Focus on connectedness: social, technological and environmental issues

Raffaela De Martino[1], *Caterina* Frettoloso[1,*], *Francesca* Muzzillo[2]

[1]Department of Architecture and Industrial Design, University of Campania "Luigi Vanvitelli", 81031, Aversa, Italy
[2]Department of Humanities and Cultural Heritage, University of Campania "Luigi Vanvitelli", 81055, Santa Maria Capua Vetere, Italy

Abstract. The theme of connectedness, as a keyword in the revitalization processes of anthropized contexts, constitutes the focus of the paper which investigates its thematic areas related to the environmental, technological, and social dimensions. Sharing the importance of a strongly systemic approach in urban open space transformation interventions, the authors transfer the concept of connectedness, usually applied at vast territorial scales, from the ecological sphere to the urban one. The proposed approach highlights the need to decline the concept of connectedness into multiple dimensions capable of covering the various aspects that characterize the complexity of sustainable transformation processes of the open space-built system. The methodology, through the integration of connectedness in its various declinations, is an attempt to create new relationships of a different grade among and between single design spots (open spaces as an urban infrastructure) to emphasize relations that are not immediately recognizable, but which are at the basis of a regenerative design strongly oriented to providing social and technological-environmental services (inclusiveness and ecosystem services).

Introduction

Sharing the importance of a technological systemic approach in urban open space transformation interventions [1], the authors transfer the concept of connectedness, usually applied at vast territorial scales, from the ecological sphere to the urban one.

Recalling the concept of "design operation" applied to environmental design, the authors delve into the theme of connections between artificial and natural components in the context of the processes of modifying urban scenarios.

Such a scenario will be outlined by sharing international experiences that have made connectedness the interpretation key in the processes of existing and planned open space organization. The guiding criteria of the approaches examined, provide interesting insights into issues related both to how to mend the spatial and environmental fragmentation that characterizes our cities and to the creation of a system of open spaces conceived as infrastructures serving citizens.

1 Methodological approach

The reflections proposed by the authors, while sharing the methodological approach of a technological matrix, are affected by the scientific-cultural fields in which the topic of connectivity has been addressed.

The proposed methodological approach, in fact, articulates the concept of connectedness into multiple dimensions: social, technological, and environmental

issues. The environmental dimension of connectedness concerns the possibility of ensuring at the ecological level structural and/or functional continuity between the different open spaces that make up the system through the maintenance or creation of "support structures" to the network. The technological dimension is deepened about both the methodological aspects, i.e., the criteria that should guide the organization of the open space system, and the functional and fruitive aspects (addressing climate change issues too). Finally, the paper delves into the social dimension of connectedness understood in terms of the connecting relationship between the two worlds, the landscape world, and the human world, involving at the same time the appearance of places and the lives of the people who inhabit them. The main implications of our work regard both efficacy and resilience (providing dynamic responses to the changing needs of dwellers while optimizing the resources available).

In the social field, methodological first approach instruments have been different: tests, surveys, perceptive observation schedules, and answers in questionnaires. In the second step, looking at a compound human-centered approach, research methodological data have been combined with an open complex approach, which integrates causes and effects in a unique human vision of investigative strategies.

The methodological approach to the ecological dimension of connectedness involves analysing the territory to identify the emergencies and constraints present, highlighting the functional relationships

* Corresponding author: caterina.frettoloso@unicampania.it

between the various ecosystem units. The use of spatial indices of fragmentation makes it possible to highlight the number and quality of existing connections within the territorial mosaic, thus helping to identify which corridors may need to be restored, protected, or enhanced to increase the overall degree of the environmental system connection in the subsequent planning phase.

From the point of view of the technological dimension of connectedness. the proposed approach to the redevelopment of urban open spaces is strongly focused on a systemic vision that integrates, in brief, the conservative dimension of resources (natural, human, economic) with the transformative one according to adaptive and dynamic logic.

