# Representing and Visualizing in Landscape, between Hard Sciences and Humanities

Rossella Salerno

## Introduction

The issue proposed in the call 'The representation of landscape, territory and environment' is placed in the crossing of various disciplines: geography, ecology, urban design, architecture, but also social sciences and humanities, till to include the latest interdisciplinary exchange between life sciences and techniques which is on the basis of computation.
At first glance, landscape representation seems today to include –because of diversified applications coming from digital technologies in the field of data processing– the territorial and environmental representation too; in fact it employs both data information of geomatics, and opposite, the interpretative images of the ambiance, characterized by time/space parameter which is subjective and cultural.
In other words, landscape representation appears to take an original position, making use of geographic data processing and sensory depiction concerning the tangible and intangible components in a territory.
In our generation, the approach to landscape outlined in the very well-known book of Vittorio Gregotti *Il territorio dell'architettura* (1966), was a reference point –as properly for a multilayered reading open to the diverse geographic and anthropologic facets– so, it could be use-

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ful to question what is changed over the years, if we wish to represent such complexity [Gregotti 1966].
Today, what is emerging in a very clear way is that, considering the many and different digital graphic outputs created by a diversified processing of a huge quantity of territorial data, we are more and more moving towards a visualization topic, or, in other terms, it is now arising a very specific attention in visually depicting the geometrical description and the interpretation of geographic contexts, namely the picture of quantitative and qualitative aspects: last but not least, we can consider landscape representation as the result both of data coming from hard sciences and from the more blurred facets of subjective perception of environment.

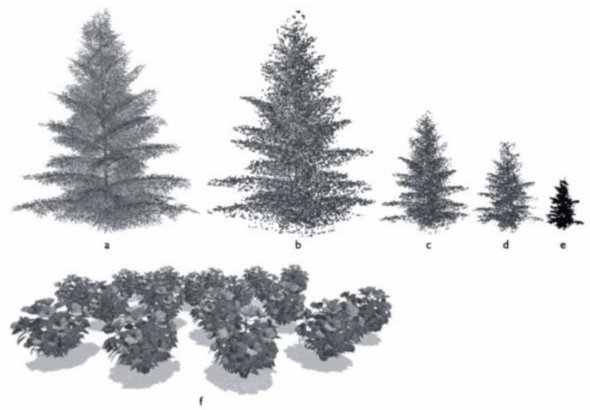
## Landscape Visualization

In such direction, over the last twenty years major developments implied the realistic depiction of vegetation; in parallel, the visualization of terrain turned out to be more and more effective and we can watch images and terrain models automatically generated applying GIS data.
As state Bishop and Lange in *Visualization in Landscape and Environmental Planning* [Bishop, Lange 2005] –which has been for over a decade a cornerstone in the field of landscape digital representation– recently, important step forwards have been made as concerns computer graphics employed to visualize environment in three or four dimensions, applying mainly animations required to record different time phases, or more in general, introducing movement in space representation.
In the book's foreword Stephen M. Ervin, in a little unexpected way –mainly for the position of the text in the field of the exact sciences– writes that words and images are same necessary, actually they get stronger each other in visualizing and communicating landscape, both in designing and planning the environment. Furthermore, Erwin underlines the relevance of communicating e discovering knowledge in the field of site visualization, because they are two fundamental features in the cognitive and imaginative process of representation, and more in general he emphasizes the role played by representation, because it "is not purely artistic, like a painting or a poem, but is rather embedded in a real-world context, often with social, ethical, economic, political and other implications. These real-worlds demands are part of what make the art and science of landscape visualization so important" [Erwin 2005, p, xii].
In a way, the consciousness of the representation's potentialities, as result of two intertwined components of knowledge and communication, is what allows to start the engine of applications used for visualizing landscape in forestry, agriculture, energy and the urban milieu (fig. 1), that is, in all those fields where creating a likely 'aided by computer' image is employed to answer questions like: How will that design solution work? But also: How shall it look like?
Considering that the 'eye/brain system' is a very sophisticated instrument, able to recognize pattern and to focus on differences, visualization can finally result an effective help detecting correlations, implications, anomalies, and not only playing a role of aesthetic control.
More broadly, the goal which the visualization of landscape seems so to aim, is to make visible the facets beyond their aesthetic dimension, and so, to go into the substance of the dynamics between anthropic and natural components; in other words, to use visualization is a clever tool when we want to make the invisible, visible, employing it as an excellent test for functional and visual aspects in the field of landscape planning and design.

