Giuseppe Antuono
Engineer, PhD in History, Design
and Restoration of Architecture
(XXX Ciclo, Curriculum Design,
SSD ICAR/17).
He conducts research in the De-
partment of Civil Engineering,
Building and Environmental in
the survey and documentation
of complex architectures of his-
torical, urban and environmental,
with integrated methods and at-
tention to the management and
implementation of IT systems.

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.

DISEGNARECON   volume 12/ n. 22 - june 2019   DRAWING THE TERRITORY AND THE LANDSCAPE   ANTUONO   2.2

ISSN 1828-5961   The landscape along the banks of the Tiber in Rome. An informative and representation model

THE KNOWLEDGE-GATHERING AND TRANSFOR-MATION 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 the built-up areas; the landscape and monumental contents in these areas were adapted to fit in with the lungotevere embankments.
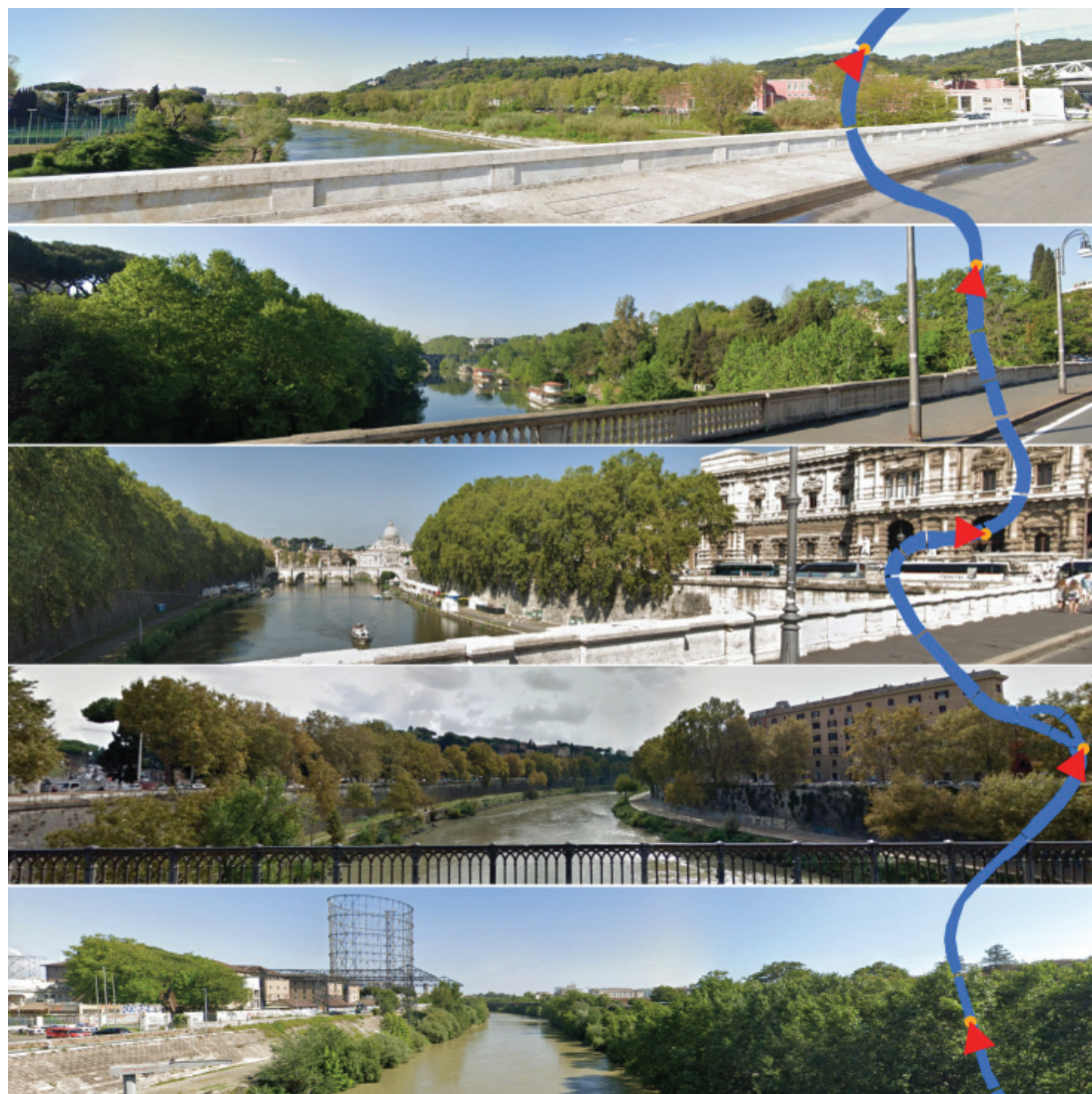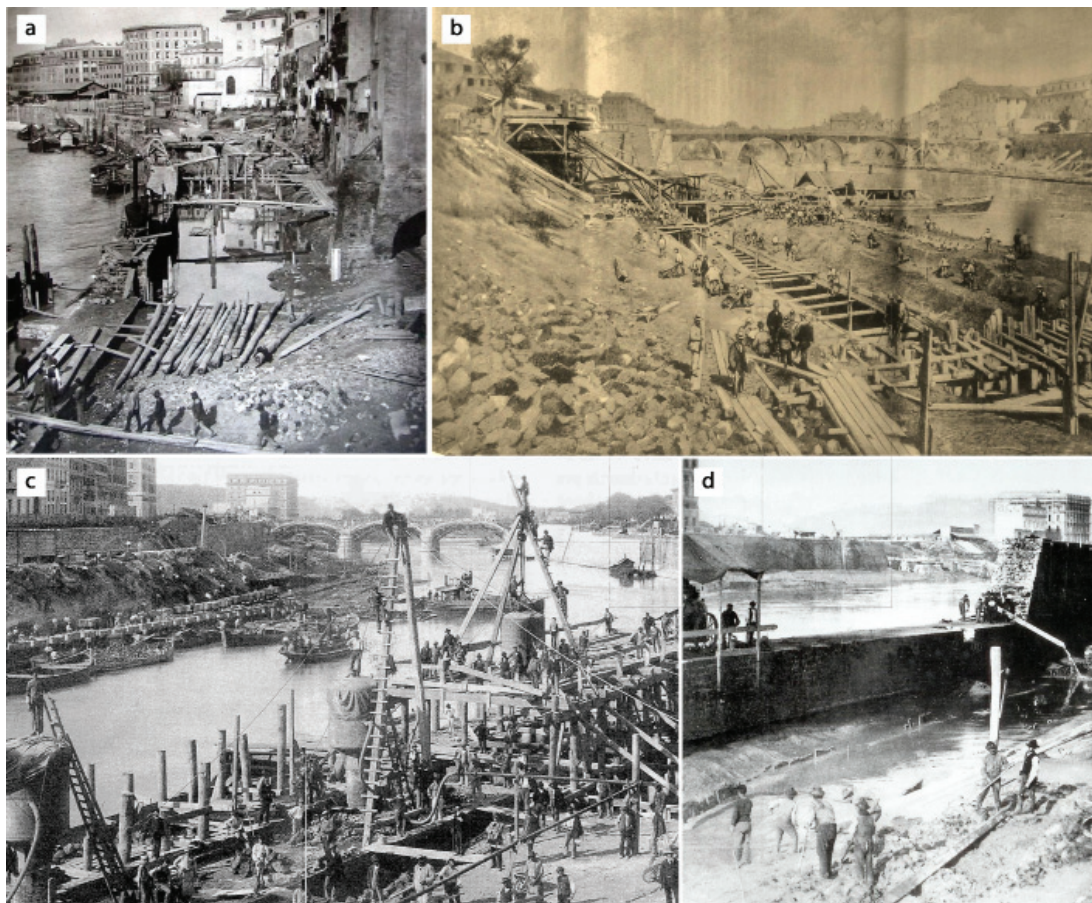
Fig. 1 - Panoramic north-south views along the Tiber in Rome: view from Ponte Duca D'Aosta towards the *Lungotevere Maresciallo Cadorna*; view towards the *Lungotevere delle Armi* from *Ponte del Risorgimento*; view towards *Lungotevere Castello* from *Ponte Umberto I*; view towards *Lungotevere Ripa* from *Ponte Palatino*; view towards *Riva Ostiense* from *Ponte dell'Industria*.