1.1 Open Space Design Foundation References

Could we look for the foundation tradition of Open Spaces Design in order to find some stable principles? Possible research could start from Pompeian open spaces strictly connected with architecture into a layout which was capable of creating two different sensations: the first one of being isolated in a confined place, the second one of being perceptively connected with other adjacent voids. With concatenated views two apparently opposed sensations were compounded together. Le Corbusier in Pompei was fascinated by its open spaces appearing at the same time as enclosed and opened with a succession of multiple views. A correlated system of connected points recurs in Le Corbusier's Pompeian sketches.

Studies of Amedeo Maiuri show that the connectedness of layout was, anyway, corresponding to the connectedness of human relationships, involving at the same time the appearance of places and the lives of Pompeian people [2]. Hence, we could certainly deduce one principle: the relation of open spaces is also a relation of people, so their design value should come from a system which is both physically and socially offered, encouraging social connectedness through the consciousness of the connection between each designed area even in remote positions. Definitively the interactions among single places should rely on the interactions of human daily life with the medium of strategic projects that comprehensibly highlight the sense of reunion attraction.

However, we have said that in Pompeian architecture there was a movement of connection among voids and open spaces and, at the same time, a movement of inverse direction that we could define as "towards the deeper". Perceptive-based experiences of well-designed open spaces have immediate and long-term effects on well-being, as has already been said by eighteenth-century aesthetic theorists. Shaftesbury's theory remains indeed one of the most reliable approaches to adopt when we care for people's interior balance and for an equilibrium of environments with a vision which considers nature itself the main reference for the design process. In that way the English Landscape Garden tradition could again connote environmental design and the main point remains in the aesthetic principle thought by Shaftesbury, as even today the best way of working on landscapes is, as he suggested, "designing as the nature itself had designed", with maximum esteem of its intrinsic characteristics, its perceptive and dynamical rules.

At that time the gardeners transformed the landscape for both aesthetic and functional reasons, giving the idea of a place untouched by men, often realized through earth movements that created a new morphology of the ground. A typical example of this approach is the invention of the ha-ha: a ditch that functions as a vertical barrier without obstructing the view of the landscape, obtaining a non-circumscribed area with no visible limits. But the main point was not only in the so-called "idea of beauty". The reference is to the emblem of the Eighteenth-Century aesthetic: a man-designed landscape that seems designed by nature, not only in the physical aspects but more in the way the asset could follow nature's rhythms and gradual adjustments over time. When we comprehend how this understanding of nature suggested a vision capable of associating the aesthetic of nature with its dynamic rhythm, a bond with contemporary environmental design is traced.

Anyway, the substantial approach of the eighteenth-century English aesthetic theories remains a partly unexplored land today, while it should be a key strategy for tackling environmental care for the state of places. The archetypal English Landscape Garden mode of shaping the ground is not only a question of informal aesthetic choice, but also a more complex natural approach which denies a strong human continuous control of the vegetation assets, leaving instead space for autonomous biological processes [3]. Consequently, it would be useful to adopt today a second principle here summarized: to try designing with a passion for nature and like the design had been made not by human hand.

But how did this aesthetic attitude evolve from a question of taste toward environmental responsibility?

The content has been aimed at giving appropriate methodological tools, to manage open public spaces' design in view of a more welcoming environment. It has been intended to provide adequate capabilities in the fields of creative design, and executive detail drawing, both in the built environment and in the natural environment. As a basis of knowledge, the reference to English Landscape Gardening experiences guides us toward a flexible design that can be disassembled into visible parts.

So, we have traced a double-perceptive movement to be pursued looking at Pompeian and English traditions. The first perceptive movement delineates an extension towards other single-designed open spaces in order to relate to other focus points of attraction with perceptive lines of conjunction. The connectedness is directed to elaborate new design forms, adapted to underline also in their main image the visible aspect of people's relationship's nature, through the development of structures that comprehensibly highlight the sense of connectivity and reunion, with a social dimension. The second perceptive movement to be promoted in an open space project is guided towards the inner dimension of these spaces, so the environment appears in a certain

sense also protected and recognizable as a distinctive place, promoting an individual dimension of conciliation with nature and an inner dimension. An appropriate design methodology could create environmental interactions along the two delineated perceptual criteria, creating better conditions for people's reunion and wellness.

