CERTIFICATION PROTOCOL "HISTORICAL SMALL SMART CITIES": A DECISION SUPPORT SYSTEM TOOL FOR THE STRATEGIC MANAGEMENT AND RECOVERY OF MINOR HISTORICAL CENTERS

Pica, Valentina [1]

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Abstract

The ongoing research is presented for the definition of a Decision Support System (DSS) addressed to the minor local administrative bodies of the internal areas. The tool, called HISMACITY Protocol (Historical Small Smart City), has been built in its hierarchical structure, which runs from objectives identified on the basis of a preliminary study. It is the SWOT analysis of the characteristic elements of the small historical centers of the areas examined, both in Italy and in Spain. The objectives contribute to the reduction of the depopulation risk of these urban centers and to the improvement of basic services and localised employment opportunities, while at the same time aiming to protect historical heritage. The guidelines contained in the protocol formulate the opportunity to provide for the relocation of services to the capitals or some specialised centers, i.e. major centers that offer the concentration of multiple services and productive activities, according to a network strategy, and the Institute of Union of Municipalities, as supported by the National Reform Plan in Italy, promoted by the Agency for Territorial Cohesion, and by the consequent National Strategy for Internal Areas.

The protocol definition method is briefly described: through a comparative analysis of the literature on the Smart City and sustainable cities, on the recovery of historical centers, as well as on the protocols for sustainability and urban regeneration initiatives, the evaluation criteria have been defined and connected to the established objectives. These criteria have been then joined with simple and compound indicators that allow the measurement of qualitative and quantitative performance standards, for the purposes of classification and scoring. The criteria are sorted into six action areas: Mobility, Economy, Environment, Heritage, Living, Governance. Each criterion is associated with at least two alternative proposals for integrated intervention, and a series of concrete actions which will be partly chosen by local decision makers on the basis of the Analytic Hierarchy Process (AHP) technique of the Multiple-Criteria Decision Analysis (MCDA). Each municipality will be obliged to choose at least one alternative associated with one criterion for each area of action. The system can be modified during the decision-making process by means of a geolocated data platform, processed on a GIS software. Regarding cultural heritage protection, this framework includes the "modulation of the protection". It is a procedure already included in the technical standards for implementation (NTA) of the Recovery Plan of the historical center of Formello (Cerasoli, 2010). It detects the types of intervention range, from restoration and conservative rehabilitation to building repositioning. They follow a cataloging work and in-depth analysis of the characters and types of existing built heritage, which allow for the classification of building categories.

The data used in the framework refer to the various constituent elements gathered on the historical analysis centers (road, infrastructural, geomorphology of the urban tissue, etc.), useful for the definition of performance indicators. Currently the system's architecture has been defined on the pilot project of the urban center of Sutri, in the province of Viterbo. It is also being assessed the possibility that it can be made scalable on the historic center of Berga, in the province of Barcelona, in Spain. The protocol can become the first case of experimentation of a dynamic data collection and analysis tool for the intelligent management of small historical centers in rural areas, also useful for monitoring the expected results through its connection to the application of IOT sensors. The numerous challenges that today's centers in marginality are facing, including climate change, in addition to gentrification and the risk of the inexorable loss of much of the minor building heritage, make tools such as HISMACITY necessary and the evaluation of their adoptability at the institutional level, a possible plan to be seriously evaluated.

Key words: strategic planning; GIS data analysis; decision making; smart cities

[1] University of Studies of Roma Tre, https://orcid.org/0000-0003-3447-3124, contact e-mail: valentina.pica@uniroma3.it

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1. Introduction

The present research work describes the design process and utility of a dynamic planning tool referred to as the "Historical Small Smart City" Protocol (HISMACITY). It is oriented to the development and protection of small historical centers of the internal or rural areas in Europe. The tool's applicability focuses on the Italian territory, being the case study located in Sutri, in the province of Viterbo. Nonetheless, it has been investigated its scalability in Spain, for the case of Berga, in the province of Barcelona.

The main scope of the research project is to counteract the increasing phenomenon of depopulation of the internal areas, which threatens small historical towns (Pica, Cerasoli, 2018), that also face tremendous challenges in terms of security, prosperity, and management (Tosics, 2011).

These settlements are selected based on the threshold of 10,000 residents. In Italy, among the 8,057 municipalities, 6,797 register less than 10,000 inhabitants, 5,652 have a population of less than 5,000 inhabitants, of which 1,936 have less than 1,000 residents (Palazzo, 2017, pp. 214).

In Spain, according to records of the National Institute of Statistics (INE), the inner or peripheral areas of the country are also in a worrying demographic crisis. Of the 8,125 minor towns that exist in this country, 4,955 have less than 1,000 inhabitants (Franco, 2017).