DISEGNARECON volume 12/ n. 22 - june 2019   DRAWING THE TERRITORY AND THE LANDSCAPE   ANTUONO   2.3

ISSN 1828-5961   The landscape along the banks of the Tiber in Rome. An informative and representation model

Fig. 2 - Construction of the Embankments: *Lungo Tevere Rione Trastevere* (a), *Rione Regola* towards *Ponte Sisto* (b), *Rione Trastevere* towards *Ponte Garibaldi* (c), the *Porto di Ripetta* area (d).
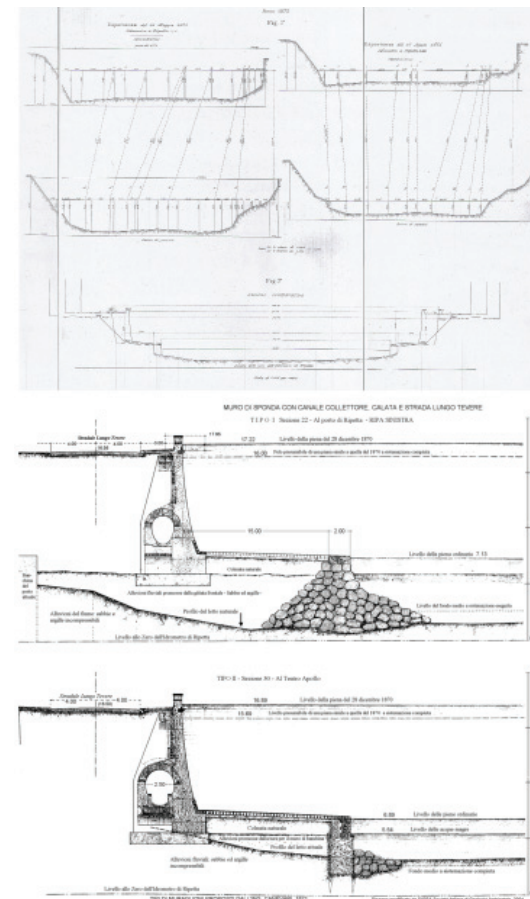

Fig. 3 - Above, hydrometric survey of the Porto di Ripetta, taken from the book *"Studi per la sistemazione del Tevere nel tronco entro Roma Relazione alla Commissione istituita con decreto 1° gennaio 1871 con note e allegati"* Raffaele Canevari 1875; below, sectors of the Embankment project at the *Porto di Ripetta*, with the original quay buried by the embankment, and *Teatro Apollo*, proposed by Engineer Canevari and implemented between 1876 and the end of the century (Cfr. Frosini, 1977).

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) (Ravaglioli, 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.

DISEGNARECON volume 12/ n. 22 - june 2019   DRAWING THE TERRITORY AND THE LANDSCAPE   ANTUONO   2.4

ISSN 1828-5961   The landscape along the banks of the Tiber in Rome. An informative and representation model

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

Fig. 4 - The route and transformation of the waterfront along the Tiber from *Ponte Margherita* to *Ponte Sublicio*, Photographic Archive of the Civil Engineers.

DISEGNARECON   volume 12/ n. 22 - june 2019   DRAWING THE TERRITORY AND THE LANDSCAPE   ANTUONO   2.5

ISSN 1828-5961   The landscape along the banks of the Tiber in Rome. An informative and representation model

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 Tecnhologies) (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).

