How knowledge subjectivity affects decision-making: a Geodesign case study for the Cagliari Metro Area

Elisabetta Anna Di Cesarea, Roberta Florisb and Michele Campagnac

[a]University of Cagliari, DICAAR, Cagliari, Italy (elisabetta.dicesare@unica.it, roberta.floris@unica.it campagna@unica.it)

Key-words: Geodesign, Strategic Environmental Assessment, participation, Planning Support System.

Introduction

Strategic Environmental Assessment (SEA), introduced by the European Directive 42/2001/EC, promotes a significant methodological innovation in the planning elaboration process with the aim to integrate environmental considerations and public participation. Two important condition for SEA to be effective is represented by its inclusive and incremental attitude (Fisher, 2003), in defining the objectives of the policies which need to be assessed, and the effective participation of all the key-actors in the process (Zoppi, 2012), as regards both the preliminary and ongoing evaluations (Brown and Thérivel, 2000). However, many difficulties can be found by experts on the proper implementation of these principles (De Montis et al., 2014), especially in setting a democratic process, in finding as many compromises during the participation phase and in consensus building (Zoppi, ibidem).

Geodesign (GD), intended as a methodological approach to decision making informed by digital spatial information, allows promoting multidisciplinary collaboration and participation (Steinitz, 2012). The GD logic can be applied in regional landscape studies in order to understand how the context should be transformed in the future, through the Geodesign Framework (GDF), consisting of six models. The first three models describe the study area before the implementation of the plan: based on a detailed description of the study area (Representation Model - RM), the process models representing how it is evolving in the present situation are identified (Process Model - PM) and then assessed in order to evaluate possible strengths or vocation for a particular purposes (Evaluation Model - EM). The last three models consist of a practical design stage in which, starting from the identification of alternative scenarios for development (Change Model - CM), and their impact assessment (Impact Model - IM), it is possible to choose a shared development alternative (Decision Model - DM). Therefore, while the last three models are related to the intervention stage and the initial three concern the assessment stage. With these respect, the GDF shows a consistent logic with SEA, which should run since the early stages of the planning process in order to inform decisions at any stage, and it may contribute to address many current SEA pitfalls encountered in the regional planning practices (Campagna and Di Cesare, 2016). In line with the description above,

the practical design phase, as generally intended, starts in the GDF with the CM. Nevertheless the alternative scenarios' definition, and as a consequence the decision-making process, is strongly influenced from the results of previous three models, in fact the output of the EM constitutes the input of the CM.

In the next sections, two examples of EM thematic maps are presented. These maps are realized during the preparation of the "Geodesign Workshop on Future Scenarios for the Cagliari Metropolitan Area", to be

held from 9 to 11 May 2016 at the University of Cagliari. The workshop consists of a 3 intensive planning studio days within a multidisciplinary team of students, scholars and local public and private stakeholders, in order to build up collaborative future scenarios based on sustainable development for the new Cagliari Metro Area. During the workshop's organization 10 systems are analysed, starting from the description of the existing situation (i.e. RM) to the evaluation of territorial inherent vocations (i.e. EM), in order to give participants 10 evaluation maps of selected phenomena from which to start designing (i.e. CM). Three of these systems represent vulnerability elements (i.e. Cultural Heritage, Ecology, Hydrogeological hazard), the last seven systems represent attractiveness elements (i.e. Tourism, Agrifood, Transports, Low density housing, High density housing, Commerce and Industry, Smart services). This maps' elaboration provides a useful basis for reflection on the difference between the objective phenomena' representation and the subjective one, and how a different type of representation may profoundly influence the latter stage of the plan alternatives' design.