Almost all minor historical centers in Italy, Spain, and in other many European countries originated in antiquity and evolved into medieval settlements which still represent the identity of place for local communities. Nonetheless, European rules do not require that historic buildings be retrofitted in order to preserve their cultural value (De Fino et. al., 2013)[2].

Moreover, traditional planning tools have proven to be obsolete around the world when confronting new, 21st century challenges, especially as they clash with the technical, operational-managerial, and financial inadequacy of local authorities (Aristone & Palazzo, 2000). Such tools consist of master plans or territorial plans with a top-down, centralised, rigid, and prescriptive approach (Hall, 2014), which is often ineffective in meeting real community needs (Dreier, Mollenkopf, Swanstrom, 2004).

1.1. The certification protocol "Historical Small Smart Cities"

To reverse the largely ineffective application of traditional planning tools and the depopulation trend that threatens small historical city centers, it is urgent to consider new technologies, that can support communities and local governments to work together on protecting the cultural landscape while stimulating development[3] (Pica, 2018a).

Therefore, the "Historical Small Smart City" Protocol is designed as a Geographic Information System (GIS)-based tool that can be integrated with a Multiple Criteria Decision Support System

[2] Directive 2010/31/EU on the energy performance of buildings. Available at: https://eur-lex.europa.eu/legal-content/it/ALL/?uri=CELEX%3A32010L0031.
[3] See: https://www.interregeurope.eu/policylearning/news/1675/use-of-ict-in-protection-of-natural-and-cultural-heritage/.

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(MCDSS) to help small municipalities orient decision-making and monitor various interventions aimed at guaranteeing quality standards of sustainability, cultural heritage protection, and technological innovation. The Protocol could be used in conjunction with traditional planning tools.

The development sustainability, introduced and defined in the 1987 Burdtland Report, correlates the protection and enhancement of natural resources to the economic, social, and institutional dimension (WCED, 1987). According to this statement, sustainability must be considered incompatible with cultural heritage degradation.

Based on these premises, the protocol is a performance-based reward certification system that encourages integrated interventions for the smart development (referred to as “smartness”) and the protection of the cultural heritage of the aforementioned small municipalities. The protocol also helps these settlements to accomplish their planned proposals in a defined time frame.

The framework has been conceived with the possible use of participated planning programs, as the number of citizens who are aware of the concept of landscape as "common good" is increasing, and therefore can be considered a valuable resource (Minervino, 2016).

2. Objectives and concept

For achieving success, the Protocol design concept aims to easily and dynamically test analytical procedures to set new evaluation techniques. Through successive phases, certification credits could be assigned by interacting with social actors and local administrators. The tool is based on defining a broad integrated planning program that prioritises and organises different strategic actions. It works through 32 evaluation criteria used for assigning the certification credits.

The criteria constitute the operational translation of the objectives so that they can be measured by comparing different levels of realisation. Their level of achievement is measured by indicators (simple and composed). They are encompassed in six priority areas of action: Mobility, Economy, Environment, Heritage, Living, and Governance.

The system could contribute to making urban planning adherent to the Sustainable Development Goals of the Agenda 2030 for Sustainable Development[4] (UN, 2016). Moreover, the Protocol aims at counteracting not only rural and internal area depopulation but also soil consumption through built heritage reuse promotion (EC, 2012)[5].

These objectives involve strategic project management. The tool offers a valid system to encourage municipal authorities to submit regional or community-funded projects. Such an action could contribute to reactivating the settlement dynamics of small historical centers on a provincial, regional, and national level. More specifically, in Italy the Protocol can become the means on which to build the criteria to allocate funding provided by the Territorial Cohesion Agency in the National Reformation Plan (PNR) framework.

[4] Available at: https://sustainabledevelopment.un.org/post2015/transformingourworld.
[5] For soil consumption data in Italy. For more information: https://www.eea.europa.eu/soer-2015/countries/italy and http://www.isprambiente.gov.it/files/pubblicazioni/rapporti/Rapporto_Consumo_di_Suolo_in_Italia_2014.pdf.

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Included in this plan is the National Strategy for Internal Areas[6], which is a financing program to connect local administrations of small Italian historic centers and communities, as well as private individuals, around common programs. It is also intended to relaunch development and services in the internal areas (TCA, 2014). The plan views the territory as a network of urban centers or “poles” that might develop differently in relation to various public services. Communication networks can also be improved through the use of Information Communication Technology (ICT) and 4G technologies.

Minor municipalities could then generate important dynamics by organising a networking distribution of services offered, acting as "attractors" of new inhabitants. They could work through the Union of Municipalities, i.e., a Convention (Article 30 of the Italian Legislative Decree 267/2000) or territorial system capable of generating mutual funds. Such a process can help in obtaining funding and its corresponding management of services and functions envisaged by the strategy.