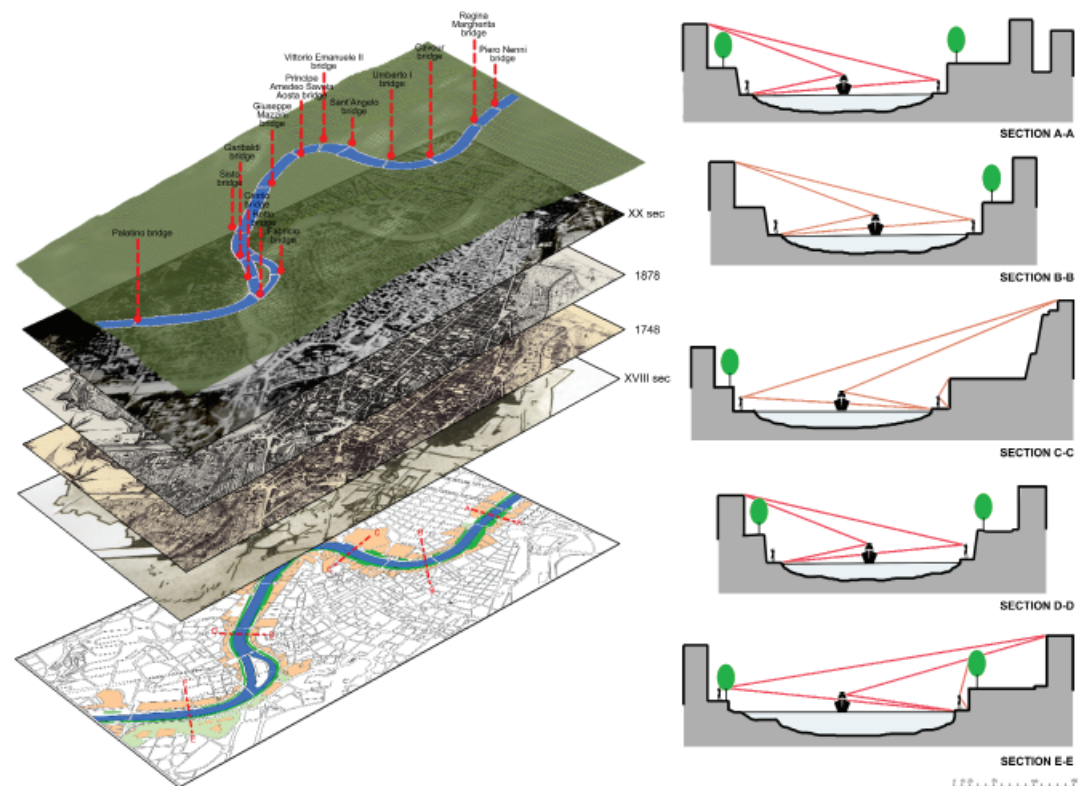Throughout the centuries the image of Rome con-

Fig. 5 - Concise view of the Informative System illustrating the Tiber in Rome, plus a perceptive analysis of its route.

veyed 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.

DISEGNARECON   volume 12/ n. 22 - june 2019   DRAWING THE TERRITORY AND THE LANDSCAPE   ANTUONO   2.6

ISSN 1828-5961   The landscape along the banks of the Tiber in Rome. An informative and representation model

Fig. 6 - Evolution and urban transformation along the Tiber River in GIS (Cfr. Muratori et alii 1963): geo-referencing of cartographic data, layering of tracks and historical settlements, integration of archival documentation and perceptive-degradation component to draw predictive information on future enhancement actions.

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/thereness, 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,

DISEGNARECON   volume 12/ n. 22 - june 2019   DRAWING THE TERRITORY AND THE LANDSCAPE   ANTUONO   2.7

ISSN 1828-5961   The landscape along the banks of the Tiber in Rome. An informative and representation model

2013; Papa et al., 2016) creates "an excellent, flaw-less document imbued with all the psychological solicitations and reflections and all the memories inspired by the architectural work" [4].

