvalue, the Consistency Index and the verification of the Consistency Ratio, we obtain the WEIGHTS to assign to the criteria and sub-criteria (Saaty, 1980). The matrix of the comparison in pairs of the four main criteria is shown in Table 2. From this comparison we obtained the weights that is the importance that each family of sub-criteria (A, B, C and D) takes within the Multi Criteria Evaluation (Table 3).

CRITERIA WEIGHTS					
Criteria	**A**	**B**	**C**	**D**	**WEIGHT**
A	1	1	1	1	**0.237**
B	1	1	3	3	**0.400**
C	1	1/3	1	1/2	**0.152**
D	1	1/3	2	1	**0.211**
				TOTAL	**1.000**

Table 2. Comparison in pairs of the four Criteria. Source: Authors' elaboration.

The same method is used to obtain the relative weights of each sub-criteria family in relation to each analyzed goal function so as to obtain the importance of each sub-criterion of evaluation on the project in question. The matrices analyzed were therefore of this type:

Once we define the weights, there is the most delicate phase of the whole analysis, i.e. the choice of Indicators.

The Indicator is the numerical element that allows the defining in synthetic, measurable and objectively verifiable terms of the criteria and, in this specific case, the sub-criteria.

SUB-CRITERIA WEIGHTS						
A	**1A**	**A2**	**A3**	**A4**	**A5**	**RELATIVE WEIGHT**
A1	1	3	2	2	3	**0.363**
A2	1/3	1	1/2	1/2	2	**0.130**
A3	1/2	2	1	1/2	1	**0.160**
A4	1/2	2	2	1	2	**0.235**
A5	1/3	1/2	1	1/2	1	0,112
B	**B1**	**B2**	**B3**	**B4**	**B5**	**RELATIVE WEIGHT**
B1	1	1/3	1	1/3	1/2	**0.102**
B2	3	1	2	1	1	**0.261**
B3	1	1/2	1	1/3	1/2	**0.111**
B4	3	1	3	1	1	**0.284**
B5	2	1	2	1	1	0.241
C	**C1**	**C2**	**C3**	**C4**		**RELATIVE WEIGHT**
C1	1	2	1/2	1		**0.241**
C2	1/2	1	1	1		**0.208**
C3	2	1	1	3		**0.374**
C4	1	1	1/3	1		**0.177**
D	**D1**	**D2**	**D3**	**D4**		**RELATIVE WEIGHT**
D1	1	3	3	1		**0.370**
D2	1/3	1	1	1/2		**0.138**
D3	1/3	1	1	1/3		**0.123**
D4	1	3	3	1		**0.370**

Table 3. Comparison in pairs of the sub-criteria with respect to the Goal Function "Museum". The same evaluation was made for the five other Goal Functions for a total of 24 pair comparisons.
Source: Authors' elaboration.

Given the nature of the sub-criteria and the heterogeneity of the elements to be quantified, each indicator can be qualitative or quantitative and be represented with different units of measurement. It is fundamental to highlight that criteria (and sub-criteria) and indicators are not the same thing. In fact, the indicators have a different importance and units of measurement in relation to each criterion and sub-criterion. For example, if you take the "closeness to health facilities" as an assessment criterion, the indicator will be the distance (linear meters) between the objects analyzed and the health facilities located in a specific area. In this case the objects analyzed are the barracks and the area corresponds to the neighborhood in which they are located.

In this research, we have identified a set of 18 sub-criteria referring to each of the three study alternatives with both qualitative and quantitative indicators. The Tables 4, 5, 6 and 7 summarize the method of processing the sub-criteria and the Figures 4, 5, 6 and 7 are examples about the method used to calculate some sub-criteria indicators.

criteria	sub criteria	indicator	U.M.	processing method
		qualitative indicator		Survey of the status of the areas and processing using the AutoCAD technical drawing program.
A	**A1** **A2** **A3** **A4** **A5**	Available areas for the localization of the new uses decided in relation to 18 meta projects	**mq**	

Table 4. Choice of indicators of the sub-criteria of Criterion A, related processing method and units of measure. Source: Authors' elaboration.

