The landscape along the banks of the Tiber in Rome.
An informative and representation model

Over the centuries the Tiber in Rome has played multiple roles in the country’s identity, from a water resource and main communications, transport and trade route - an integral part of the city - to marginal space and hiatus in the construction of the urban image. Today its banks represent a distinct demarcation line between the river and the neighbourhoods it crosses; a marginal space characterised by the diverse transformations that have taken place in time and space. The correlation between “landscape” and “time” is clearly visible in the dynamic transformation of the physical dimension of landscape design along its shores and banks where there are “intervals” of discontinuity while some areas still await a solution.

Historical views, artists’ impressions, and cartographic representations bear witness to changes in the harmony between the built landscape and the natural environment, re-signifying the identity and perception of these sites.

This contribution transversally crosses the landscape along the banks of the Tiber in Rome, outlining an informative and descriptive study model merging the geometric-historical-cartographic component with figurative and perceptive elements.

By integrating different traditional and digital drawing methods and tools - from photography to photogrammetry - the representations illustrate a complex urban reality, made up of empty spaces, fragmented dichotomous elements, and deterioration. The realization therefore of an open analytical-relational information structure, articulated in scalar succession of different elaborative levels and connected to the modern technologies for the virtual fruition of the ancient fluvial landscape, provides an important support for the knowledge, the analysis, the management, the enhancement and protection of the architectural heritage.

Keywords:
Informative Model; landscape; perception; survey; enhancement.
THE KNOWLEDGE-GATHERING AND TRANSFORMATION PROCESS

The Tiber in Rome has traditionally been a ‘hinge’ element in the urban landscape and an important functional water resource. The gradual growth of the city and in particular associated hydrogeological problems (Bencivenga, Di Loreto, Liperi, 1995) led to an inversion of its roles, so much so that the river - the first directrix in the design of the city - was gradually ‘tamed’, altering the fruition and perception of the landscape around it (Fig. 1).

The great flood of 1870, necessitated a real systematic action designed to protect the city from the Tiber (Frosini, 1977); the implementation of the defensive-town planning system, known as the “massive embankments operation” [operazione muraglioni] (Canevari, 1875), involved the recalibration of the riverbed sections, the rectification of the river bends and the elevation of the embankments, as well as the construction and transformation of the urban fabric along the river defining a new dimension, parallel and submerged with respect to the city; this emphasised the multilevel nature of the city, i.e., the higher city, along the lungotevere [roads at the top of the embankments], and the lower city, along the banks and shores.

Till then the river had been a busy place where people lived and worked, chiefly in water-related activities characteristic of the Roman landscape (floating mills, fishing grounds, jetties, warehouses and meeting places). The massive embankments irremediably destroyed the image of Rome linked to everyday life on the banks of the Tiber. The image of the city from the river was radically modified, whose memory remains etched only in the rich repertoire of landscape drawings, proof of the beauty of the places visited by travelers.

The interventions on the Tiber (Fig. 2 e 3), coupled with the demolition of the old city centre and the construction of new neighbourhoods, gave Rome a ‘new face’, altering not only the river’s roles, but severing its dialogue with its built-up areas; the landscape and monumental contents in these areas were adapted to fit in with the lungotevere embankments.

Fig. 1 - Panoramic north-south views along the Tiber in Rome: view from Ponte Duca D’Acosta towards the Lungotevere Maresciallo Cadorna; view towards the Lungotevere delle Armi from Ponte del Risorgimento; view towards Lungotevere Castello from Ponte Umberto I; view towards Lungotevere Ripa from Ponte Palatino; view towards Riva Ostiense from Ponte dell’Industria.
Many monumental buildings along the banks were either demolished, radically altered, or lost their active, perceived link with the river (e.g., the Castel Sant’Angelo park, the gardens of the Villa Farnesina and Palazzo Farnese, the garden of the Diocesan chapel complex in Via dei Genovesi, and the green areas at the foot of the Aventine Hill) (Ravaglioni, 1982). Before the embankments were built to save the city from flooding, the urban stretch of the river was much shorter. The muddy ribbon of the Tiber began to lap the built at Porta del Popolo, the river lost contact with the city only at Porta di Ripa Grande and the opposite area just in front of the Bocca della Verità. Before the embankments were built the city neighbourhoods stretched down to the river, but in the twentieth century the development of new, constructed areas redesigned the urban waterfront.