The representation of the vertical plane (section) continues to display the linear continuity of the river and not only provides open-ended options regarding the redesign of the fluvial landscape, but also highlights a perceptive variation of the architectural backdrop along the moving flow of the river below.

However, freehand drawing coupled with pho-tography is the best study method if one wishes to enter into contact with the experience (Albis-inni, Chiavoni, De Carlo, 2010). Drawing as a way to depict places is an experience that involves "looking while walking through"[5]; it is a com-plex, profound cognitive approach to the city to try and decipher the identity of places. Following the Tiber the city disappears: a multiform, dissonant reality emerges "that is lost in the river and in the river is found again". Multiple identities emerge by changing one's viewpoint, identities regarding the historical and geographical evolution of contem-porary Rome. "Representation of the relationships between forms rather than just the forms"[6], can be achieved thanks to "(...)... a systematic field reconnaissance of the area, made on foot by a trained observer mapping the presence of various elements, their visibility, their image strength or weakness, their connections, disconnections and other interrelations; ... in order to discover individ-ual images"[7].

Various images appear along the Tiber; they can be interpreted differently depending on whether one is going upriver or downriver. A dialogue cre-ated 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 imag-es with different viewpoints which, all together, help to map the complexity and fragmentation. A sequence of feelings, of disorientation and orien-tation, foreignness and recognition, aimed at es-
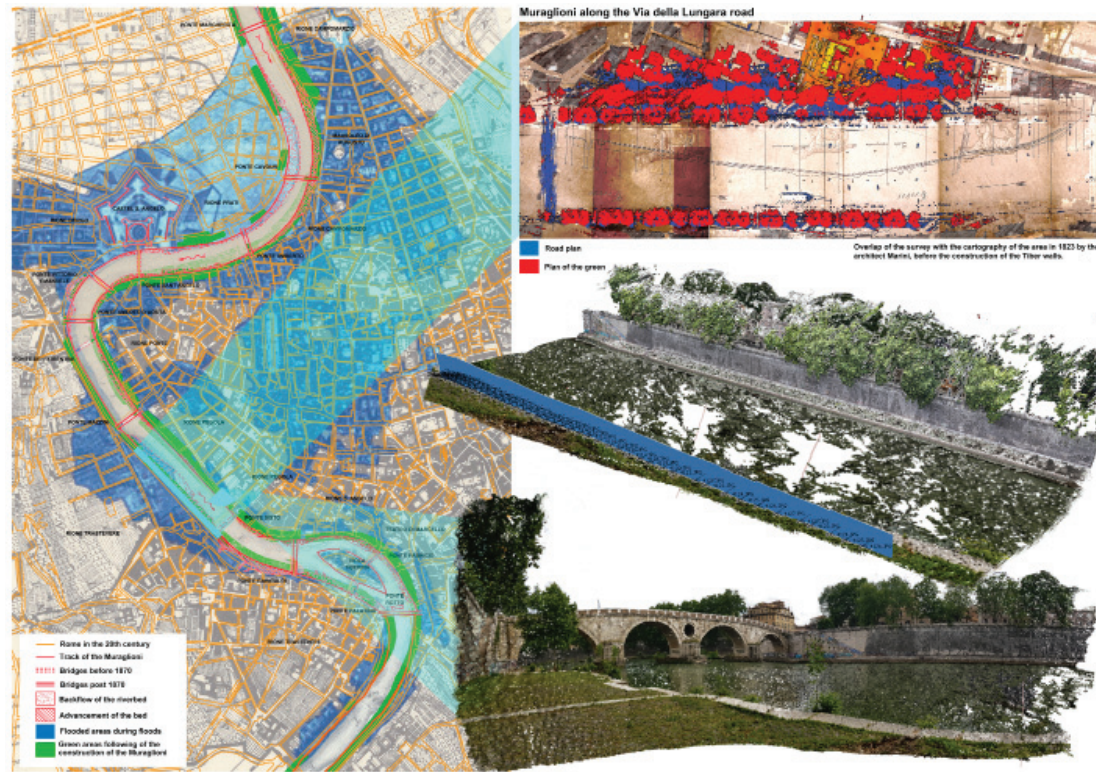