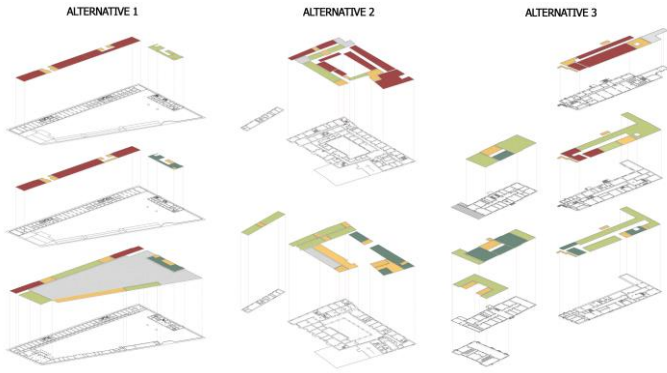

Figure 4. Study for the construction of quantitative indicators of sub-criterion A (A1, A2, A3, A4, A5) for the Goal Function "Student Residence": each color corresponds to a sub-criterion to which the quantity in square meters of the identified area is assigned as an indicator. Source: Authors' elaboration.

B	**B1**	**qualitative indicator** Verification of the compatibility of the intervention with the current regulatory framework	**Valuation scale 0 - 1**	Traditional analysis of the current regulatory framework
	B2	**quantitative indicator** Calculation of the average distance between the studied alternatives, the services and activities related to the Goal Function	**m**	DIJKSTRA ALGORITHM for minimum paths and average distances; data processing through functions implemented within sw GIS
	B3	**quantitative indicator** calculation of the percentage presence of residential house numbers within a 500 m influence radius from each studied alternative	**%**	data processing through functions implemented within sw GIS
	B4	**quantitative indicator** Calculation of the average distance from the study alternatives to the main nodes of mobility and urban accessibility	**m**	DIJKSTRA ALGORITHM for minimum paths and average distances; data processing through functions implemented within sw GIS
	B5	**quantitative indicator** Calculation of the percentage presence of abandoned buildings within a 500 m influence radius for each studied alternative	**%**	data processing through functions implemented within sw GIS

Table 5. Choice of indicators of the sub-criteria of Criterion B, related processing method and units of measure. Source: Authors' elaboration.

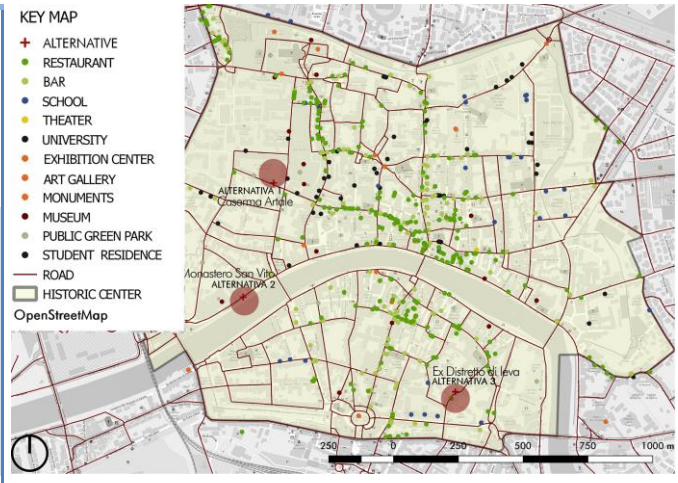

Figure 5. Example of the construction of the indicator of sub-criterion B2 for the Goal Function "Museum": calculation of the average distance from alternatives to necessary services (method: Dijkstra's Algorithm). Source: Authors' elaboration.