## Simulation, Virtual and Augmented Reality

Visualization is equally crucial in experiential landscape simulation process: in this case it is possible to observe an increasing of perceptual components which involve not only the visual

*Fig. 1. Digital models of trees, levels of detail description: a) geometric description of a pine tree, b) representation by 13,000 points, c) 6,500 points, d) 3,250 points, e) 1,600 points, f) group of cloned plants. (from Bishop, Lange 2005, p. 59).*

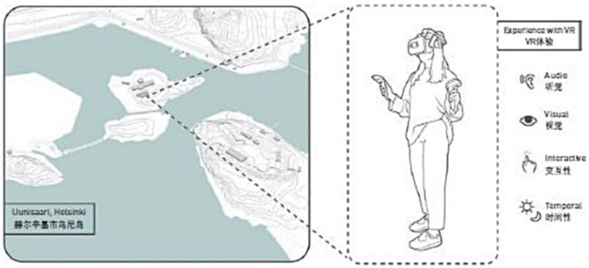


dimension but also sound and touch, so describing an all-round environmental experience. What makes similar this approach to the one previously described, is the 'anticipative' feature of the graphic outputs, "enabling a trustful and comprehensive understanding of places that are not reality yet, in order to ease their quality assessment in advance" [Piga, Morello, Salerno 2017, p. 2] (fig. 2).
The experience made in exploring dynamically a site is based –as previously said– on perceptual parameters which realize reference's elements in elaborating both the analytical phases and the design's ones. The experiential simulation of space implies to apply digital modelling: modelling and simulation are so strictly connected for the evaluation of the cumulative environmental effects, necessary for the designer project solution.
The centrality of visual control is considered relevant also in the most up-to-date technologies about Virtual Reality/Augmented Reality which can be addressed to check, anticipating it, a landscape project, utilizing a user-friendly visual language.
VR in fact aims to simulate experience, reproducing it as a whole, in an entirely virtual environment; differently AR shares in the same simulation space, real world and digital contents, so the part which is 're-built', 'augmented', turns out to be represented by digital information added in real time, leaving the 'real real' in background.
Pia Fricker, who is responsible of Digital Landscape Architecture Laboratory in Helsinki Aalto University, considers immersive technologies able to intuitively interact too, in a similar way namely to a process which happens in a real environment; the benefit coming from AR/VR so derives by employing digital and information models capable to cause quickly interaction (fig. 3).
Immersive technologies of visualization allow to check interactive audio-visual fields and meantime, to interpret the

*Fig. 2. St. James's Park, London, 3D Landscape Visualization for an experiential text of sounds effects (from Lindquist, Lange, Kang 2016, p. 218).*

*Fig. 3. Interactive Data-Sets in Virtual Reality. Digital Landscape Architecture Laboratory, Aalto University in Helsinki.*

*Fig. 4. VR technology layout for immersive co-design applications: investigation of temporal, interactive, visual and audio aspects. Digital Landscape Architecture Laboratory, Aalto University in Helsinki.*




data flow deriving from specific places, using novel and diverse tools to implement the awareness of changes in our life environment (fig. 4).
These innovative tools incorporate different features of the human cognitive neuroscience system –perception, experience, memory– and decision making; about the issue, the space perception resulting from analytical methods applied to complex systems, permits to better simulate the design result, establishing to easily take part in decision making processes about urban environment.
Definitively, the AR/VR digital technologies consent to open a shared vision of landscape projects to an increasing number of people, so they get able to understand the complexity of territorial dynamics.

### Visual techniques and visual representation of ideas

In the Anglo-Saxon world, a wide professional field embracing both urban design and landscape disciplines, shows great attention to perceptive environmental analysis which employs a wide range of representation techniques to describe visual aspects. Such tradition, also moving towards digital, maintained a visual approach, as it is well shown in the Nadia Amoroso's book, Representing Landscapes: Digital, which systematizes the most effective examples of "good visual techniques and visual presentation of ideas."
In this book, we can find several papers connected by a unique leitmotif which "captures visually various landscape types and case projects using drawing conventions (drawing types), composed digitally, and taught in the profession to communicate concepts" [Amoroso 2015, p. 3].
Besides the conventional techniques of representation –such as, plans, sections, axonometries digitally 'translated'– are shown some innovative tools as Mapping, that in "landscape architecture is often related to visual markings and notations referenced to geographical areas" [Amoroso 2015, p. 3].
So, Mapping seems to have a double employment, playing a role meantime as an abstract depiction and as a visual representation: on one hand it is considered like a creative process which helps to understand the site's complexity, 'visually abstracting' some selected parts from a geographical context, on the other it allows "visually recording objective and subjective measures of the site" [Amoroso 2015, p. 4] (fig. 5).
Also in the case in which Mapping synthetizes the abstracted facets of a place, it preserves a visual component,