Methodology

In this session we explore how the maps representing the EM of two of the ten systems, are created in a GIS environment. The first system is the "Cultural Heritage" (CULTH), which locates the mainly vulnerable areas in relation to the concentration of the most significant historical assets. The second system is the "Tourism" (TOUR), which identifies of the most attractive areas to develop appropriate tourism strategies. The EM maps are elaborated through a land suitability analysis, aiming at identifying, for each system of the study area, its inherent vocation. The information utilized in the maps creation includes data collection from social networks, namely social media geographic information or SMGI (Campagna, 2014) and their integration with Authoritative geographic information (A-GI), retrieved from the regional Spatial data infrastructure (SDI). As a matter of fact SDIs faced prosperous development worldwide in the last decade and allow the spatial data accessibility to the wider public in order to support informed decision-making (Campagna and Craglia, 2012).
CULTH, as a vulnerability system, identifies the areas affected by the major spatial distribution, density and proximity to the cultural heritage to be protected for its historical value, according to the Sardinian Regional Landscape Plan (RLP). The information used to define the RM of the CULTH system (Fig. 1a) is retrieved from the regional SDI as digital geographic datasets representing the cultural and historical characterisation of the area. Specifically, these areas include: historic city centres, cultural goods (i.e. the combination of historic architectures and the archaeological sites) and archaeological industrial areas related to the production processes of historical relevance (e.g. the Geological Mining Park and the historic saltworks).
TOUR represents an attractiveness system, which depicts the spatial distribution of tourists' preferences regarding existing tourism lodging services (TLSs) and natural and non-natural resources. The innovative aspect of this map is the fact that it includes and represents consequently, tourists' and local communities' perceptions and opinions, spontaneously generated by users (Goodchild, 2007) and available on social media platforms. This information, or SMGI, provides relevant knowledge for better investigating tourism phenomenon (Briassuolis, 2002); in fact, understanding the tourists' perceptions and opinions, and integrating this information with traditional authoritative data sources, or A-GI, may represent an opportunity of great potential to enrich, eventually, sustainable tourism goals with a broader, deeper and more multifaceted understanding of tourist destinations. With an improved awareness of the users' characteristics, decision making can be simplified (Leslie et al., 2007) by emphasizing the strengths of tourist destinations for past and potential visitors. In the light of these considerations, the RM of the TOUR system (Fig. 1b) includes the concentration of the following three key elements:

- the existing TLSs and their relative perceived quality, retrieved from TripAdvisor.com and Booking.com. This dataset includes quantitative information concerning the TLSs scores based on rankings, divided into several categories, such as value/price, rooms, location, cleanliness and sleep quality.
- The already planned tourist areas, or F areas, defined by the 2266-U/83 Decree, namely Floris' Decree, and spatially localised according to each Municipal Master Plan (MMP) of the 17 municipalities comprising the Metro area and to the Sardinian RLP.
- The users' contributions on Panoramio, considered as points of interest, from which it is possible to elicit their landscape, natural and non-natural resources perception.

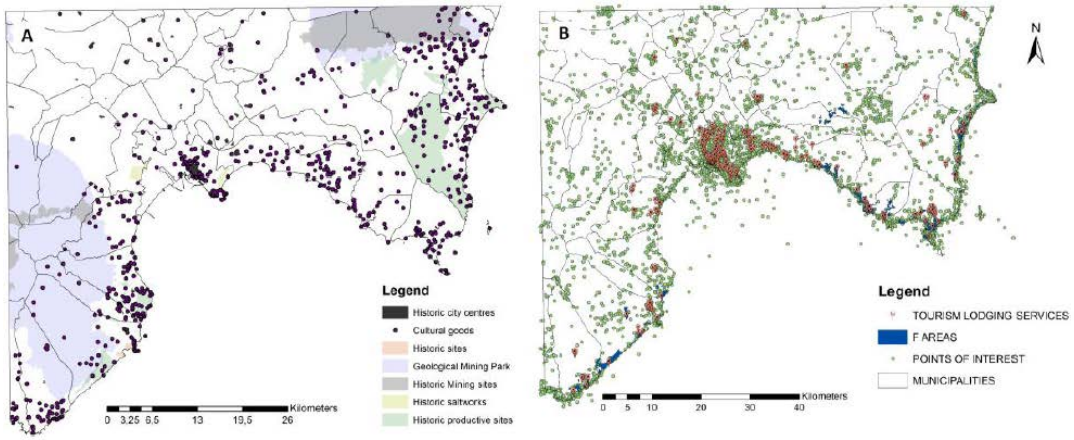

Fig. 1. Representation model of the CULTH and the TOUR systems.

In order to obtain an EM map of the CULTH and the TOUR systems, each dataset is considered as a criterion in the following analysis.