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The redesign of the banks was followed by a new, necessary, albeit insufficient urban and perceptive link with the city. The transformation of the network of places and functions involved a new "restitching" between the river and the city; in fact, in a mere thirty years the number of bridges across the Tiber tripled. Shortly afterwards the new road network required the construction of several bridges: Palatino (1882), Regina Margherita (1886), Garibaldi (1888), Umberto I (1906), Cavour (1902), Mazzini (1904), Risorgimento (1911) and Vittorio Emanuele (1911). However, this did not succeed in incorporating the image of everyday life along the river banks; instead it was replaced by the new role of Rome as the Capital of Italy.

The new architectural backdrop ostensibly suited its new role; if it creates with a strong modern characterization a solid continuity between the historical center and the new districts, however the city was no longer directly connected to the river but hidden behind two imposing rows of trees, creating a visual-perceptive barrier.

The eight-kilometre long ensemble of embankments and landings along the river represent an interrupted dialogue; the contrasting relationship between the river and the architecture along its shores would have been mitigated by several practical measures and material and technical tools coupled with good ornamentation (never implemented for pressures to modify the project and for the high costs of the infrastructure) [1] (Fig. 4).

The complete series of photographs of the construction of the embankments by the Civil Engineering Dept. testifies to the radical changes made to the city's image.

The most important reasons for this transformation of the original, romantic image frequently depicted by artists and travellers over the centuries include: flood protection for the city's inhabitants, public decor, and the need for a modern road network.

A series of volumes, geometries, forms and structures define the shores and threshold of the river and edges of the city.

A backdrop of buildings which, in the city centre, maintained a seamless feature of continuity made
up of multiple, heterogeneous fragments along the “water’s edge” (agricultural areas, natural reserves, roads, elements enhancing the architectural perspectives, gardens of historical villas, water containment areas, parks and urban green areas).

This outcome of the transformations of the built fabric and variations in the river bed and its fruition changed the perception of the “moving panorama” once visible from the river.

Contemporary historical, iconographic and archival sources, and the transformations recorded by modern digital information and representation tools, can convey the scope and critical issues inherent in a process involving the whole lungotevere; the integration of analogical-digital data, can contribute to the creation of specific landscape models that can be implemented, for the management and direction of future transformations (Geospatial Big Data) (Brusaporci et al., 2012; Papa, 2015) and for the transmission of knowledge of places, through ICT (Information and Communication Technolo-gies) (Bonacini, 2011; Empler, 2018), to involve the “traveler” and rebuild a new relationship between the city and its river which, thanks to its position, characterisation, economic-recreational and tourist potential, can still play a key role in the urban context.

DESCRIPTIVE AND URBAN ANALYSIS MODELS

Despite partial changes to the Tiber’s riverbed, the installation of production units along its shores, the complex issue of its old bridges, and the radical raising and reinforcement of its banks, for many centuries the stretch of river within the city boundaries had remained basically the same. Isolated and slightly restricted from view, it now seems to have no appeal at all. Imprisoned by a series of rapids along its urban stretch, all that remains are pictorial images of its former charm, based on a now idealised beauty. Comparison with contemporary photographs only succeeds in instantly emphasising the crude interventions and discontinuous composition (Fig. 5).

Throughout the centuries the image of Rome conveyed by sketches, drawings, watercolours, photographs, and all kinds of representations, whether on paper or other materials, and sometimes enriched with details inspired by travellers’ creative imagination, have helped to document what the city looked like for all those physically unable to visit Rome; in some cases, these images were the only way to disseminate news and propaganda.

Today these images, coupled with the data in historical and cartographic sources, are important documents that help to identify and characterise the natural and anthropic landscape elements that no longer exist; they allow the iteration, analysis and visualisation of specific data in a network of relationships used to orient future interventions aimed at enhancing the image of places and based on the idea that “knowing how or why it was designed, is already a design act” [2].

The spatial georeferencing of analytical data in a GIS environment (Teti, 2004; Ferrighi, 2015) (Fig. 6) made it possible to construct critical thematisms and pre- and post-design evaluative simulations.
In an integrated environment of digital data management (photographic, historiographical, and technical), the objective is to support the activities of specialists in various fields as well as systematically organise data flows regarding the documental stages of the surveying process to the future design intervention.