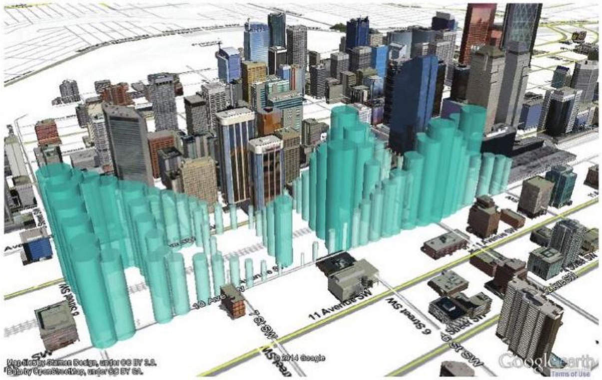
an attention to the perceptive dimension that returns also in other forms of representation as, for example, perspective drawing: "The designer –Amoroso writes– can compose fairly realistic 'view' of the landscape via a photorealistic application in a perspective drawing [...] We have adopted a new term to draw the perspective drawing –'photoshopping'. Textures, colors, and effective lighting can be quickly added to change the space. Existing sites transform into new landscapes with the addition of elements, textures, people, and lighting effects overlaid on the aspects of existing site contexts" [Amoroso 2015, p. 5]. (fig. 6).

## Visual Data Mapping and Landscape Visualization

Data Mapping and Landscape Visualization are in the core of some research labs and centers over Europe; among them, there is ETH Zurich DARCH – Landscape Modelling and Visualizing Lab, guided by Christophe Girot who is developing an interesting methodology of point cloud modelling for large scale projects, using geographic data coming from territorial surveys realized by drones provided with laser scanner.
Images resulting from these environment's surveys, are characterized by a complex coordinates system which ensures an extremely high exactness level; an employment of high precision instruments, deriving from structural engineering, consents so very accurate simulation of real, where datasets of tiny dots in the point cloud model obtain a final effect recalling, in a way, the pointilliste painting (fig. 7).
A fly-through model is often joined to sounds recording carried out in the same place, which denotes how –despite the high technological complexity in the graphic output– an aesthetic visualization of landscape more or less intentionally remains in this kind of representation, emphasized by visual and sound perceptual components (fig. 8).
By the way, it is important recalling how a basic idea in Girot's program for MAS LA (MASTer of Landscape Architecture), is thematically questioning which data should be used in order to detect the more relevant ones in the design process.
A visual control is anyway based on those applications implementing meantime 3D GIS and Geo Data; in fact, these ones offer to landscape architecture and urban design suitable tools to analyze and visualize data from multi-dimensional perspectives (fig. 9).
The 'animated maps' drawn up by Nadia Amoroso, applying DataAppeal Software, utilize a webGis able to visua-

