Article

Representation and Visualization Processes for a Sustainable Approach to Landscape/Heritage

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Abstract: This paper intends to focus on the modes and forms of representation for a novel and sustainable approach to landscape/heritage, to those "tangible and intangible landscapes", which are also called "emerging landscapes of heritage". The long tradition of landscape description is grounded in visibility/objectivity terms as well as on nature/history. Nowadays, a sustainable approach to landscape/heritage should also carefully describe the participatory processes in recognizing, enhancing, and sharing meaningful values for a community. Starting with the Icomos recommendations about heritage modes of representation, this paper extends the research question to landscape/heritage where there are required methodologies that take into consideration both visible and objective aspects for depicting the interactions of people and territory, and its "becoming". This contribution will therefore outline the main forms adopted today for the visualization and communication of the landscape that can monitor human and physical processes in progress and that, while being in continuity with the idea of landscape rooted in the West on the intangible aspect of "visibility", they also need to be increasingly performative in describing the territorial and tangible complexity of dynamics and phenomena on a large scale.

Keywords: landscape/heritage; forms or representation; processes of communication and visualization

1. Introduction

The topic Tangible and intangible landscapes visualization and communication proposed by the call emphasizes how the concept of landscape in the West is strongly connected to the sphere of visibility [1,2]. This is often considered in the construction of a representative image of territories and populations, and at the same time, both are able to describe a concrete context and to evoke its intangible values [3].

An iconic image, often cited as an explanation of the complexity of material context and immaterial meanings of which the idea of landscape is a synthesis, is represented in the fresco panels of "Effects of Good Government" by Ambrogio Lorenzetti (1338–1339), in which the Sienese countryside appears depicted as a landscape "ordered to the view" [4]. It depicts a beautiful landscape that came as a result of the work of the man who built, cultivated and inhabited it: in short, the fresco panel constitutes the self-image representation of a community that is recognized in its landscape [5].

The example cited, which is one of many that characterizes the pictorial production of the theme throughout the Renaissance period, is an interpretation of two components coexisting in the very concept of landscape and its representations: the functional component (concrete, productive, and material) and aesthetic [6].

Representation, image, and recognition of one's own identity are points that direct the understanding of landscapes today to the idea of heritage as an interpretative process based on a community [7–9], in a social and intercultural setting [10,11] and that shows a growing interest between cultural heritage and territory with both its tangible and intangible cultural heritage [12,13].

Nowadays, in the political vision of the European Commission, cultural heritage and landscape are united by the need to build social cohesion and education for citizenship, based on processes of interpretation and representation of communities.

In relating the concepts of citizenship and cultural heritage, Copeland has shown that there is some correspondence in the changing meanings of the two notions. With the end of the last century and the emergence of the new, the concept of citizenship has developed from an exclusive, elitist, formal, content-based, knowledge-based, and educational transmission to an inclusive and participatory one, based on processes, values, and interactive interpretation. At the same time, new approaches to the concept of heritage have emerged in Europe, marking the step from a meaning based on top-down identification criteria on a national basis to an interpretation in a social and intercultural community [14].

European policies reflect this cultural approach, with the European Landscape Convention [15] also addressing the landscapes of "everyday" for the new idea of "widespread" heritage to be preserved in the form of memory and traditions of a community that can be passed down to future generations.

The concept of heritage is thus transformed from an approach focused on the protection and preservation of the elements of the past to incremental attention on the present, attaching increasing importance to personal identification with space as part of the heritage experience and simultaneously introducing the concept of cultural landscape [16].

As you can read in one of the many texts written by the European Commission on the topic: "The subject of landscape provides many advantages for pupils' education and is an important means for them to become familiar with the surroundings considered as their living space and to understand them. It should provide an opportunity for pupils to discover the role of everyone in his or her role as an inhabitant of the landscape surrounding them, as a guardian of its identity and its culture and as a protagonist aware of its future development" (p. 8) [17].

This emphasizes recognition of one's own cultural identity, starting from younger generations, through a conscious appropriation of the physical and cultural space, of one's own heritage and of one's own landscape.