2.1. Theoretical and operative framework

The research project has investigated the applicability of the Strategic Choice Approach (Friend & Hickling, 2005) to conceive the logical structure of the Protocol and to set its conceptual and methodological framework of reference, which is linked to the logic of Strategic Problem Solving as established by the Mental Research Institute (Watzlawick, Weakland, Fisch, 2011).

This theoretical framework is translated operationally into the Multiple-Criteria Decision Analysis, and empirically show that it is impossible to dynamically change a complex system, such as a city, by the mere study of the causes of previous changes. This is possible only regarding its functioning in the present and on alternative procedural solutions (Nardone & Watzlawick, 1993).

By renouncing an *a priori* knowledge of the phenomena under consideration, the problem solver or researcher must set a "complexity reducer" system to intervene in the reality to be modified, thus progressively revealing its mode of operation (Watzlawick, Weakland & Fisch, 2011).

This premise supports the dynamic decision making model by which the Protocol is conceived, that could be coordinated by the local administrators, and that could become a participatory process management system with a common set of objectives.

Regarding both the theoretical and the operative aspects, this research has been developed by retracing such premises while bearing in mind that, concerning operative procedures and technological advance, the use of sensors associated with georeferenced systems is certainly one of the most widespread fields. This, along with virtual architecture and augmented reality for cultural heritage tourism, is linked to reconstruction following natural disasters or museological models of fruition (Novelli, *et.al*., 2015). Moreover, several user-friendly software, platforms, and apps have been developed over the last three decades to implement ICT for workplace risk management, such as the platform EMS[7].

[6] http://www.oecd.org/cfe/regional-policy/1.2%20Promoting%20Growth.pdf.
[7] Available at: https://www.findwhere.com/en/ems/ (accessed on 3 November 2018).

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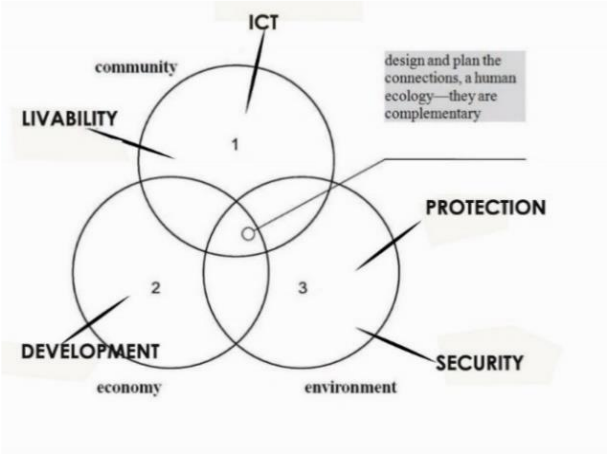
Regarding small historic centers revitalisation, to date, in Italy the Franceschini Commission directives for historical center conservation (Law No. 310 of April 26, 1964), that followed the Charter of Gubbio of 1960, republished in 1990 (ANCSA, 1990), have not been implemented in a specific regulation sector by the national legislator. The numerous issues involving historical centers make this a difficult task. Further, no univocal definition of historical center exists and previous attempts have often resulted in vacillating notions (Sanapo, 2001).

This regulatory flaw is also present internationally and ties into risk management. Various projects are being carried out in both the entrepreneurial field and experimental research in order to counter it. This is done by increasing security, even in reducing hazards through the use of new technologies[8]. Valid examples include the Urban, Urban II, and URBACT institutional initiatives that have addressed urban neighborhoods "in crisis". Although this background appears particularly suitable for urban recovery and revitalisation by taking into account economic and commercial purposes, there are no global use indicators to evaluate the impact of cultural heritage on sustainable development and disaster risk management (Appendino, 2016).

3. Methodology

This research adopts a new, integrated approach that is grounded on a responsive urban planning design. It utilises a human-centered focus for sustainable development and capacity building in local communities (Barberis, 2011; Wei, 2014). Under this approach, cultural heritage becomes a resource that is part of a wider strategic framework of environmental valorisation, as well as an economic strategic development plan from a multilevel governance perspective.

Figure 1. **Integrated approach model based on a traditional model of sustainability**



Source: Williams, 2007.

In light of this, the Protocol's strategy relies on the following assumption: any territorial governance tool able to put small historical cities on track toward integrated interventions allows for far-reaching possibilities of making sustainable development a tangible process (SEPI,

[8] Final Report Summary—FIRESENSE (Fire Detection and Management through a Multi-Sensor Network for the Protection of Cultural Heritage Areas from the Risk of Fire and Extreme Weather Conditions). CORDIS, 2013. Available online: http://cordis.europa.eu/result/rcn/143051_it.html (accessed on 31 November 2017).

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2011). This can be achieved by obtaining broad consensus throughout a multi-annual planning, which has been conceived with the tool.