*Fig. 5. Mapping of pedestrian movement (from Amoroso 2015).*

*Fig. 6. Rendered Perspective (from Amoroso 2015).*



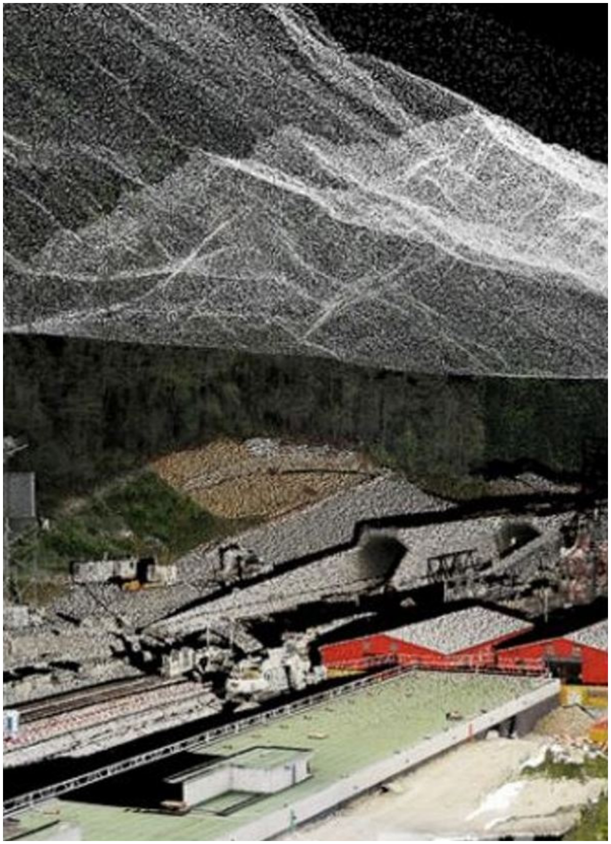

lize hidden data in a clear way and so they are useful also to be employed in participatory processes. As Amoroso herself wrote promoting this app: "DataAppeal provides a simplified GIS platform, therefore landscape architects without any GIS training can use the application to get visually engaging site analysis, that can be used to retrieve further insights on the site and can also be used for visual communication purposes" [Amoroso, Sechter 2012, p. 352]. These graphic outputs derive from 'row' data processing, stored in government's website dedicated to natural resources, so thousands of information scripts can be visualized in landscape images (data-map) to reveal trends differently hard to share.
However, it is clear that a dataset's representation can be often be meant, easily and in a unaware way, in an incorrect manner, so as some specialist suggest, among them Pia Fricker, Big Data visualization in the field of landscape architecture, together with understanding data, requires literacy in coding field to have an independent control position using data and to be successfully able to transform them in design tools (fig. 11).
In fact, data and statistical representations are addressed to communicate complex ideas in a clear, exact and efficient way, even if to visualize information today takes first to give meaning to huge amount of data to extract results from them.

*Fig. 7. Point Cloud Model, ETH Zurich DARCH – Landscape Modelling and Visualizing Lab.*

## Computational design thinking and landscape representation

As in the previous paragraphs it has been shown, both landscape architecture and urban design by the means of update representations, have forwarded in exploring digital technologies, however without being able to really employ them like a medium for the design project: a thought-provoking hypothesis suggests that thin unsatisfaction comes from a weak theoretical discourse which contributes to the difficulties to conceptualize a role for technologies, from a theorical and cultural point of view, inside the design process [Fricker, Kotnik, Piskorec 2019, p. 240].

*Fig. 8. Gotthard Landscape, The Unexpected View, ETH Zurich.*



On the same issue, it has been observed that if digital media are usually considered 'inadequate', it is because they are mostly employed to re-produce the hand-drawing techniques, rather than to explore in deep the possibilities embodied in the media themselves.
Instead computational design seems to introduce a novel approach that will have consequences not only on the large scale project, but also on its representations: "Computation is an approach to design that consciously explores the potential of the defining elements of a computable function as design tools: the formal relationship between sets of entities, the quantifiable properties of these sets of entities, and the algorithmic transformations and interaction of different quantifiable properties" [Kotnik 2010, p. 7]. We are namely facing a way of depicting geographical contexts and of describing the changes produced by design, based on relationships among data, geometry and space, generated through parametric modelling, first addressed to represent not as much form as the process underlying.
Now, it is relevant to highlight how, from a theorical point of view, computational design refers to structuralism, not in the anthropologic meaning given by Ferdinand de Saussure, rather to structuralism of life and technical sciences, grounded in Norbert Wieser's studies on cybernetics and on Bartalanffy's work on general system theory.

In such perspective of structuralism, computational design is a fertile ground for an interdisciplinary exchange between life and technical sciences, further it opens a new way in connecting paths of scientific and artistic thinking by means of computation.
The landscape representation, and so the landscape design project, is based in this context, on the research of local parameters of a specific site (urban growth, flows, sedimentation, water dynamics, human factors), in order to obtain a systematic approach and 'translate' the results in patterns.
Although patterns are abstract models aiming to interpret data and to foresee design solutions, it should be noted that the graphic outputs correspond, also in this case, to visual and aesthetic control parameters.

## Conclusion

This paper aims to catch in a synthetic way, what in matter of landscape representation is emerging more clearly in the field of digital technologies. Attention has been given not as much to technological process methods of graphic outputs, as to figurative forms that the graphic outputs take in turn.

*Fig. 9. Data map visualization, MAS LA (MASTer of Landscape Architecture), ETH Zurich.*

The visual research area seems today to be ongoing in depicting the landscape dimension, even if it reveals diverse forms ranging from simulation, to Virtual/Augmented Reality, including computational design's patterns, so pursuing a legacy that for ages represented landscape from a perceptual point of view and not only in terms of quantitative and technical parameters.