The overlapping of the relational system in the urban context in the different historical periods, through a process of rubbersheets and choosing as control point the “recurring points” of the urbanized territory, and the integration with digital photogrammetric survey and laser scanner, with reference for example to the river piece of the Lungotevere Farnesina (Fig.7), highlights another idea of the river that over the years no longer links various parts of the city; in people's collective imagination it has become an element merging an ensemble of separate scenarios rather than acting as the 'glue' behind a continuous structure.

More than any other architecture, the bridges built to transversally connect the urban fabric have de facto severed this longitudinal linearity and provided an unusual discontinuous solution, contrary to the natural meandering of the river.

A strata by strata interpretation shows, amongst other things, that along the line most affected by the defensive embankments, the riverbed has shifted and created softer banks, either adding or subtracting from the historical built in order to facilitate the dynamics of the current and re-establish the width normalised by the design project specifying a constant 100 metres, except where the river divides to pass the Isola Tiberina.

However, the cartographic interpretation and abstraction, as well as the creation of thematic maps providing a restitution of the topological-relational and concise characterisation of the sites, does not fully capture the sense of an urban reality composed of specific dichotomous elements (exposure/enclosure, hereness/hereness, here/there, recession/projection, in/out)\[3\].

By integrating different traditional and digital drawing methods and tools - from photography to photogrammetry (Fig. 8 e 9) - the analysis of the perceptive component of places (Carnevali, Papa,
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Various images appear along the Tiber; they can be interpreted differently depending on whether one is going upriver or downriver. A dialogue created by the different situations that emerge during the journey. Travellers’ attention is captured by the animated shores, the banks, the area beyond the banks, and the edges of the built landscape where travellers almost never, or just distractedly, turn their gaze. The result is a series of orderly images with different viewpoints which, all together, help to map the complexity and fragmentation. A sequence of feelings, of disorientation and orientation, foreignness and recognition, aimed at establishing the coordinates of a different perception and representation of the context.

The images of the site reveal green areas broken up by roughly bordered spaces, residual spaces along the river robbed of its trait as an environmental and figurative system. The high embankments carve out a rhythmically static, repetitive, incessant, and obstinate space. A universe cut off at the top of the fence-embankment; a line of separation beyond which there is a world of colours and forms; an uninterrupted line vertically hindering vision but, at the same time, opening up horizontally. This horizontal stratigraphy is coloured by the cold hues of the water, the nuances of the earth, of matter, made of light and shadow, solids and basic vegetation; light, natural elements and ambience change the perception of space; a space in the middle between the banks separating the river from the city; a space we could define as in-between, a pause in the construction of the...

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urban image; a space which, differently from the past, establishes a physical-perceptive scale relationship with its context; an interval connecting the two parts of the city; its duration, number, dimension, proportion and rhythm define the character of the whole urban composition.

Representation is more than its cartographic and geometric-compositional component; it enables a shift from the definition of space to a definition of place; in other words, a space in which specific physical and perceptive relations are created with the context based on their material nature and the fact they are crossed by light, inhabited, and are capable of triggering sensations and emotions that can be recorded on paper; the fence, metaphor of the embankments, assumes the dual role of an ordering, unifying structure or threshold and a sign of disconnectedness in urban perception.

The process of hybridization between representative design and photography systems is fundamental to the organizational structure of information to make historical and archive research communicate with the potential offered by the methods of detection and digital representation, capable of transmitting the greatest quantity of valences and variables that characterize the physical landscape (Cianci, 2008, p.22).

The analysis thus established a multifaceted mapping of the status of the river, revealing a stratified ensemble of components linked to the site’s geological footprint, to history, to its uses, and to the material heritage of buildings, architectures, and artefacts which, together with the immaterial components, represent factors that input into creating a tourist and cultural identity and “confer a visual form on the city”[8].

To this end, the analytical-relational GIS structure
is configured as a container for different types of useful data, always with a view to safeguarding and enhancing the cultural heritage, to return complete documentation that is easy to use and understand to non-experts as well; through the design of a new online platform (WebGis) for the digital use of places and the introduction of the new information technologies of the Virtual Tourism (AR and VR Technologies), the data bank from “static” becomes interactive, with linked and open given to foster active digital participation and to revive the ancient artefacts along the slow meandering of the river.