The six action areas of the Protocol have been defined by a comprehensive analysis of the literature and the main projects concerning Smart Cities[9] (Nocca, 2017). The framework has also been set according to the recent Italian concept of the Sustainable Historical Smart City (CDP, 2013; Forum PA, 2014). This includes new action categories of Smart Tourism and Cultural Heritage within the typical European Smart City models, as promoted in 2010 by the Strategic Energy Technology Plan (SET) through the "Smart Cities and Communities" initiative. The concept has been published in the Vienna University of Technology's 2007 Ranking Report under its Smart Cities project[10].

A preliminary SWOT analysis has been conducted to identify the main characteristics of small historical centers to be included in the GIS database. This phase has allowed to better define the objectives. The SWOT analysis has been integrated into a comprehensive literature review (Armstrong, 1982) and a preliminary study of the main characteristics of several referenced Smart City pilot projects in historical centers[11]. This study is validated by cataloguing and describing the architectural, environmental, and infrastructural elements, along with the main problems and lack of services or connections present in historical center pilot projects. Such a process has been done prior to defining the priority areas of action, the milestones or criteria and before collecting the information for the design of the tables of the tool.

Secondly, the data framework has been structured through the definition of the evaluation criteria articulated by the aforementioned indicators. These elements guide decision makers and allow assign credits to each alternative intervention. The scores will be totalled so that the municipality can measure their quality level in each priority area.

To achieve this functionality, the certification system of the Protocol integrates methods that are rarely applied to sustainable development planning. In order to work as an MCDSS, the applicability of the Multiple-Criteria Decision-Making (MCDM) or Multiple-Criteria Decision Analysis (MCDA) is being tested as a sub-discipline on Linear Programming and Decision Support Systems. Several studies have set methods in this field for solving multi-objective linear problems in management science, engineering, or operations research (Romero, 1994; Garcia Leyton, 2004; Di Zio & Bernabei, 2009). They often involve conflicting criteria and can determine multiple performance levels. Therefore, to simplify complexity it is more convenient to formulate them as multi-criteria optimisation models where the solutions usually relate to finding a reduced set of variables by fixing the value and weight of one or more of them. Such an approach is being studied and optimised in the protocol's criteria and indicators (Colorni & Tsoukiàs, 2018: 6-7) definition.

Particularly, the composed qualitative indicators to measure some of the evaluation criteria[12] are designed to attribute specific values to the weighted elements in the calculations according to the formula:

[9] See the project "Bee Smart City" available online: https://hub.beesmart.city/smart-city-indicators/ (accessed on 13 February 2019).
[10] Available online: http://www.smart-cities.eu/download/smart_cities_final_report.pdf (accessed on 2 February 2018).
[11] Among these, Chiari (Brescia), Tavagnacco (Udine), Oriolo Romano (Viterbo), and Baronissi (Salerno) can be cited.
[12] Other criteria are measured by simple quantitative indicators.

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$$P_p = \sum_{j=m}^{n} (pj \times fj)$$

Pp= final value of the composed indicator, *i.e.* the total weighted percentage, resulting from the weighted sum of the partial percentages (factors) (*fj*) multiplied by their weights (*pj*).

These weights could cater for adapting the evaluation criteria to the local specificities and could be consulted together with local decision makers. As of now, the weights attributed to the factors which form part of the composed indicator have been established by the research team with "default" numbers: 5 as a common value to avoid discretion, and 10 in case of historical-archaeological value of the element.

According to the logics of Strategic Problem Solving, Multiple-Criteria Decision Analysis, and Strategic Choice Approach, the methodological key lies in the operative management of uncertainty through time by establishing alternatives or design hypotheses in a structured hierarchical form. Such an orientation aims to challenge the traditional planning model norms of linearity, objectivity, certainty, and comprehensiveness (Friend & Hickling, 2005: 67). This dynamic view contemplates evaluation (*ex ante*), validation (*in itinere*), verification (*ex post*), and the possibility to finally modify the problematised decision.

The operative method used for the evaluation workflow is the Analytic Hierarchy Process (AHP) of Saaty (1980). It is one of the Multiple-Criteria Decision Analysis techniques, that is developed to simultaneously consider a multitude of specific aspects regarding the problem (objectives and solutions), both qualitative and quantitative. Particularly, it is applied the AHP "method of comparison in pairs" to allow local decisors prioritising the interventions and to reduce the wide discretion of their decisions, as it contributes objectivity and transparency. Recently, this method has been acknowledged by the italian legislation on public works, services, and supply contracts[13] (Zeppetella, Bresso, Gamba, 2012).

It is applied to allow decision makers prioritising the alternative solutions, and it also resolves the complex task of giving values to the evaluation criteria and could be applied to calibrate the weights introduced in the composed indicators formula.