1.2 Connectivity, multiplicity, and liveability: useful key concepts for open spaces?

A variety of design initiatives in the last decade are restoring the well-being of contemporary cities by demonstrating the qualities of hybridity, connectivity, porosity, authenticity, and vulnerability, a model which seeks to integrate buildings with nature, centre with the periphery, local contexts with global forces, and draws from different disciplines to address diverse and multi-cultural social contexts [4]. In this logic of integration, open space, recovering the role of infrastructure it has historically played in urban and territorial contexts, is configured both as an organising element of the built environment and as a technological system supporting the city. In the context of changing climatic conditions, there is a need for an approach that amplifies these potentials to address urban vulnerabilities and threats, while also reducing that sense of fear of open space in which we probably no longer recognise ourselves [5].

A true network of voids capable of providing diversified responses to strategic technological-environmental issues for the community: mending fragmentation by increasing physical and ecological connectivity between the various spatial units, rationalising the rainwater regimentation system starting with the skilful use of permeable and non-permeable surfaces, reducing the heat island effect by working on the integration of green-blue systems and maximising existing environmental quality [6].

Working according to a network logic makes it possible to systemise urban open spaces, which are thus enriched with new functionalities: ecological (as has already been discussed) but also fruitive and environmental. From the point of view of use, the networking of urban spaces makes travel safer and access to individual spaces easier. Also, according to structural considerations, connected spaces are more effective in articulating the urban fabric and facilitating orientation [7]. From the environmental point of view, the network logic allows the conservation of natural resources in the area and the connection between the environmental and landscape values of the zones for an overall enhancement of the territory [8]. In the context of issues concerning the regeneration of anthropised contexts, the authors are working on the methodological definition of an approach to urban open spaces conceived as a technological infrastructure. An interconnected system of open spaces that provides performance both in terms of fruition (reachability of connected nodes, soft mobility, legibility of spaces) and technological-environmental (increasing permeable surfaces, shading, ventilation control, recovery and reuse of rainwater, greenery) [9].

Globally, we are experiencing a transition towards more multi-purpose infrastructures that mimic nature provide ecosystem services, and promote healthy and active living when thinking about the urban open space network, the conceptual and functional reference is green infrastructure. Paraphrasing one of the most widespread definitions of green infrastructures [6], we could imagine the urban open space system as a network characterised by multi-functionality whose nodes and their connecting elements work in an integrated and synergic way to meet common objectives. Objectives that concern both the active maintenance of natural resources and, in general, existing quality spaces, and the identification of new spatial and environmental units to provide services to the community and produce ecosystem services.

In the methodological definition of this network, it is possible to identify a series of key concepts against which a system of criteria for the 'construction' of the basic layout (meta-design phase) can subsequently be elaborated, which can be adapted to the different peculiarities of the application context.

The first concept I would like to focus on concerns connectivity. When working on the idea of creating a network of quality open spaces, the physical and functional connections, which benefit not only people but also fauna, constitute the framework of the system itself. It is also for this reason that it is strategic to think about the relational aspects that structure the network, both in terms of a net of interconnected habitats and eco-systems, and the connection within a transport network, which is a measure of the level of accessibility/isolation of the connected spaces. The concept of connectivity therefore also implies a definition in meta-design terms of the linking elements. As Pregill writes, *"Urban connections and walkability are influenced by the five spatial elements, all of which derive from specific physical and cultural qualities. Topography, hydrology, and plant associations interface with street alignment, building typologies, and material compositions to render both routine and unique pedestrian experiences. (...). Collectively these qualities define each moment of pedestrian experience. The process begins with the optical reception of primary visual elements along surfaces and edges, followed by a higher order of interpretation of a visual setting. During the moments of pedestrian movement, individuals experience this process and rely on the interpretation of the experience as a mechanism for achieving a specific intention, including moving from a point of origin to a desired destination in a specific urban setting"* [7].