C	**C1**	**quantitative indicator** Counting of similar and / or equal functions	**number**	data processing through functions implemented within sw GIS
	C2	**qualitative indicator** Evaluation of the need for further study on study alternatives	**Valuation scale 0 - 1**	Technical evaluation
	C3	**quantitative indicator** Calculation of the cost of site preparation of each alternative for the Goal Functions	**€**	Measurement of the areas to be demolished or reconstructed using the AutoCAD technical drawing program
	C4	**qualitative indicator** Evaluation of the necessity of preventive actions for the safety of the study areas	**Valuation scale 0 - 1**	Technical evaluation

Table 6. Choice of indicators of the sub-criteria of Criterion C, related processing method and units of measure. Source: Authors' elaboration.

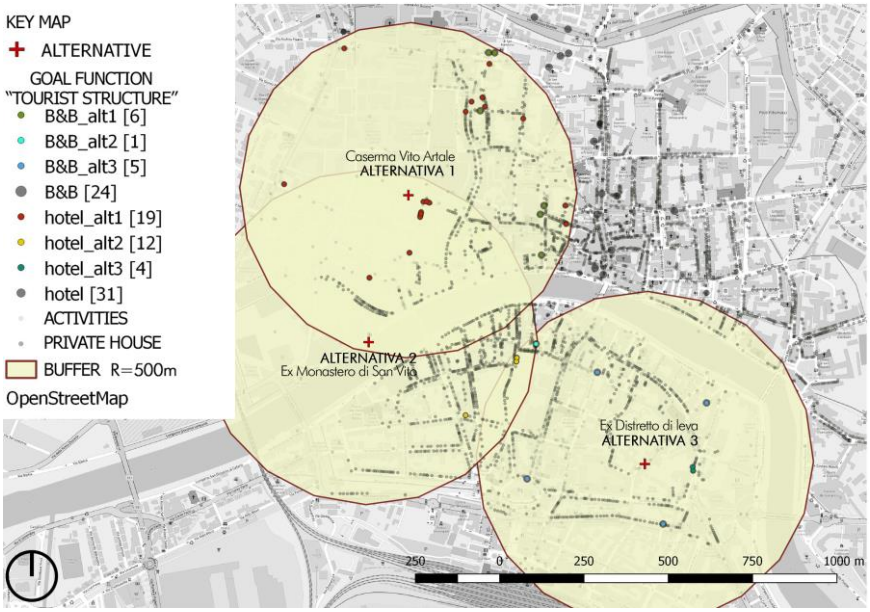

Figure 6. Example of the construction of the indicator of sub-criterion C1 for the Goal Function "Tourist Structure" i.e. the presence of similar activities within a radius of influence of 500 meters from each barracks. Source: Authors' elaboration.

D	**D1**	**qualitative indicator** Evaluation of the acoustic impact of the Goal Function on each of the study alternatives	**Valuation scale 0 - 1**	data processing through functions implemented within sw GIS
	D2	**quantitative indicator** Calculation of roof surfaces suitable for hosting integrated photovoltaic systems	**mq**	Measurement of the areas using the MAutoCAD technical drawing program
	D3	**qualitative indicator** Evaluation of the coherence of the Goal Function with the historical and architectural vocation of the study alternatives	**Valuation scale 0 - 1**	Technical evaluation
	D4	**quantitative indicator** Summation of public green areas and those with free access within 500 m of each alternative	**mq**	data processing through functions implemented within sw GIS

Table 7. Choice of indicators of the sub-criteria of Criterion D, related processing method and units of measure. Source: Authors' elaboration.