According to AHP, the evaluative function can be expressed as follows:

$$V = f(O, C, A)$$

In other words, the results of evaluation within a given decision-making context are a function of:
- the objectives, - the criteria, and - the alternatives.

The hierarchical structure of the evaluation framework, facilitates to reach a prioritisation of the alternatives, *i.e.* the integrated interventions.

[13] Autorità per la vigilanza sui contratti pubblici di lavori, servizi e forniture (2011), *Linee guida per l'applicazione dell'offerta economicamente più vantaggiosa negli appalti di servizi e furniture*.

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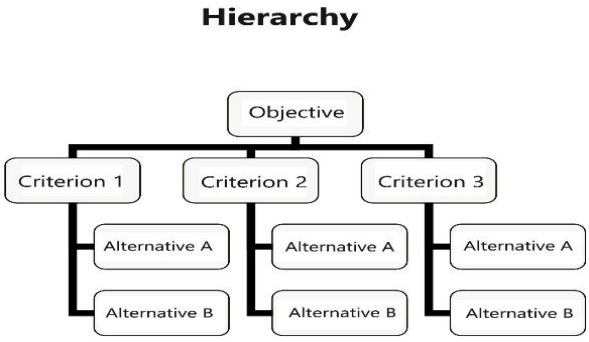
Figure 2. **Analytic hierarchical structure of the evaluation framework**



Source: Author.

Thus, based on n criteria, the decision maker estimates a matrix (n x n),

$$A = [aij]$$

Where aij is the (subjective) measure of the relative importance of the alternative i versus another alternative j (with regards to a criterion), according to a standardised scale of 1 (equal importance) to 5 (absolutely more important)[14].

The value aij can also be related to the criterion i versus another criterion j (with regards to an objective or priority area), whenever the matrix is applied to evaluate the certification criteria of the Protocol. Likewise, this value can measure the relative importance level of the factors in the composed indicators.

3.1. The dataset framework design process

The design process of the tool of the Protocol is a work in progress, set for a 2019 completion. After the research project's deadline, the entire Protocol Certification System will consist of three elements: The Geographic Portal for Data Analysis and Evaluation; Tables with Evaluation Criteria linked to the assigned Bonuses, and the Guidelines document.

The framework's workflow has been designed to be rigorous and systematic but also flexible. More specifically, the structural design of the Protocol has been developed by three phases. In the first step the baseline milestones have been set, i.e. the evaluation criteria encompassed in the priority action areas.

Next, a Work Breakdown Structure (WBS) has been created to unpack large action fields according to the hierarchical form required by the AHP method. A baseline management plan has been defined. It details how local administrators, stakeholders and citizens could provide information to the validation and verification processes for the baseline changes.

[14] See Tables n.2 and n.3 in section n.4. See also: http://www.iuav.it/Ateneo1/docenti/architettu/docenti-st/Stefano-St/archivio-p/Clamarch-11/10_Valutazione-multicriteriale.pdf.

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In the initial two phases of this design process, each criterion has been optimised based on a series of feasible solutions and indicators that have been partly borrowed from the report analysis on Urban Quality of "Sustainable and Equitable Wellbeing" (BES), the Italian (ISTAT) framework[15], and the Green Building Council (GBC) Neighborhoods Protocol[16].

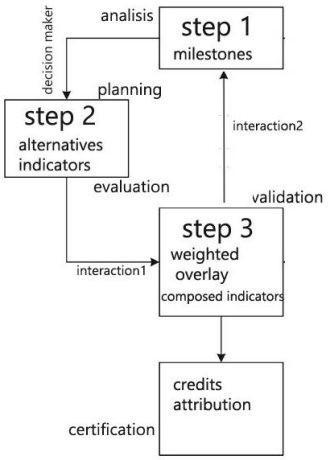
The first phase includes the Strategic Problem Solving application in designing the best scenario for each goal that corresponds to the highest score or ideal values assigned by the system to each evaluation criterion. Lower values are also obtained by minimising each criterion's standard separately. The decision maker has not been involved in this design process, unless for the Local Data retrieval.

In fact, after step 1 the team of experts (researchers) has asked to the decision maker (the municipal city council) the necessary local input data and has defined the values or scores of the evaluation criteria of each priority action area, with a medium of 3 credits each. These credits are determined by the fact that the total value of all the criteria is 100. The entire amount is 96, so the 4 credits that are left over are attributed to those interventions that are realised by the municipalities that form a Union.

The score or weight assigned to each criterion could be modified in the future through the "comparison in pairs" of the AHP analysis. A detailed list of the input data has been recently published, together with the GIS Data framework developed during the first two phases (Pica, *et.al.,* 2019). In the third step, which is in progress, there have been set the calculation models with the "weighted overlay" technique, i.e., an overlapping procedure of different feature classes with linear combinations to obtain weighted indices to constitute the composed indicators.