The second guiding criterion concerns integration. This principle indicates a mode of action in which several elements are combined, e.g., for green infrastructure, it means proposing integration both with other urban infrastructures and with the built environment. Integration means mutual support between two systems such as blue and green infrastructure which "feed off each other" according to a complementarity principle [10]. It also means suggesting approaches, strategies, and solutions that provide for a "functional

overlap", thus attributing to the same area or system several strategic functions that are activated as external inputs vary (especially about climatic factors). By experimenting with integration, it is possible to implement the capacity of the open space system, not necessarily green, to contribute to the provision of so-called ecosystem services.

However, the aspects related to the functional dimension must always be linked to a general condition of quality of the open space, to the concept of liveability, which translates not only into an interest in sustainability that moves from the building to the district but also into an interest more oriented towards bringing out the strategic character of the connections between the different elements of the urban system [11]. All the activities that animate the connective tissue (walking, working, socialising, ...) influence the overall liveability of our cities. *"How urban liveability relies on how communities elect to define the quality, including the role urban connections will play in the future quality of life and urban contexts. Health, safety, connection, and recreation are all potential factors, with each influencing order and function of landscapes within the urban context"* [7].

Connectivity, integration, and liveability can be considered as guiding ideas in the construction of this network of hybrid, grey/green/blue spaces, which we imagine as a system of even small spaces that infiltrate to support the "life between buildings" that expresses a need that is still very much felt, especially within land-use logics that work increasingly on (controlled) density [12, 13]. A network that insinuates itself between buildings and when necessary "leans" on them, incorporating roofs, façades that even if not always usable participate in the macro - system contributing to increasing that connectivity [14] that in our case should considered not only physical aspects (isolation/reachability/proximity) but also purely ecological - environmental aspects.

1.3 Ecological issues for the urban context

Ecological connectivity is defined as the unimpeded movement of species and the flow of natural processes that sustain life on Earth. This connectivity is negatively impacted by landscape fragmentation, which happens when large habitat patches or lineal features like rivers, are divided into smaller, more isolated fragments. It is primarily caused by urbanisation, intensive agricultural practices, and barriers like roads, railways, dams, weirs, and locks. These pressures disrupt habitats, threaten biodiversity, and hamper climate change adaptation measures. Creating a network of ecological corridors that are properly governed, managed, and funded, as well as eliminating or lessening these barriers, could help solve the landscape fragmentation problem [15].

In recent years, in fact, in the field of planning/management practices of anthropized contexts, particular attention has been paid to urban greenery and the recovery/conservation strategies related to it, which are fundamental for the protection of wildlife,

environmental comfort, and adaptation to climate change. In fact, the degradation of urban ecosystems, with the consequent loss of biodiversity, has called for a new approach to the environmental rehabilitation of highly anthropized territories, which has been increasingly oriented toward the regeneration of small basins of naturalness and potentially valuable areas.

For the development of these areas, then, the structuring of urban ecological networks was attempted, through which the green tissues present in urban areas were to be stitched together by applying the same logic as that of wide-area ecological networks, that is, through a hierarchy of green areas that involves the identification of main areas (the poles) and linear elements for connection (corridors) [16].

The network approach is based on two basic conditions: adequate ecological/environmental quality of the network poles and good connectivity between these nodes must be ensured. Ecological connectivity concerns the possibility of ensuring both structural and functional continuity between the different open spaces that make up the spatial system under consideration.

Structural connectivity concerns landscape structures independently of any biological or behavioural attributes of the organisms interacting with them, so it dwells on spatial and physical characteristics, such as shape, size and continuity of connections. In contrast, functional connectivity includes species-specific aspects and their interaction with landscape structures [17].

Thus, functional connectivity refers to the set of processes that occur and that bind together, through energy flows and matter transfers, the structural components of the links.

So, the mere cartographic identification of environmental continuity may not serve conservation objectives. Some species may, in fact, show difficulty in dispersing along bands of apparent continuity, effective at a preliminary spatial analysis but only presumed at the functional level. Connectivity is then determined, as mentioned earlier, not only by a structural component, linked to the spatial context, but also by a functional eco-ethological, species-specific one. The choice of scale and the connective or barrier function of spatial elements are thus related to the different ecological characteristics of the target species identified from time to time, i.e., those species that can serve as models for a large following of ecologically related species [18].