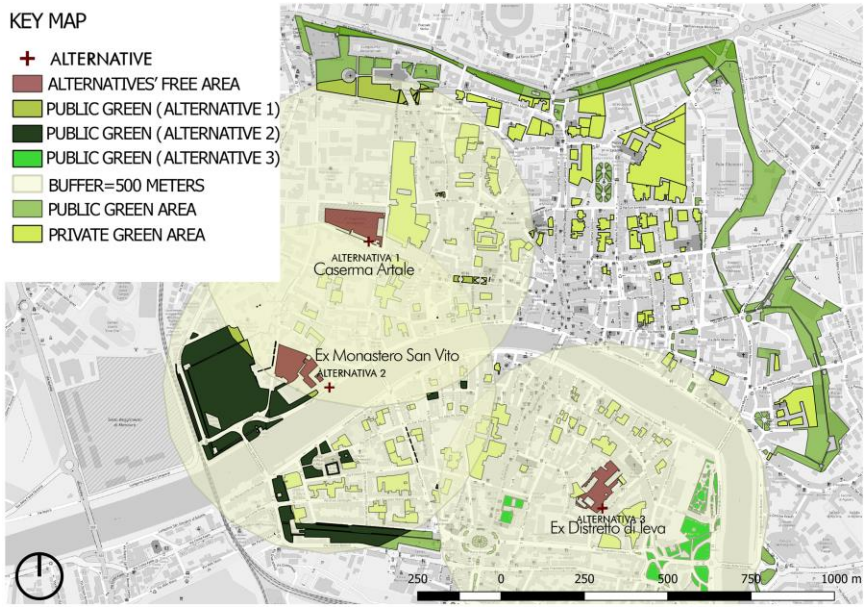

Figure 7. Example of the construction of the indicator of sub-criterion D4 for the Goal Function "Services Center" i.e. the presence of public green areas in the historic center. Source: Authors' elaboration.

3. ELECTRE 3: the software and the ranking of alternatives

Once we had defined the Weights and Indicators of the criteria and sub-criteria, we proceeded to the application of the ELECTRE Method, developed by Bernard Roy in the mid-eighties (Roy, 1985). The acronym comes from the French term "ELimination Et Choix TRaduisant the REalité" (Elimination and choice translating to reality) and is a Multi Criteria evaluation method making it possible to draw up a ranking of the alternatives with respect to the evaluation criteria outlined (weights and indicators) and to the study goals (for a review of on ELECTRE group methods see also Roy, 1996). The combination of GIS and Electre offers the possibility of using the information provided by the GIS mapping to the categories of evaluation according to multiple, conflicting and incommensurate evaluation criteria (Sánchez-Lozano et al., 2014).

As mentioned, the three decision alternatives can be represented in the physical space of the study area territory. In this case, through the construction of a dedicated application (Figure 8) within the software and written directly in the computer language (Avenue), it was possible to implement all the phases of the ELECTRE 3 procedure directly in the GIS environment.

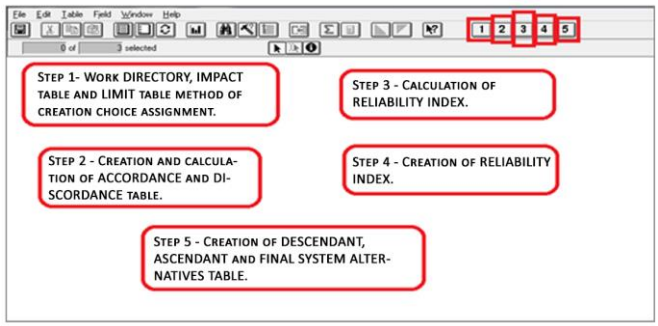

Figure 8. Software structure and description of the computational step. Source: Authors' elaboration.

The ranking process of spatial decision alternatives is divided into five steps. In the first two phases all the basic information (performance matrix, preference table) is loaded. In the third phase the matrices of concordance and discordance are computed and in the fourth step the construction of the credibility matrix takes place.

Finally, in the fifth and last phase the distillation process is implemented; it involves the construction of the two ascending and

descending orders from which the final order derives (Figure 9). Then, after quantifying the values of the indicators for each sub-criterion and establishing the weight vector to be attributed to the different criteria and sub-criteria, we proceeded with the construction of the Thresholds of Preference, Indifference and Veto. They provide the instrument described below with all the information necessary for the classification of alternatives with respect to the functions (Lapucci et al., 2009).