The baseline management plan *ex ante*, *in itinere* and *ex post* concerning the interventions, has the same structure of that described for the design process of the tool. In the first step the decision maker must cater for input data, that will be managed by the digital system of the Protocol and the team of experts.

Figure 3. **Workflow of the Protocol HISMACITY**



Source: Author.

[15] Available at: https://www.istat.it/it/benessere-e-sostenibilità/la-misurazione-del-benessere-(bes)/gli-indicatori-del-bes (accessed on 10 February 2019).
[16] Available at: http://www.gbcitalia.org/web/guest/quartieri

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The operative practicability of correcting the values and measurement methods of each intervention criterion based on the effects detected has been set during the data framework design. It is valid in every single phase of the baseline modification of the Protocol. Particularly, it deals with recalibrating the values or credits assigned to each criterion, the weights assigned to the indicator's formula and their measurement value. The last two factors can be changed automatically thanks to the tools of the GIS software. This baseline management or correction process follows an interactive dynamic, that is contemplated by the MCDSS-oriented approach (Siskos & Despotis, 1989).

This dynamic system can provide a "two-level" interaction with the dataset framework: (1) interactive assessment by the research team, and (2) interactive modification of satisfaction levels through participatory process assessments (the engagement of the decision maker or even the local community could be included).

As for the first interaction, during the stage 2 of the workflow of the process, the team of experts (researchers or institutional body) can ask the decision maker (the municipal council) to apply the "comparison in pairs" of the AHP technique on the alternatives defined for each evaluation criteria (see section n.4).

Through the second interaction there can be realised, with the same method: the modification of the weights of the evaluation criteria; the modulation of the weights assigned to the factors encompassed in the composed indicators. At a later stage the team of experts can introduce these modifications into the digital system.

The city council must undertake at least one intervention related to each criterion to obtain a basic certification standard for each priority area. The decision maker will choose the option with the highest level of satisfaction, that will be the first intervention to be executed. The AHP technique can also be utilised in successive validation (*in itinere*) and verification (*ex post*) phases through participatory assessments.

Regarding cultural heritage protection, a definition of the historic center and its boundaries has been proposed. As for the definition, the dimensional threshold is a criterion that has been combined with others. In this regard, it is interesting the approach proposed by the Institute of British statistic in 1981, that refers to the definition of "town" to further investigations in terms of type and morphological aspects (built-up area) and functional (functional area) (Palazzo, 2017, pp. 214).

In line with this assumption, the Protocol includes a tool for the "modulation of the protection" (Cerasoli, 2017), based on a typological analysis of the buildings which considers the generative and progressive evolution of historical centers' urban tissue. It prescribes interventions for cultural heritage conservation in the dataset by joining the buildings' feature class with tables of attributes to indicate the levels of transformability in the historical fabric (Pica, 2018b). It is a procedure already included in the technical standards for implementation (NTA) of the Recovery Plan of the historical center of Formello (Cerasoli, 2010). The physical delimitation corresponds to the line of the external medieval walls (registered or existent) of the historic center.

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4. Results

The expected results of the research project follow the specific goals pursued. One of the most significant is the housing supply for the younger, less wealthy population and migrants. This counteracts soil consumption and urban sprawl. The GIS database designed to build the Protocol provides strategic integrated solutions to these critical points by establishing a dynamic and user-friendly digital tool. It contains data analysis for calculating the various indicators. The system can integrate different elements during the spatial analysis to understand territorial trends. Its process can be oriented in the future toward disaster risk management (Cherubini *et. al*., 2006).

By including a database in the platform that contains a catalogue of historic buildings, site conservation status, and risk assessment, it could then be possible to inform authorities and experts responsible for emergency management on such details. Further, through the georeferencing of data that can be acquired via remote monitoring, users would have the opportunity to have a real-time alert and relevant feedback about the effectiveness of their intervention. This involves continuously updated maps that indicate affected buildings and points of cultural interest.

Yet the potential of such a system is not limited to the scope of the emergency. It also represents a frontier for improving knowledge of cultural sites and city services.

Another expected outcome is to introduce a technological tool commonly used in the future by networks of municipalities that could establish a future baseline platform on which smart online public services could be offered. The project's WebGIS, which is a component of the Protocol, could then not only disseminate the content of its Guidelines but also contribute to this future.

Public online services could be made available in the future to citizens and visitors through mobile device access to the platform for security reasons. This can also provide information on actions to be taken in case of need.

Open Source data sharing and Open Labs supported by this platform would allow "peer-to-peer" planning that focuses on participatory and democratic processes, making real-time management and decision making possible. Utilising Information and Communications Technology (ICT) and the valorisation of specific local strengths and priorities are the foundation of this process. Once the research project is complete, it is necessary to design the architecture of both the server and the client of the future platform.