Fig. 7 - Survey and spatial analysis of the relationship system between the river and the city: on the left a summary of the information system with an example of data integration, from laser scanners and digital photogrammetry, of the area between *Ponte Sisto* and the gardens of *Villa Farnesina*, destroyed by the construction of the *Lungotevere* in the nineteenth century.

tablishing 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 environ-mental and figurative system. The high embank-ments carve out a rhythmically static, repetitive, incessant, and obstinate space. A universe cut off at the top of the fence-embankment; a line of sep-aration beyond which there is a world of colours

and forms; an uninterrupted line vertically hinder-ing vision but, at the same time, opening up hori-zontally. This horizontal stratigraphy is coloured by the cold hues of the water, the nuances of the earth, of matter, made of light and shadow, sol-ids and basic vegetation; light, natural elements and ambience change the perception of space; a space in the middle between the banks separat-ing the river from the city; a space we could define as in-between, a pause in the construction of the

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

Fig. 8 - View towards *Ponte Sisto* and the *Lungotevere Raffaello Sanzio*, digital integration of data from analogical, line and watercolor techniques, and photogrammetric data, connected to the management Information System.

Fig. 9 - The relationship between the Tiber river and the city through the continuity of the embankments of the *Lungotevere degli Anguillara*; digital integration of historical and watercolor images.

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

DISEGNARECON   volume 12/ n. 22 - june 2019   DRAWING THE TERRITORY AND THE LANDSCAPE   ANTUONO   2.9

ISSN 1828-5961   The landscape along the banks of the Tiber in Rome. An informative and representation model

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 vagues; 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 engeenering (Velho et al., 2009; De Luca, 2011; Del

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*.

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

DISEGNARECON   volume 12/ n. 22 - june 2019   DRAWING THE TERRITORY AND THE LANDSCAPE   ANTUONO   2.10

ISSN 1828-5961   The landscape along the banks of the Tiber in Rome. An informative and representation model

device connected to the GIS map-web-server; the head-monted display, with the help of a suitable QR code system, at the same time makes the experience immersive (Milgram et al., 1944; Portalès 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 IC 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].

DISEGNARECON   volume 12/ n. 22 - june 2019   DRAWING THE TERRITORY AND THE LANDSCAPE   ANTUONO   2.11

ISSN 1828-5961   The landscape along the banks of the Tiber in Rome. An informative and representation model

NOTE

[1] Cfr. *L'ingegneria civile e le arti industriali. Periodico Tecnico quindicinale.* Anno XXVII. Torino, 1901. n. 15. pp. 225-235; Ravaglioli, A. (1982). Le rive del tevere, come erano e come sono. Roma: Edizioni di Roma Centro Storico, pp. 24-31.

[2] Cfr. Gresleri, G. (1991). Dal Diario al progetto. I carnet 1-6 di Le Corbusier. In *Lotus*, 68, pp. 7-23 e 11-14.

[3] Cfr. Cullen, G. (1961), *The Concise Townscape*. London: Architectural Press.

[4] Cfr. Docci, M., Maestri, D. (2009). *Manuale di rilevamento architettonico e urbano.* Roma: Editori Laterza.

[5] Cfr. Ferraro, G. (1998). *Rieducazione alla speranza. Patrick Geddes planner in India 1914-1924.* Milano: Jaca Book.

[6] Cfr. Bisogni, & S., Rema, A. (1988). Introduzione ai problemi di disegno dell'area napoletana. In *Edilizia Moderna*, n. 87-88.

[7] Cfr. Lynch, K. (1960). *The image of the city.* Massachusset M.I.T.:Harvard Univ. Press, Cambridge; trad. it. (1964). L'immagine della città. Venezia: Marsilio, pp.23-35.

[8] Cfr. Lynch, K. (1960). *op. cit.*, pp.23-35.