As a vulnerability system, the CULTH map is implemented in order to describe spatial distribution of historical areas to be protected for future preservation strategies within the Metro area. Firstly, the historic city centres are given the highest vulnerability score, while a decreasing score are assigned to two buffer zones of influence around them: the first buffer zone extending up to 300 m away and the second one up to 1500 m. Secondly, a kernel density is implemented for points representing the cultural goods' distribution, in order to identify the areas affected by their highest concentration. Lastly, the historical industrial sites are identified and given a vulnerability value. Two final maps are generated by assigning different weights to each of the three criteria, considering their importance and combining them together. In the first solution historic city centres and cultural goods have the same high weight while industrial areas have the smallest value for their presumed less vulnerability (Fig. 2a). In the second solution historic city centres have the biggest weight, cultural goods a medium value and the historical industrial sites the smallest weight (Fig. 2b).

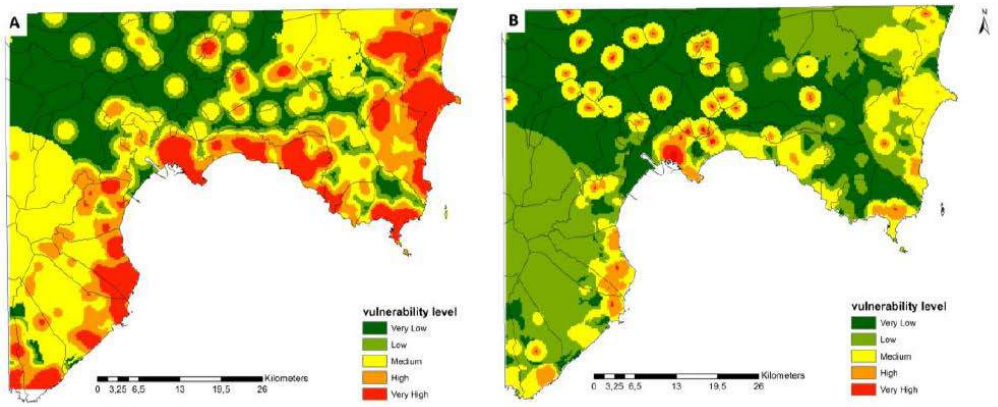

Fig. 2. Evaluation models of the CULTH system.

As an attractiveness system, the TOUR map is implemented in order to describe spatial patterns of tourists' preferences and to identify locations of interest for future tourism development strategies within the Metro area. In order to obtain an EM map of the areas suitable for tourism development, three different criteria are defined, relying on the three elements described above. Firstly, a kernel density is implemented for points representing the spatial distribution of

tourists' preferences, in order to identify the areas affected by their highest concentration. Secondly, the existing F areas are identified for the 17 municipalities comprising the Metro area and treated as a boolean variable. Finally, a kernel density is implemented for points concerning the users' contributions on landscape, natural and non-natural resources perception. Then, two maps are generated by assigning different weights to each of the three criteria, considering their importance and combining them together. In the first map, we consider the presence of TLSs and spatial distribution of tourists' preferences on them, and users' interest on landscape and natural and no natural resources the key factors for emphasizing the development of new tourism facilities for potential visitors. Thus, the spatial distribution of tourists' preferences and the users' contributions based on their landscape' perceptions have the same high weight, while existing F areas have the smallest value (Fig. 3a). In the second solution, we hypothesize the presence of tourism facilities, accommodation and high tourists satisfaction' level as the most important factors for determining the attractive areas to implement appropriate tourism strategies. In this case, the biggest weight is assigned to the spatial distribution of tourists' preferences, while the users' perceptions on landscape and resources and existing F areas take a medium and the smallest weight, respectively (Fig. 3b).