In the future, a number of more significant, unused or misused buildings could be identified as potentialities and suggestions for refunctionalisation. This process of selecting the best functions could again be led by the AHP method as recent research realised at the Center for Soil Politics and Valuations of the Polytechnic University of Barcelona (Sanchez Riera, 2010).

As of now, the general structure and the main contents of the Protocol Tables have been drafted, while the complete definition of the Protocol contents and guidelines are still in progress (Table 1).

Table 1. **Evaluation Criteria and alternative interventions of the Historical Small Smart City Protocol**

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MOBILTY	ECONOMY
- Criterion: Transitability Alternative A: pedestrian Alternative B: by bicycle Alternative C: by Local Public Transport	**- Criterion: Measures for Urban Development** Alternative A: fiscal and financing incentives for building renovation Alternative B: Measures to combat the abandonment of buildings
- **Criterion: Ciclability** Alternative A: E-bike sharing services Alternative B: infrastructures for parking and storing of bicycles	- **Criterion: Promoting Development** Alternative A: Public-private partnerships Alternative B: Business networks
- **Criterion: Accessibility** Alternative A: pedestrian Alternative B: by bicycle	
- **Criterion: Security for Mobility** Alternative A: pedestrian Alternative B: by bicycle	- **Criterion: Slow Tourism** Alternative A: tourist efficiency Alternative B: hosting promotion and containment
- **Criterion: Smart Mobility** Alternative A: Remote sensing monitoring of two-wheeled mobility Alternative B: Insertion of electric bus(es) Alternative C: Local Public Transport enhancement Alternative D: Interchange points and smart parking lots Alternative E: On-demand transportation Alternative F: Info-mobility systems	- **Criterion: Resources efficiency** Alternative A: saving energy through smart street lightning Alternative B: efficiency of heating and cooling networks
	- **Criterion: Local marketing** Alternative A: Promotion of local product's marketing Alternative B: E-commerce
ENVIRONMENT	**HERITAGE**
- **Criterion: Conservation** Alternative A: Maintenance and protection of biodiversity Alternative B: Conservation of wetlands and water bodies	- **Criterion: Specialized Public Buildings** Alternative A: Preferential localization of interventions Alternative B: Preliminary energy audits of public buildings Alternative C: Refunctionalization Alternative D: Visitability and universal accessibility
- **Criterion: Enhancement** Alternative A: Enhancement of rural uses Alternative B: Urban green areas	
- **Criterion: Risk Management** Alternative A: Prevention of areas exposed to flooding Alternative B: Protection of steep slopes	- **Criterion: Minor Public Buildings** Alternative A: Preferential localization of interventions Alternative B: Preliminary energy audits of public buildings Alternative C: Visitability and universal accessibility
- **Criterion: Renewable Resources** Alternative A: Plants for the reuse of waste water Alternative B: Power plants	- **Criterion: Specialized private buildings** Alternative A: Preferential localization of interventions Alternative B: Mixed functions in preferential localizations
- **Criterion: Waste management** Alternative A: Differentiated waste collection efficiency Alternative B: Measures for waste prevention and reduction	- **Criterion: Minor private buildings** Alternative A: Preferential localization of interventions Alternative B: Mixed functions in preferential localizations Alternative C: Varied housing units for *mixité sociale*

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- Criterion: Network management Alternative A. Creation, control and monitoring of thermal waste utilization plants Alternative B: Long-term management of the conservation of the natural habitat	**- Criterion: Public Space** Alternative A: Security of open spaces Alternative B: Enhancement of bioclimatic potential for open spaces Alternative C: Visitability and universal accessibility
- **Criterion: Smart Environment** Alternative A: Smart grids and other smart facilities (remote sensing) Alternative B: Reduction of water supply leakage Alternative C: Sustainable resource management	**- Criterion: Recovery** - Recovery Plan with modulation of the protection - Drafting of the Strategic Plan, or the Operative Plan with the Urban Regeneration Programme - Adoption of Urban Building Regulation Plans (PRU) with schedules for buildings recovery
- **Criterion: Pollution Reduction** Alternative A: Reduction of light pollution Alternative B: remote sensing control of pollutants	
- **Criterion: Reuse** Alternative A: Reuse and recycling of infrastructure Alternative B: Energy retrofit of existing buildings and infrastructures	
LIVING	**GOVERNANCE**
-**Criterion: Local Productivity** Alternative A: Development of retail outlets (short supply chain) Alternative B: Local productivity promotion	- **Criterion: Shared Governance** Alternative A: Participatory planning initiatives Alternative B: Involvement of community cooperatives Alternative C: Conventions with dioceses of the Catholic Church Alternative D: Common Assets Regulation
-**Criterion: Livability** Alternative A: Flexible work Alternative B: Indoor comfort quality (domotics, smart appliances) Alternative C: Proximity of residences to the workplaces	-**Criterion: E-Government** Alternative A: Open Access digital public services Alternative B: Digital tourist services
-**Criterion: Public Services** Alternative A: Accessibility to the public transport system Alternative B: Accessibility to basic services Alternative C: Transportation and education	-**Criterion: Data Sharing** Alternative A: Data collection and processing Alternative B: Access to information
	-**Criterion: Networking Planning** Alternative A: Covenant of Mayors Alternative B: Sustainable Energy Action Plan (Italian PAES) Alternative C: Union of Municipalities Alternative D: Inter-municipal Recovery Plan Alternative E: Integrated Strategic Plan with an Operative Planning Programme and various plans (Mobility plan, etc.)