In recent years, there has been a convergent interest in landscape and heritage, not only for policies but also in research and teaching, whereby both have been considered as "markers of identity" [18]: in fact, both concepts can be labelled as cultural and/or natural, tangible and/or intangible, and own or collective, with them finally becoming mutual reference points for popular, political or scientific narratives [19,20].

Such a contiguity of themes is what has given rise to the recent production of studies in which heritage and landscape are firmly interconnected in terms of epistemologies, ideologies, and methodologies, gradually conquering a common intellectual space, which is both broad and interdisciplinary [21].

Both areas seem to be characterized by dynamic processes and relationships between the two components, both of which have also developed an increasing involvement in related social aspects [22].

Because of this cultural approach, both fields of research tend to emphasize the contingent and procedural nature of their subjects: what increasingly seems to unite these fields is the notion of "becoming", which is a constant state of cultural construction, deconstruction and reconstruction. Such a "processual" approach is what allows us to imagine places as an active becoming and to reinvent social relations, the uses of the territory and their identities [23].

These considerations define a sustainable approach to landscape/heritage that is able to consider how a territory is really lived in and transformed by its inhabitants, instead of being only seen in a preservation vision. In the meantime, such an approach requires the employment of contemporary ways of visualizing and communicating material, and intangible landscapes that are suitable for describing their inherent complexity in this way, which, while exploring the potential of technologies, allows the possibility of cultural appropriation by people.

In this research perspective, it appears relevant to focus on a methodology which analyzes the most useful forms of representation in depicting both visible and objective aspects of the interaction of people and territory and its "becoming". Further, this paper will investigate some case studies, which are currently relevant from the point of view of their efficacy in representing the phenomena related to landscape/heritage.

2. Materials and Methods

2.1. Representation for Landscape/Heritage: A Conceptual Framework

Many geographers and landscape theorists have resorted to landscape paintings to support their theoretical reflections. The case of the "new cultural geography" is well known, focusing on the landscape as "a mode of seeing" [24] and on the ideological dimension of the pictorial representation of the landscape [25].

Recently, Pettenati returned to this subject in an interesting essay devoted to a critical perspective on landscape as heritage, where he chose the reference Les charmes du paysage, (1928) by René Magritte [26].

As the empty frame of Magritte's painting suggests, the themes of the landscape, the meanings and its boundaries are never objective. In fact, during its conceptualization, the landscape has often been described as a "volatile" concept [27], and as a vague perspective on the material forms of the earth [28].

In the meantime, the landscape represents the expression of multiple—individual and collective—subjectivities that are "framing" reality [26]. This process of "framing" determines how spatial characteristics contribute to the landscape, what their meanings are (including that of "heritage"), and how the landscape should be lived in, experienced, transformed and organized: in such a perspective, it can be considered a place of negotiation, where conflict, exclusion, resistance and the exercising of power can produce different versions of the past at the core of heritage-making [29].

In this way, heritage narratives become "interpretative keys" that allow interiors and exteriors to read the landscape and its meanings. They thus constitute a sort of "embedded" frame in the perception and representation of the relations between the past and the future of a landscape [30].

Coming back to the painting by Magritte, the process of building heritage concerns "a frame" on the landscape, which is transformed from an undivided and constantly changing entity into a symbolically and materially delimited local entity, that is governable and separate [29].

The landscape representations that are produced during heritage building processes are very performative, as they concern how the landscape is perceived, managed, transformed, and practiced by local communities, tourists and stakeholders [29].

2.2. Interpretation/Communication Strategies for Visualizing Landscape/Heritage

Now the question is: how, with what tools, and with what modes of communication and visualization can the actors, stakeholders, dynamics, negotiations, and the process of building a place be seen through the contextual framing of "heritage and landscape"?

In terms of representational tools, it is crucial to start from the communication strategies adopted for cultural heritage sites that Icomos (International Council of Monuments and Sites) divides into two approaches: an Interpretation strategy regarding research and "bottom-up" practices, and a Presentation strategy, which relates to "top-down" actions [31].