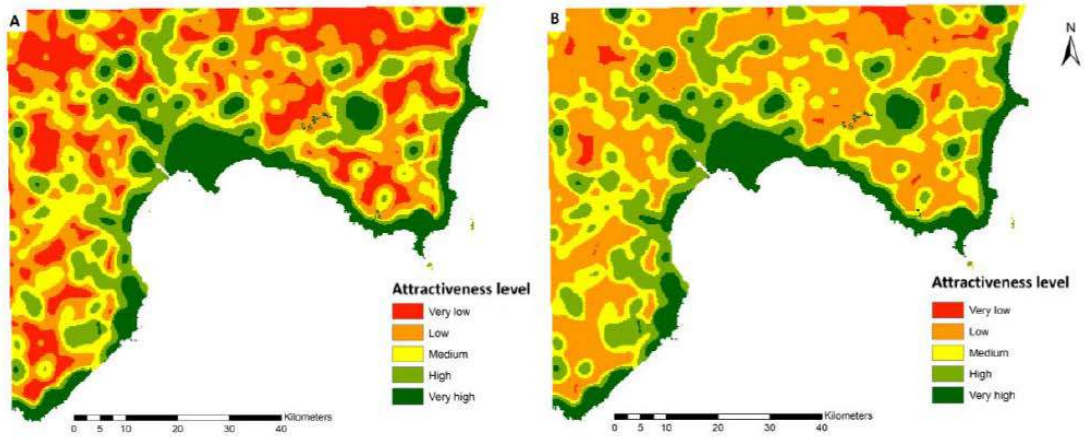

Fig. 3. Evaluation models of the TOUR system.

Results and discussion

The result of the analyses of the CULTH system EM are two thematic maps classifying the territory in 5 vulnerability levels, where red areas indicate those characterised by a very high vulnerability, in which only actions aimed at preserving and promoting these sites can be permitted. To the contrary, the dark green areas are the less vulnerable ones, in which do not persists any restriction in use. Also in the TOUR system, the final two maps are classified into 5 levels of colour ramp, where green colour identify very high attractiveness areas for developing appropriate tourism strategies, thanks to the presence of tourism facilities, accommodations, scenic values and high users interest level. Conversely, areas affected by very low attractiveness, due to the lack of tourism facilities, users' interest and very low accessibility, are depicted with the red colour.

According to McHarg (1969) each place is a sum of natural processes to which correspond social values. In order to respect these values it is important to identify the intrinsic vocation of a territory. EM pursues this objective, but it is strongly influenced by the cultural and scientific knowledge of the individual participants elaborating it and by their role in decision making. As a matter of fact the case studies in the previous session show how maps can vary considerably in

function of: the data collected to describe a specific phenomenon, the criteria analysed and their respective weights, the spatial analysis performed and the modelling tools implemented.
Analysing the two different systems is obvious that the information utilized during the maps creation' phase results into different RM. In fact, RM is sometimes more objective, as the case of CULTH system, where the information includes data retrieved from the regional SDI and represents A-GI, and sometimes more subjective, as the case of TOUR system, defined using data retrieved by social networks, or SMGI, representing users' preferences and opinions. By contrast EM is always characterised by subjectivity. As a matter of fact, the EM definition relies on the planners' expertize, encoded in the processing model. For the output of the EM provides the knowledge support for plan alternative scenarios' design (CM), decision-making process is strongly influenced by its results. Considering planning practices, a subjective perception of phenomena may represent the key factor in decision making stage, being really powerful in determinate future development scenarios.

Conclusions

In a Geodesign planning studio, EM maps may strongly influence the design and decision-making stages, thus an inclusive, participatory and multidisciplinary approach is fundamental in order to ensure a more democratic and transparent process during their definition. In this regard, the ultimate goal of the SEA is to find the best way to represent all the interests and needs that meet up in a specific territorial context, and especially to find as many compromises as possible so that all the key-actors' wants are represented in the decision-making processes. This approach strengthens the evaluation process, which is basically orientated at creating inclusive consensus building among local population in respect to democratic choices, sustained over time.
Future research streams will concern the investigation of how the participation of different stakeholders may influence the Geodesign assessment phase (i.e. the three initial GDF models). A test-bed for these assumptions will be the Geodesign Workshop, wherein different private and public stakeholders will participate.

Acknowledgements

Elisabetta Anna Di Cesare gratefully acknowledges Sardinia Regional Government for the financial support of her PhD scholarship (P.O.R. Sardegna F.S.E. Operational Programme of the Autonomous Region of Sardinia, European Social Fund 2007-2013 - Axis IV Human Resources, Objective l.3, Line of Activity l.3.1.).

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