With regard to structural continuity, there is also a point to be made that it is not always feasible on highly urbanized territories because of spatial interruptions related to the presence of anthropogenic network elements that produce a barrier effect against animal species. However, it is almost always possible to achieve functional continuity through the approach of stepping stones.

The latter are structures formalized by the Pan-European Ecological Network [19] which proposes a scheme of ecological network units formed by Core areas, Buffer zones, Restoration areas, Ecological corridors and finally Stepping Stones.

Specifically, Ecological corridors are continuous physical connections that serve various vital ecological

functions and ensure the self-regulating capacity of ecosystems by allowing key species to move between ecosystem mosaics. Stepping Stones, on the other hand, are habitat fragments spread throughout an area and not directly connected that are important elements of the landscape for stopping species in transit or accommodating specific microenvironments in critical habitat situations.

It is evident that in urban areas physical connections are difficult to achieve due to urban density and spatial fragmentation. However, it is possible to appeal to the functional continuity provided by stepping stones i.e., smaller points of support between them sequentially (similar to what stones do along a ford line of a watercourse) that can perform a connecting function.

But what do connect elements actually connect in man-made settings?

The nodes of the network are green spaces, which, include not only large parks and equipped green areas, but also small gardens, squares, entire undeveloped areas or other (non-green) open spaces such as pedestrian areas, parking lots and roads, the latter being particularly important in the urban matrix as connecting elements par excellence [20].

To these types of open spaces, green building systems have been added, following recent studies that have highlighted their important ecological value, which represent real competing infrastructures for strengthening the resilience of the urban environment.

In fact, these "green" elements on buildings can take on the function of stepping stones for wildlife, particularly for some endangered species, by complementing existing natural elements around them and enriching the network of green corridors that may exist [21].

However, in order for green building systems to contribute to a real increase in the ecological/environmental value of the areas in which they are placed, knowledge of ecological aspects and respect for the floristic consistency of the plant species to be used is essential. By following these criteria, these works can result in increases not only in the perceptual value but also in the ecological and environmental value of places. In fact, if properly designed and implemented, they are able to activate "pro-biodiversity" processes, initiating the formation of contexts capable of favouring many wild animal and plant species [21]

2 Final remarks

The identification of connectedness as a driver for a renewed approach to open spaces in the urban context is closely linked to the concept of urban open space as a network of undeveloped spaces. The idea can be traced back to approaches matured in different disciplinary sectors and requires a trans-scalar vision of the project that finds in the technological approach, methodologies, and tools to propose transformative actions that take into account the systemic and, therefore, dynamic character of the city in an attempt to initiate a continuous process of adapting to change.

The critical reading of significant design experiences concerning the discourse of connectivity highlights how these usually respond to site-specific needs that it would be interesting to "conceptualize" to apply them to other contexts. The scientific investigations conducted so far show, in fact, as the main result the need to define meta-design criteria capable of supporting the construction of an interconnected open space system.

Criteria such as inter-connectedness, public realm definition, compactness, diversity, and efficiency lead to rights of way that are interconnected and multimodal, buildings that frame the public realm of thoroughfares, parks, and plazas by containing and hiding parking, projects and their uses that enjoy good pedestrian access and are accommodated within a broad range of places, buildings and unit types, and infrastructure that is affordable, effective, a and green [22].

Fig. 1. Malaga waterfront, longitudinal connections (credits: C. Frettoloso).

Fig. 2. Elevated connection systems in Berlin (credits: C. Frettoloso).

Fig. 3. Pedestrian connections in Berlin (credits: C. Frettoloso).

The paper is edited by all the authors. In particular: the paragraph *"Open Space Design Foundation References"* is edited by Francesca Muzzillo; the paragraph *"Connectivity, multiplicity, and liveability: useful key concepts for open spaces?"* is edited by Caterina Frettoloso; the paragraph *"Ecological issues for the urban context"* is edited by Raffaela De Martino.

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