*Fig. 10. Washington Ave, Miami Visual Study, Night-time activity and sound levels, Data-map designed using DataAppeal application (from Amoroso, Sechter, 2012).*

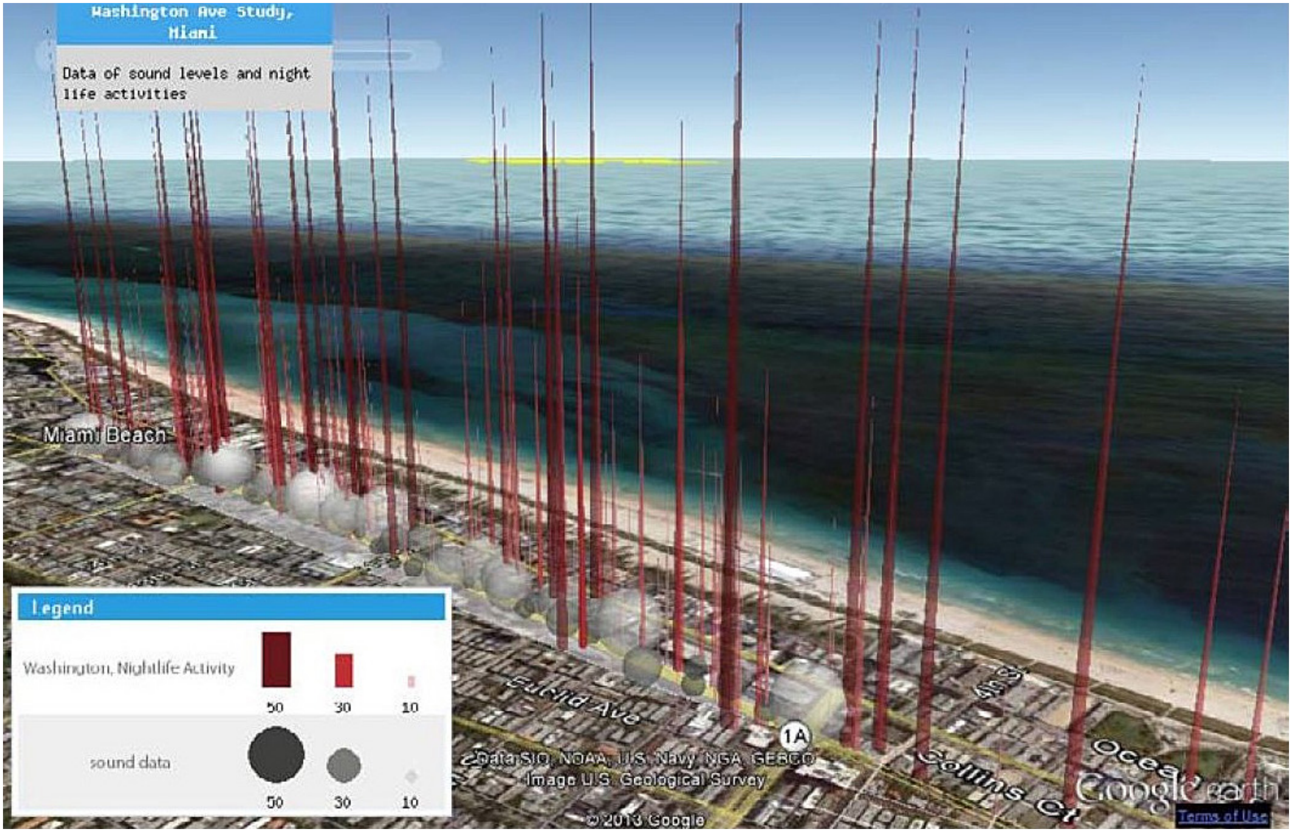


*Fig. 11. Big Data Visualization. Map of views along a path. The algorithm developed can determine the visibility of all areas for any area along the path. The different areas are drawn around a place, each within their own radius. Students A. Comninos e A. Theodoropulos' project (from Fricker, Munkel 2015).*