FROM DATA INTEGRATION TO USER-CONTEXT ITERATION

It is possible to distinguish a “third landscape”[9], in the artificial basin of the Tiber, the landscape of not only a geographical limit - transition between city and non-city, interstitial areas - but also a temporal limit. Closed spaces, open spaces, waiting areas, areas of debris, frontier, shores, boundaries, terrain vague; these are the features of the area straddling the waterfront of the Tiber, one in which all the descriptive categories emphasise an insufficient degree of fruition and “liveability”.

The attempt to re-disclose and re-build the linear landscape of the river, based on identification of its relational system, contains in nuce all the elements that can help create a real tourist attraction and recreational area.

If in the past an architecture or landscape could be narrated using images, photographs or tourist guides, modern visualisation and communication technologies enables the modern integrated models used to study space to disseminate heritage based on a new concept of open-air musealisation of Cultural Heritage (Fig. 10).

The example application, created for the river segment adjacent to the Lungotevere dei Vallati, is an information-training structure for knowledge and planning of transformations and tourist-accommodation promotion. 2D maps and reality based models, processed through SFM and reverse engineering (Velho et al., 2009; De Luca, 2011; Del Pizzo, Troisi, 2011; Remondino et al., 2012), can be recalled by the visitor through the iteration with the hotspots inserted in the virtual scene; the user as a simple observer becomes an active subject in exploring the library of textual, photographic, video and archive information, through a mobile

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Fig. 10 - Project for an interactive museum: simulated experience with interactive applications and augmented reality to visualization three-dimensional exemplary reconstruction-historical view of the original values of the Lungotevere dei Vallati near Ponte Sisto.
The landscape along the banks of the Tiber in Rome. An informative and representation model connected to the GIS map-web-server; the head-mounted display, with the help of a suitable QR code system, at the same time makes the experience immersive (Milgram et al., 1944; Portalés et al., 2010; Boyer, Marcus, 2011) for the increased vision of historical and virtual reconstructions. This therefore reveals a renewed dimension of the river which, thanks to modern ICT technologies and integrated telecommunications systems, allows users to visualise, understand and explore lost heritage, presented in a scalar sequence on different levels. The view seen by travellers in the eighteenth century reappears in the virtual history box, a beautiful journey along the architectural and fluvial landscape. The technological innovations applied to the tourist context can make access to cultural heritage increasingly immediate, rewarding, and simpler as well as spark additional positive effects on knowledge, enhancement, conservation and protection.

CONCLUSIONS

To describe involves the use of several tools to understand and represent spatial features. To this end, drawing tools are a valid support to analyse, interpret and narrate the changing, discontinuous relations between Rome and its river. Creating integrated informative and photogrammetric models of the border areas will not only lead to the recovery of the border areas, but also facilitate the reinterpretation of historical changes, inspire future interventions legitimising the theoretical transformations, and enhance the image of the city along its river. To achieve all this requires the study method must complete integrate the perceptive component along the entire stretch of the river, because “it conjures up our memories and experiences”[10] and provides food for thought regarding the narrative potential of rivers. The objective is to consider all the elements that help to define the environment, buildings, vegetation and water, and then merge them in order to appropriately configure a theatrical scene capable of restoring the environmental image. If studies on cities are implemented based on indications regarding their historical genesis, morphological and figurative characteristics, and assessment of their environmental qualities, then they can be the premises against which every transformation has to be measured if we wish to safeguard the values consistent with an isomorphic modification process. So the development of AR Gis-based devices (Hung, Jiang, Li, 2001; Diamanti et al., 2003; Li et al., 2015), as well as offering an important contribution to the knowledge and enhancement of cultural heritage, containing the real-time synchronization of the selected data features on the image of the real world. The geographic data can be either shown as vectors, or represented in 3D as a function of semantics, thus generating a virtual environment composed of buildings, vegetation and infrastructures superimposed on the real environment; a combination of “collaborative” visualization systems for sharing data and supporting decision-making processes. In fact, “if we successfully understand the nature of what we see and the way in which we perceive it, then we will know more about the potential influence of a manmade composition on our human feelings and thoughts”[11].

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