Interpretation refers to the complex of activities, reflection, research, and creativity generated by a cultural site. This concerns the proposals and the involvement of visitors, both local and connected in community groups, and of stakeholders of different ages and backgrounds.

Their participation is essential for the interpretation and transformation of sites in places, which can become a source of learning and reflection on the past and, at the same time, important resources for sustainable development of the community.

Presentation concerns consolidated knowledge and information practices regarding cultural heritage sites, generally developed by expert scholars, design studios, and heritage professionals. Therefore, it is predominantly a unidirectional mode of communication (top-down).

Visualization and communication tools that represent the landscape/heritage should also include the more established approach among scholars, which is looking at a landscape as an entity derived from the integration of anthropic communities in territorial environments. From this point of view, the identity of a place is added to that of the populations living there because of the interactions between human and natural factors, whose enhancement finds in the sustainability of its development the main reason for responsible action towards future generations [32].

This implies a multidisciplinary approach that considers multiple disciplines to which modern and innovative technologies necessarily connect today [33].

Such an approach can handle dynamic, multidimensional, and multilayered spatial and temporal analysis that goes beyond the idea of a landscape as a simple visual and aesthetic issue, but where the set of all contributes to building and defining the environment in which we live: so, the transition from a static and mechanistic vision to a systemic theory that allows us to approach the typology of complexity [34].

In this way, the analysis carried out on an objective basis and in accordance with quantitative and qualitative criteria makes it possible to analyze phenomena of various kinds, including the contraction or expansion of urban areas; changes in land use, roads and water networks; of the canalizations and the works of reclamation; of the organization of property; and, more generally, of all the signs, structures and the natural and artificial configurations that, if correctly interpreted, allow us to establish the forms taken by the landscape over time and the complex fabric of dynamism present within the territory [35].

Today, the modern development of topographic, photogrammetric, cartographic and satellite techniques make it possible to obtain models of the territory that are valid in terms of metrics and which are significant from a graphics point of view. The applications of GIS and remote sensing to the study of earth observation (EO) and to the study of landscapes, while still in the experimental phase, constitute an increasing phenomenon.

Starting with the Icomos recommendations for heritage modes of representation, the research question should be extended from the appropriate tools of visualization of landscape/heritage to also include those technologies that can take in consideration both visible and objective aspects in depicting the interactions of people and territory and its "becoming", focusing on the main updated and performative forms adopted today.

3. Results

As seen, introducing the theme of landscape/heritage, representation is a "frame" that allows us to take into account both tangible and intangible aspects.

Such a "frame" requires consideration of the top-down approach as well as the bottom-up one. Further, the multiple heritage/landscape representations have to cope with the most updated research results in the fields of geomatics, cartography and data analysis. These provide a common ground for analyzing both structural components, visual aspects, and dynamic changes in a territory in order to produce effective and synthetic outputs.

Three case studies, coming from excellent research labs and which respect the above-mentioned criteria, have been selected to better illustrate some efficient and updated solutions for representing the complexity of the phenomena related to landscape/heritage.

3.1. Cloudism

While the methods used for representing landscapes in the past have left an important legacy, they now need to be integrated with layers of additional information regarding the space and, more generally, the environment.

Cloudist research developed at the ETH Landscape Visualizing and Modelling Laboratory (LVML)—coordinated by Cristophe Girot—has obtained considerable relevance in the field of large-scale landscape modelling using point cloud data sets.

Cloudism is in fact a profound conceptual transformation in the aesthetic representation of the landscape, made possible by new digital tools and methodologies for analysis and design. As the environment changes rapidly, a different approach to solving problems of both material culture and landscape construction is necessary.

So, the notion of Cloudism describes a new art of thinking and building of the landscape through point cloud modelling, a convincing simulacrum which converges physical reality, space and time, and therefore can produce a deep understanding of a site and its environmental issues [36] (Figure 1).