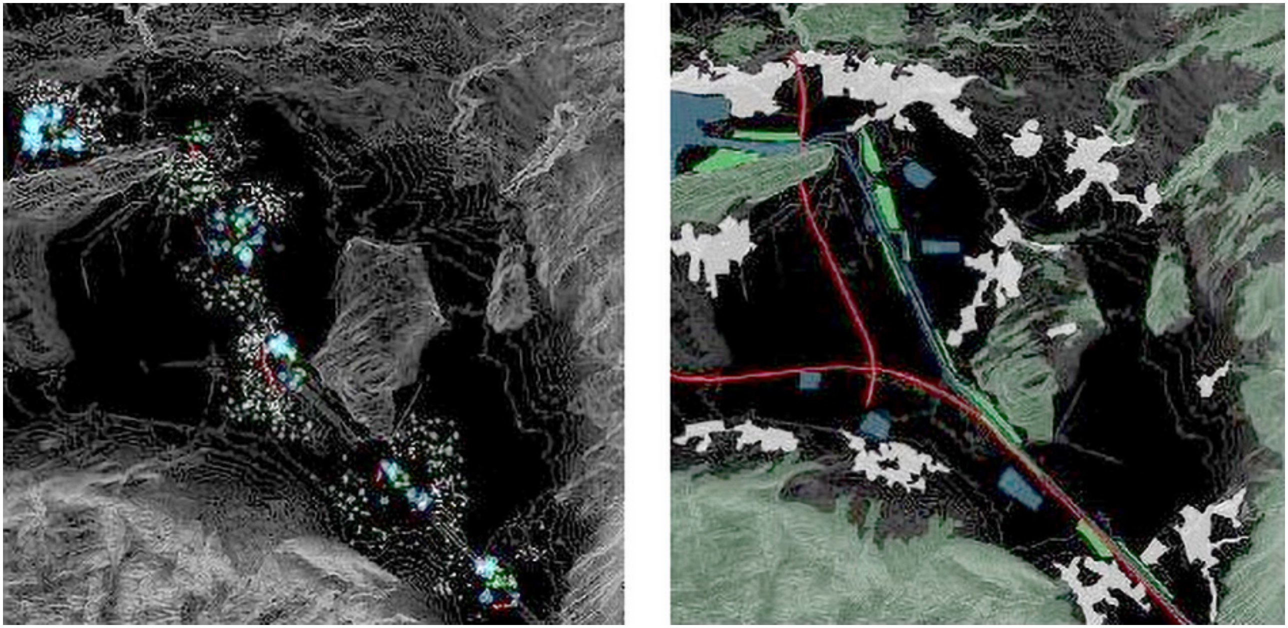
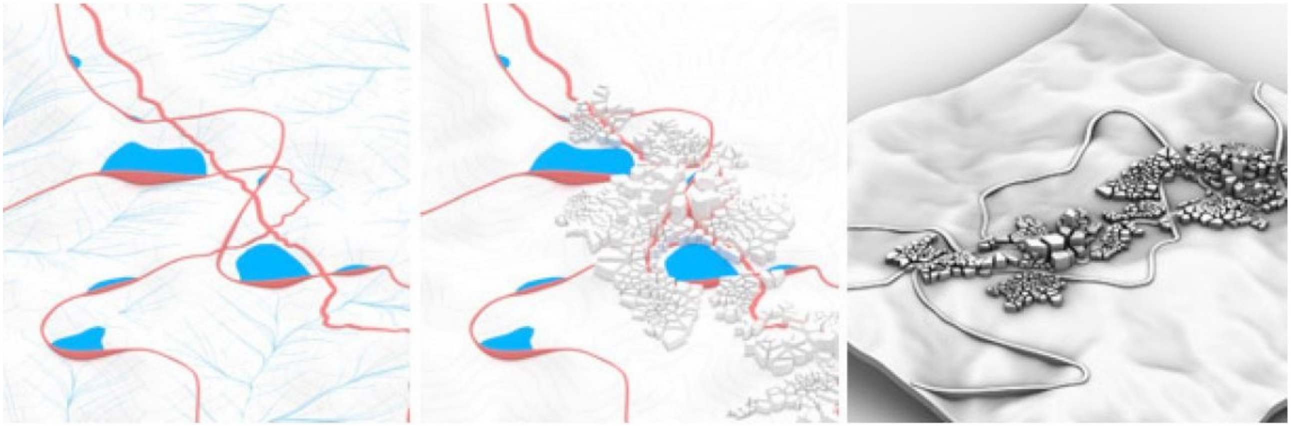


*Fig. 12. HUT, High Urban Terrain, project by S. Døskeland e J. Saarinen. The project concentrated on generating a road network on the hilly terrain, which provided an opportunity to create dams and artificial lakes around which the city could grow (from Fricker, Kotnik, Piskorec 2019).*



### Author

*Rossella Salerno,* Department of Architecture and Urban Studies, Politecnico di Milano, rossella.salerno@polimi.it

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