Source: Author.

The definition of the expected implementation results of this certification system takes into account that the National Strategy for Internal Areas prescribes regional governments to select project areas for integrated and multidisciplinary interventions. This includes protection of the territory; enhancement of natural and cultural resources and sustainable tourism; food agro-

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systems and local development; renewable energy saving and local energy supply chains, strengthening local inter-municipal public transport, as well as know-how and craftsmanship[17].

The performance indicator linked to the interventions on the quality and security of the public space is integrated with participatory processes and actions, by using tools as the "Common Assets Regulation", first experimented by the City Council of Bolonia[18]. Public space enhancement by installing new functions and a better level of lighting is among the first priority actions of the Protocol's strategy as "a leverage factor" (i.e., a complexity reducer from Strategic Problem Solving) that can further stimulate broad interventions on the built cultural heritage. An example of the functioning of the certification process is detailed below.

Table 2. **Example of the hierarchical framework of alternatives concerning a criterion**

Criterion	*Indicators*	*Measure*	*Response function*	*Alternatives*
Transitability Area: historical center within 30 minutes by foot **Total Score: 3**	Transitability by foot from the point of interest	Composed. Total weighted percentage of the incidence factors of the pedestrian connections between the points of interest, farer than 7 minutes..	600: maximum value Score: 0,7 1020: improvable Score: 0,5 2000: critic Score: 0,2	A. Pedestrian transitability: relocate points of interest (basic services such as schools) within the historical center
	Transitability by bicycle	Composed. Weighted percentage of the incidence factors of the cicle paths between the points of interest	600: critic Score: 0,2 1020: improvable Score: 0,5 2000: maximum Score: 1,1	B: By bicycle transitability: creation of cycle paths
	Transitability by electric Local Public Transportation	Composed. Weighted percentage of the incidence factors of the electric bus lines connections between the points of interest	600: critic Score: 0,2 1020: improvable Score: 0,5 2000: maximum Score: 1,2	C: By Public Local Transportation transitability: insertion of bus lines

Source: author.

Table 3. **Example of alternatives prioritisation concerning an evaluation criterion with AHP method**

Matrix of the comparison in pairs: preference of alternative C							
Criterion: Transitability							
Alternatives		Alternatives			Sum	Normalisation		Sintesis
		A	B	C		Weight of Alternative		
	A	1	0,5	0,2	1,7	0,12 (1,7/14,03)	X weight of the criterion: 1, which is a total[19]. (3 Scores)	0,36
	B	2	1	0,33	3,33	0,23 (3,33/14,03)		0,69
	C	5	3	1	9	0,64		**1,92**
					14,03	(9/14,03)		

Source: author.

[17] Funded by all available community funds (ERDF, ESF, EAFRD, EMFF).
[18] Available online: http://comunita.comune.bologna.it/node (accessed on 21/11/2017).
[19] The weight of each criterion could be less than 1 if it would be evaluated according to the AHP method in relation to the others criteria of the several priority areas of the protocol's framework.

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5. Conclusions

The Protocol “Historical Small Smart City” is a dynamic certification system which deals with the complexity of the urban environment of the small historical centers in condition of marginality to guarantee a tool that can coordinate integrated interventions management for its sustainable development and cultural heritage protection.

Its multidisciplinary approach considers participative processes solutions, as well as recent findings on traditional building types that is inclusive of decision making. Its hierarchic structure is conceived to facilitate the management of the local strategies, and it adheres to the Analytic Hierarchy Process (AHP) method, that allow local decision makers prioritizing the interventions.

The Protocol has been conceived in order to design a new model that can be scalable and useful in rethinking the foundations of actual planning legislation. It is also intended for developing planning tools and regulations that allow for maintaining the cultural continuity of the built environment. Finally, the Protocol could be adopted throughout Italy within the National Strategy for Internal Areas, as well as in Spain and other European countries as a valid method for allocating EU funds. With regard to sustainable development and territorial management, the engagement of local communities prescribed by the Protocol can offer a path midway between the public sector and civil society. This could facilitate the integration of their goals and interests.

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