Figure 1. First robotic landscape design studio in Valle Rivera, Ticino 2017. Section perspective of a river edge modelling for self-driving excavator using the Docofossor programme ETH Chair Girot and Gramazio-Kohler Research © Chair Girot, Ilmar Hurkxkens and students Ladina Ramming and Torben Westerhuys [36].

Currently, point cloud data can be collected either with lidar technology or through TLS (terrestrial laser scanner): the different data sets are adapted to a three-dimensional coordinate system that places them in a geographical space. The laser scanner works by measuring the distance to the first object on its path and returns the information to a sensor at the speed of light, giving an accurate reading of height, depth and the position of the pixel received. It is with this high degree of precision that the entire landscape can be understood and recorded.

Georeferenced geographic models are used for various applications in landscape design, its analysis and simulation. Each model can contain up to one billion information points. Through the cloud, therefore, research has moved from "contour" modelling and overlay GIS mapping to more dynamic and versatile forms of landscape surveys (Figure 2).

Figure 2. Point cloud model, in Fricker, P., Kotnik, T., Computing Landscapes, in Fricker, P., Kotnik, T., Pattern of Interaction, Springer, Cham (Switzerland) [36].

Landscape representation must account for both natural dynamic processes and the human factor, whose form evolves over time, thus overcoming one of the limits inherent in the two-dimensional system on which GIS are based.

The 'point cloud' representation system allows us to have at the same time a high degree of precision connected to the production of an aesthetic image. Point cloud modelling can also be a useful basis in participatory processes for large-scale interdisciplinary projects with different factors and interests [36].

3.2. Digital Twin

An element common to several applications and considered fundamental for the representation of the landscape is offered by the digitalization of data referring to an urban and territorial scale. In recent decades, there has been a plurality of terms and procedures ranging from cloud computing to platforms, big data, smart cities, machine learning, artificial intelligence, and finally, the latest frontier today seems to be the potential of the digital twin [37].

In strict terms, a digital twin is a mirror image of a physical process that is articulated alongside the process in question, usually matching exactly the operation of the physical process which takes place in real time.

Through digital twin, we can obtain a wide range of digital models that simulate processes concerning both socioeconomic and physical systems. In general, any system that "duplicates" something else can be considered a model, or a simplification of a real phenomenon that is not intended to replicate it with the same level of detail. However, a digital twin working in real time does not appear different from the system itself and therefore poses the theme of its use as the ability to investigate a system, simulate it and test new features, and more generally 'how can the digital twin be used to explore and inform the original twin' [37] (p. 818).

As for the theme of visualization and communication of the landscape, the digital twin seems to invest in primarily physical assets. As it is well known, GIS, including data on the building scale (level of buildings), allows us to investigate phenomena related to

energy, the use of materials and maintenance through BIM; all of this enables a digital representation of the physical structures of the city. However, GIS rarely includes processes describing how a city "works" in economic and social terms.

One of the challenges posed by the digital twin today is on how to relate these processes to the built environment and then connect the physical processes to socioeconomic representations.

An example of such functionality is represented in the digital 3D model of the Queen Elizabeth Park connected to ViLo (Virtual London) that, elaborating data in real-time, can visualize the areas visited frequently compared to those that are not. "This project is implemented through internet of things and the deployment of large-scale sensing in the city, which involves ourselves as sensors through our smartphone technologies as well as the physical sensing of energy, traffic, email and related physical and ethereal flows." [37] (p. 819) (Figure 3).

Figure 3. A digital model of the Queen Elizabeth Olympic Park in London, UK, enriched with real-time data streams and connected to the ViLo (Virtual London) Digital Platform for Data Visualizations in Participatory Urban Planning. Image courtesy of The Bartlett Centre for Advanced Spatial Analysis (https://www.ucl.ac.uk/bartlett/casa, accessed on 21 August 2023) [37].

3.3. Mapping the Spatial Flows

Current digital technologies allow maps to dynamically and visually reconnect materials and processes that would otherwise appear as fragments separated from each other [38].