For one alternative to surmount another, it is necessary for the reasons in its favor to be sufficiently strong compared to the contrary ones: this makes it possible to calculate the Index of Credibility and the related table. In fact, to extract alternatives from the matrix, there are two distillation algorithms: one from the top, from the best to the worst, and one from the bottom, that extracts them from the worst to the best.

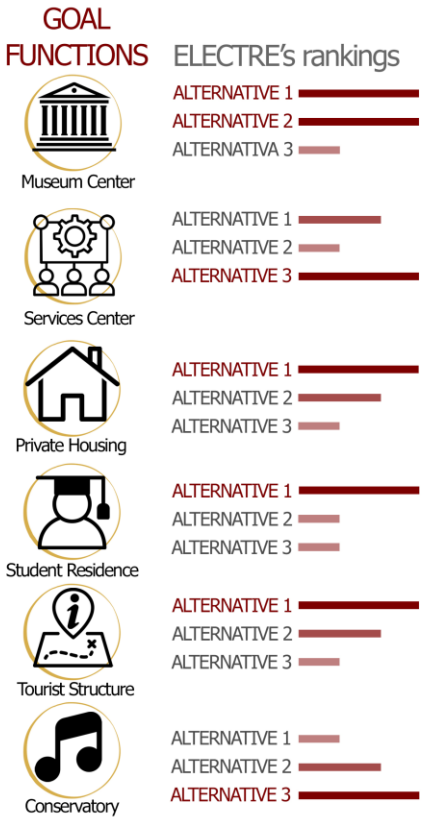

Figure 9. ELECTRE's ranking: software results. Source: Authors' elaboration.

Thus, two pre-rankings are obtained; only from the intersection of these will it be possible to reach the final ranking (Enea, 2017). At the end of the two processes, the two scores are added up and the alternatives are sorted by decreasing value: the one with the highest score is the best.

We have implemented the procedure described and the relative computational steps for each of the six evaluated Goal Functions.

4. Analysis results and the final choice

Once the results are obtained we can analyze the output data according to the priorities of the intended uses desired by the stakeholders.

If we limited ourselves only to the three winning objective functions (chosen according to the interests of the stakeholders), the analysis carried out would risk being a merely political justification. Therefore, we tried to conduct a broader and more shared analysis by addressing the problem on two precise fronts: we made a clear separation between the technical and political evaluation of the problem.

Finally, to achieve the most satisfactory choice in terms of transparency and compromise, we crossed the data coming from the priority of the stakeholder function and the final orders produced by the subclass of alternatives on each objective function.

The three best goal functions according to the intersection of the evaluations and best suited to the three military areas according to the study conducted are: the Student Residence for the "Vito Artale" barracks; the Museum for the former San Vito Monastery; the Service Center for the former Military District (Figure 10).

The Student Residence in the "Vito Artale" barracks has 200 rooms that can be reused immediately. By creating "a campus as big as the city", it fits very well into the territorial organization of the University of Pisa, which spreads throughout the historic center.

The Museum in the former San Vito Monastery is physically part of the municipal administration project of the Museum Park

located in the Galilean Citadel rich in many other cultural and landscape activities.

The Service Center in the former Military District fits very well into a morphologically very old and purely residential district in which there is a great lack of tertiary services.

The task of this methodology is to ensure that the final choice reaches the right compromise between the three goal functions declared most strategic by stakeholders and the three barracks declared most suitable by the Spatial Multi Criteria Analysis.

The goal of these tools is not to determine a choice by systematically applying the software, but to give a support to the decision through the application of methods of territorial investigation useful to better understand and visualize the relationship that different future scenarios can have on the urban fabric. The use of GIS also makes it possible to obtain a continuous update of the characteristics of the territory thus facilitating the study of its transformations. As in this case, the software provided the ranking of the adequacy of the three alternatives to new uses, but the final choice was determined by the first users of the projects: citizens and stakeholders, whose interests entered in the process through the results of the questionnaires.

The opportunity of these tools lies in the real collaboration of the politicians and administrators with the community.