[9] Cfr. Clément, G. (2005). *Manifesto del Terzo paesaggio.* Macerata: Quodlibet.

[10] Cfr. Cullen, G. (1961). *Il paesaggio urbano Morfologia e progettazione.* Bologna: Calderini.

[11] Cfr. Gropius, W. (1963). *Architettura Integrata.* Milano: Il saggiatore.

REFERENCES

Albisinni, P., Chiavoni, E., & De Carlo L. (2010). *Verso un disegno «integrato». La tradizione del disegno nell'immagine digitale. Arti visive, architettura e urbanistica.* Roma: Gangemi Editore, 96.

Albisinni, P., & De Carlo, L. (a cura di) (2011). *Architettura disegno modello. Verso un archivio digitale dell'opera dei maestri del XX secolo.* Roma: Gangemi Editore.

Belli, G., Capano, F., & Pascariello, MI. (2018). *La città, il viaggio, il turismo: Percezione, produzione e trasformazione.* Napoli: FedOA - Federico II University Press.

Bencivenga, M., Di Loreto, E., & Liperi, L. (1995). Il regime idrologico del Tevere, con particolare riguardo alle piene nella città di Roma. In *La geologia di Roma. Il centro Storico. Memorie descrittive della Carta Geologica d'Italia*, 50.

Bonacini, E. (2011). *Nuove tecnologie per la fruizione e valorizzazione del patrimonio culturale.* Roma: Aracne.

Boyer, D., & Marcus, J. (2011). Implementing Mobile Augmented Reality Applications for Cultural Institutions. In J. Trant, & D. Bearman (Eds.), *Proceedings of Museums and the Web.* Toronto: Archives & Museum Informatics.

Brusaporci, S., Centofanti, M., Continenza, R., Trizio, I. (2012). Sistemi Informativi Architettonici per la gestione, tutela e fruizione dell'edilizia storica. In *Proceedings of the 16a Conferenza Nazionale ASITA,* Fiera di Vicenza, 6–9 November 2012, (vol.1, pp. 315-322), Vicenza: ASITA.

Canevari, R. (1875). *1° gennaio 1871 con note e allegati. Studi per la sistemazione del Tevere nel tronco entro Roma Relazione alla Commissione istituita con decreto 1° gennaio 1871 con note e allegati.* Roma: tip.e lit.del Genio Civile.

Carnevali, L., & Papa, L. M. (a cura di) (2013). *Fermarsi a disegnare.* Roma: Aracne.

Cianci, M. G. (2008). *Dalla linea ideali alla città virtuali.* Firenze, Italia: Alinea.

Cundari, C. et al. (2017). L*a Villa Farnesina a Roma. L'invenzione di Baldassarre Peruzzi.* Roma: Edizioni Kappa, Documenti grafici di architettura e ambiente.

Del Pizzo, S., Troisi, S. (2011). Automatic orientation of image sequences in cultural heritage. In *Int. Archives of Photogrammetry, Remote Sensing and Spatial Information Science,* 38(5/W16).

De Luca, L. (2011). *La fotomodellazione architettonica.* Palermo: Dario Flaccovio Editore.

Diamanti, T. et al. (2003). *Gestione e Valorizzazione del paesaggio con strumenti VR-GIS.* Input 2003.CINECA-CNR ITABC.

Empler, T. (2018). I*CT per il Cultural Heritage. Rappresentare, Comunicare, Divulgare.* Roma: Dei-Tipografia del Genio Civile.

Ferrighi, A. (2015). Cities over space and time. Historical GIS for Urban History. In S. Brusaporci, *Handbook of Research on Emerging Digital Tools for Architectural Surveying, Modeling, and Representation* (pp. 425-445). Hershey: IGI Global.

Fiorillo, F. et al. (2013). 3D digitization and mapping of heritage monuments and comparison with historical drawings. In *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, vol. I.

Frosini, F. (1977). *Il Tevere - Le inondazioni di Roma e i provvedimenti presi dal Governo Italiano per evitarle.* Roma: Accademia Nazionele dei Lincei.