One request made of mapping, stemming from positivist thought, was to represent spatial stability; however, in a world such as the present one, consisting of radically unstable spaces and structures, the idea of mapping itself has been radically rethought, inducing a change in the underlying techniques to produce and reproduce the graphic images that the maps convey [39].

More and more maps today are the result of social practices and techniques subject to redefinition in a process of constant reterritorialization; therefore, they are characteristically transitory, short-lived, contingent, relational and context dependent. What maps reproduce today has moved from ontology (from 'how things are') to ontogenesis (to 'how things become') [40], from a 'certain' representation to a practice in the making, whose outputs are

increasingly sketch maps, counter maps and participatory mapping [41] (Figure 4). In short, today a representation of space created by cartographers becomes a map only through the intervention and the participation of subjects and individuals.
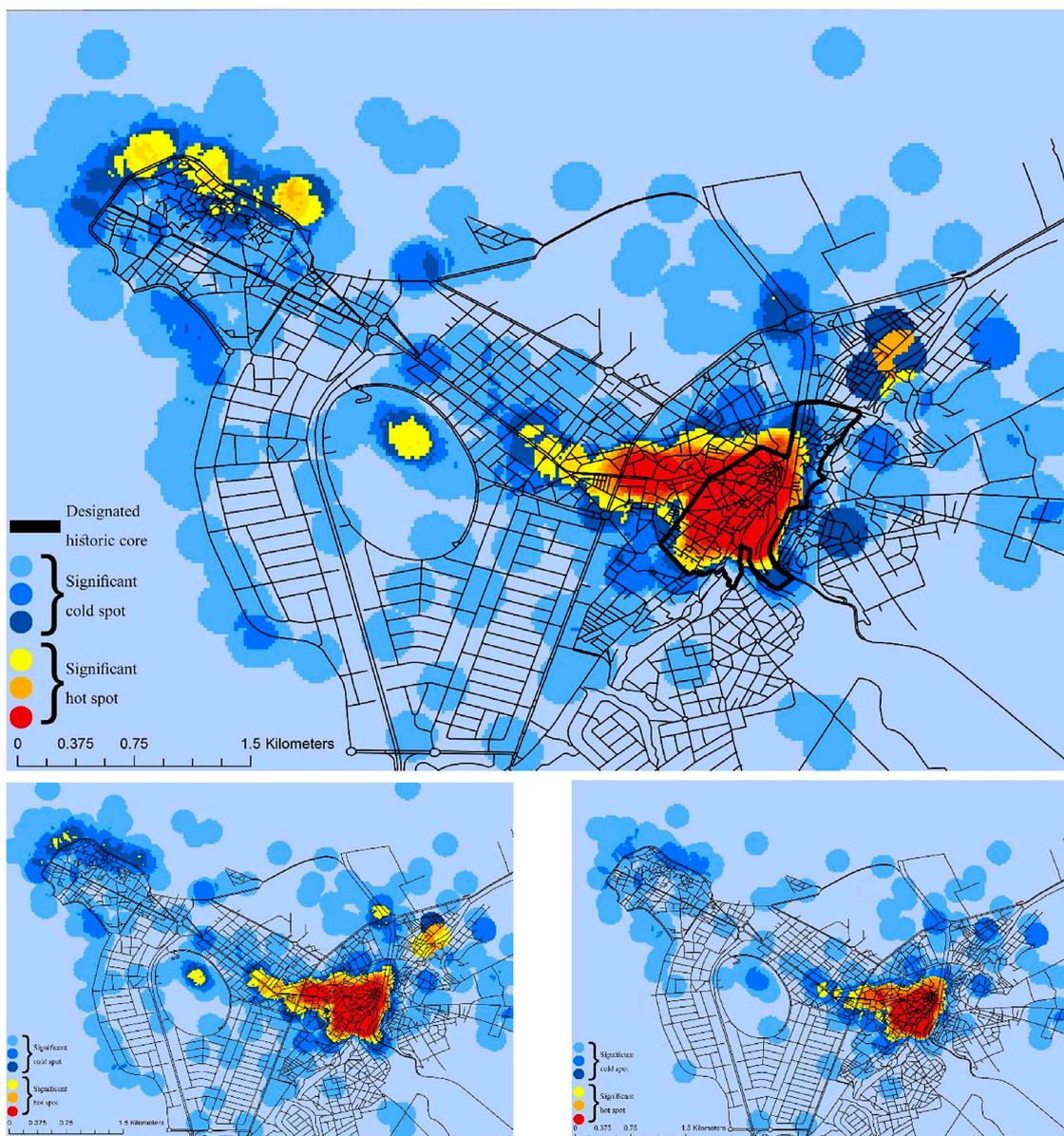
Figure 4. Use of images tagged on Flickr API (application programming interface); data related to Tripoli, Lebanon, collected between 2003 and 2016. Top: density and spatial distribution of total photos. Lower left: density and spatial distribution of photos (resident population); lower right: density and spatial distribution of photos (tourists). By Ginzarly M. et al. [41].