The participation of the actors from the initial phases of the planning process allows the reduction of conflicts; more and more often the strong opposition of the citizens (Conti, 2011) prevents, by delaying or increasing costs, the implementation of policies related to territorial transformations (Santini, 2011).

In a bottom-up logic, by becoming part of the process right from the initial cognitive phases, the local community can on the one hand collaborate to better determine the urban policies, and on the other can accept the decision without strong opposition.

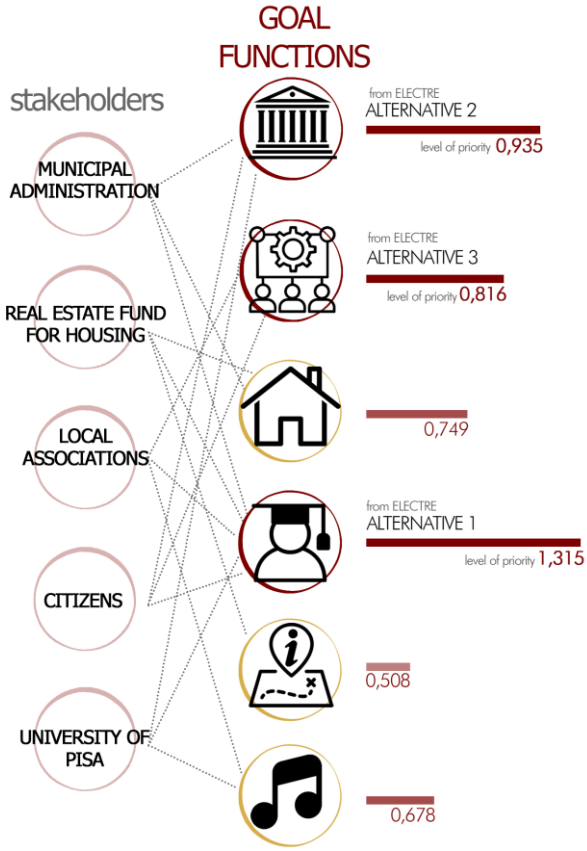

Figure 10. The intersection between the technical evaluation and the stakeholders' preferences.
Source: Authors' elaboration.

5. Conclusions

One of the recurring problems in the choices of urban planning is the evaluation of alternative scenarios. To choose the best one or the one that is able to gather the greatest number of consents, we have to take into account the territorial effects of the different projects and the preferences of all the actors involved in the process. The method that we have implemented makes it possible to reduce the complexity of the problem, giving a simplified evaluation scheme. The use of the ELECTRE Method enables those involved to make a real selection of the possibilities and to better determine which are the most valid choice alternatives on purely normative and technical elements. A further advantage concerns the integrated use of Multi Criteria Analysis and GIS. This allows us to evaluate the problem in spatial and geographical terms. In fact, it allows us to measure and

compare different criteria that distinguish present and future scenarios. The methodology that we described and which uses the implementation of these tools, makes it possible to reach a better compromise choice, as it enables citizens, administrators and politicians to obtain and know many more elements from the beginning of the process. The support of the technicians is fundamental in order to reach the final decision. In fact, this methodology creates the precondition to define the elements of the analysis (goal function, criteria) and to measure the indicators in a rigorous way. The work carried out is an experiment of new methods to develop in the planning of our cities, setting the right basis for an increasingly participatory, transparent and sustainable urban science. The results obtained from this research have also received positive feedback from the city administration which has meanwhile started a redevelopment program for the barracks with the Real Estate Fund for Housing. The real route that saw the sale of the "Artale" barracks and the former Military District has committed the buyer to building a student residence in the "Artale" barrack and a complex of social housing in the former District, although for the latter the difficulties linked to historical and architectural constraints are impressive. The former Monastery of San Vito remains outside this new Barracks Project. For this third barrack there have been no updates compared to its hypothetical redevelopment despite the opening of the Museum of Ancient Ships in the Medicean Arsenals that are in the same building complex.

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