In this way, they become able to describe "processes" rather than states of fact, and to connect data flows to spaces where residential, urban and landscape contexts are increasingly structured around networks, which connect the physical form of spaces to the intangible flow of information.

An increasingly convincing frontier within research is that which sees the use of digital and informative models dedicated to the interaction with subjects and individuals through digital devices.

The Senseable City Lab at MIT Boston—established in 2005 by a multidisciplinary research group that studies the interface between cities, people and technologies—focuses

its research interests on "the ubiquity of digital devices and the various telecommunication networks that augment our cities, are impacting urban living" [42].

Among the recent projects which can be visited on the MIT Senseable City Lab website, Wanderlust (2021) consists of a precise and quantitative description of the mobility of people through a spectrum of mobility flows that are both spatial and temporal. It aims to provide a comprehensive representation of real data that can open up unprecedented possibilities for transport planning, epidemic modelling and urban design [43].

Employing a vast sample of metropolitan areas spread across three continents, the Wanderlust project focuses on visualizing a pattern of travel flows of residents and tourists in the sample locations, the frequency of their visits and the distance travelled.

Visualization of the elaborated data from the calculation algorithm has particularly effective visual communication modes based on three-dimensional interpretative schemes. This is in contrast to the elaboration of maps accompanied by diagrams illustrating the periodic movements of individuals and the total flows of the population (Figure 5).
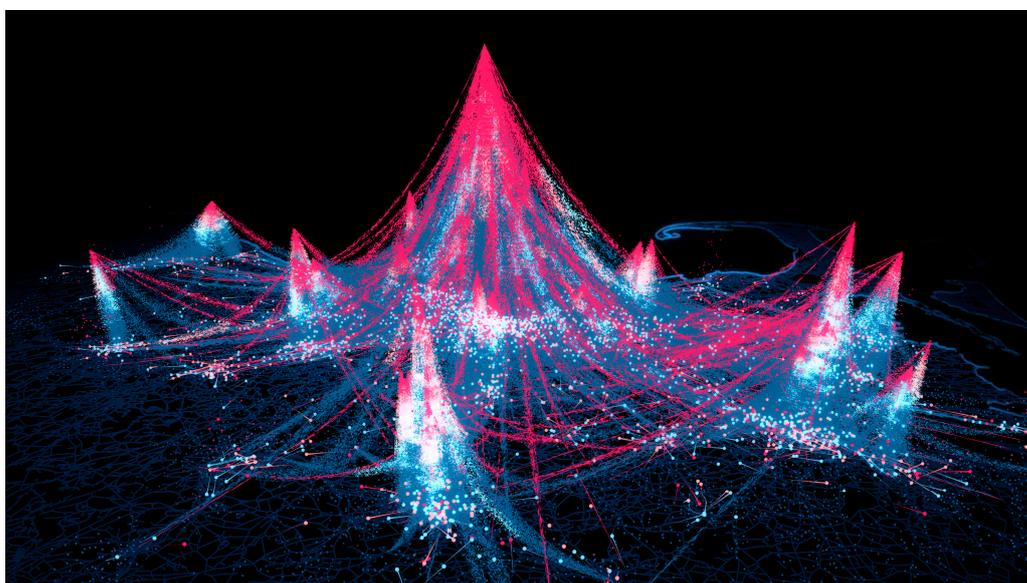
Figure 5. MIT Senseable City Lab, Wanderlust Project (2021), (https://senseable.mit.edu/wanderlust/, accessed on 22 June 2023). This image visualizes the flows of individuals across the Greater Boston area as lines (visiting frequency as color, number of unique visitors as width) that form spatial clusters of attractive places, with the height of mountains representing location-specific attractiveness [43].

4. Discussion

The modes of representation described above are some possible examples that employ updated tools to explore complex human and physical phenomena on territorial and landscape scales during their "becoming". They enable different investigative possibilities that are applicable to both the Interpretation and Presentation Icomos approaches to heritage, and, more broadly, to landscape representation.

The main forms of representation of the landscape/heritage, according with the Icomos guideline, can be employed with similar modalities in both the approaches recalled, even if it requires that the first one (Interpretation) uses preferably mental or participatory maps and the other (Presentation) employs mainly "Euclidean" tools [44]. In other words, the map (mental or participatory) can be considered as a means for a subjective representation of space, grounded in an experience of the environment that engages the senses, which is indeed a very different form than "quantitative" cartography as the output of data.

The collected qualitative information, often allowing intangible aspects of a place to emerge, assumes typical conventional forms and symbols shared by all mapmakers. These

participatory graphic representations can be transformed into geo-referenced maps, based on well-established processes and mapping techniques, such as GIS techniques [45].

This poses the question of how to make landscape/heritage representations clear and understandable both for laypeople and technicians, scholars, and practitioners.

Through both more conventional tools and the updated ones, visualization and the communication of the landscape/heritage aims to render visible aspects of a place with the merits of the visions and the dynamics of its natural and anthropic components, and thus making the invisible visible.

Visualization and communication are crucial in landscape experiential simulation processes—based on Virtual Reality/Augmented Reality—enhancing, in this case, the perceptive components that include not only the visual dimension, but also sound and tactile information, to document an all-round experience of the environment through a visual language of easy accessibility [46].

The visualization and communication of tangible and intangible landscapes reworks an aspect present in the idea of landscape from the beginning, that is the need to account for quantitative and measurable aspects in the territories and visual components.

What today seems to characterize different approaches, coming from disciplines that cross the hard sciences and the humanities, is the dynamic, mobile, changing, "becoming" character, which describes flows and movements of ideas as people and that distinguishes contemporary, local, and global societies at the same time.

5. Conclusions

For a sustainable approach to heritage/landscape, the visions of laypeople and scientists need to be gathered: the tools of graphic and visual communication in the processes of analysis and their purposes must be clear and understandable by everyone, as well as the tangible and the intangible values of the places.

The methodologies illustrated in the three case studies employ modes and forms of representation in different potentialities which can be useful in illustrating landscape dynamics and people's values that are considered during the "becoming".

Summarizing:

— Point cloud modelling allows us to merge physical reality, space and time, producing a deep understanding of a site and its environmental issues. It can be assumed as a suitable basis in participatory processes for large-scale interdisciplinary projects with different factors and interests.
— Digital twin enables the use of a wide range of digital models that can simulate processes concerning both socioeconomic and physical systems, and so connects physical processes to socioeconomic representations.
— Mapping can be employed as a tool to describe social practices in processes of constant reterritorialization; in fact, current maps aim to reproduce not only "how things are" but "how things become".

In conclusion, it needs to be emphasized that the "landscape/heritage" topic is very complex and is currently under debate; this paper has aimed to highlight the relationship between the topic and the representations that are relevant in the processes of building a sustainable approach to tangible and intangible aspects in a territory.

The three methodologies can be considered useful starting points to visualizing and communicating tangible and intangible landscapes in the process of gaining knowledge about a place, and acknowledgement of the proper identity used by people and, in doing so, to have the chance to utilize clear tools suitable to plan a sustainable vision of the territory.

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