Giordano, A., Bifulco, L., Friso, I., Monteleone, C., Barnes, C., Turri, G. (2011). The HyperRepresentation as new model of Knowledge and Representation of Architecture and City Museum. In (Ed.) C. Gambardella, *Proceeding of IX International Forum Le vie dei Mercanti: S.A.V.E. Heritage. Safeguard of Architectural, Visual, Environmental Heritage* (Aversa, Capri, 9-10-11 giugno 2011), (vol.10, pp. 1-9), Napoli: La scuola di Pitagora.

Goethe, J. W. (1970). *Viaggio in Italia.* Firenze: Vallecchi Editore, Firenze.

Huang, B., Jiang, B. and Li, H. (2001). *An integration of GIS, virtual reality and the Internet for visualization, analysis and exploration of spatial data.* Int J Geogr Inf Sci, 15, 439-456.

Ippoliti, E., & Meschini, A. (2010). Dal 'modello 3D' alla 'scena 3D'. Prospettive e opportunità per la valorizzazione del patrimonio culturale architettonico e urbano. In *DisegnareCon*, 3, 6, pp. 77-91.

Li, X. et al. (2015). WebVRGIS Based City Bigdata 3D Visualization and Analysis. In *Pacific Visualization Symposium* (PacificVis).

Mezzetti C. (2016). La rappresentazione: prefigurazione e restituzione della realtà. In C. Palestrini (a cura di), *Progetto, rappresentazione, rilievo.* Roma: Gangemi Editore.

Milgram, P., Takemura, H., Utsumi, A., & Kishino, F. (1994). *Augmented Reality: A class of displays on the reality-virtuality continuum.* SPIE Vol. 2351.

Muratori, S., Bollati, R., Bollati, S., & Marinucci, G. (1963). *Studi per una operante storia urbana di Roma.* Roma: Centro Nazionale di Ricerca.

Papa, L. M. (2015). Cartografia e modelli di gestione dati. In N. Augenti, F. Bontempi (a cura di), *Ingegneria Forense. Crolli, affidabilità strutturale e consolidamento.* Palermo: Dario Flaccovio Editore.

Papa, L. M., Antuono, & G., Pepe F. (2016). Percezione, disegno e conoscenza. In *Atti del Congreso de Expresion grafica arquitectonica,* Alcala de Henares, Madrid.

Parrinello, S., Picchio, F., & Bercigli, M. (2016). La 'migrazione' della realtà in scenari virtuali: Banche dati e sistemi di documentazione per la musealizzazione di ambienti complessi. In *DisegnareCon*, 9, 17.

Portalés, C., Lerma, J. L., & Navarro, S. (2010). Augmented reality and photogrammetry: A synergy to visualize physical and virtual city environments. In *ISPRS Journal of Photogrammetry and Remote Sensing*, 65(1), 134–142. https://doi.org/10.1016/J.ISPRS JPRS.2009.10.001.

Ravaglioli, A. (1982). *Le rive del Tevere, come erano e come sono.* Roma: Edizioni di Roma Centro Storico.

Remondino, F. et al. (2012). Low-Cost and Open-Source Solutions for Automated Image Orientation. In *A Critical Overview. Proceedings of Euromed 2012 – International Conference on Cultural Heritage.* Lemesos, Cyprus Oct 29th - Nov 3th 2012.

Testa, G., & De Sanctis, A., (2003). *Rappresentazione e Architettura. Linguaggi per il rilievo ed il progetto.* Roma: Gangemi Editore.

Teti, M. A. (2004). *Sistemi Informativi geografici. Manuale e casi studio città e territorio.* Milano: Franco Angeli.

Velho, L., Frery, A. C., & Gomes, J. (2009). *Image Processing for Computer Graphics and Vision.* Springer Science & Business Media.

Zevi, B., & Beni casa, C. (1986). *Comunicare l'architettura.* Roma: Seat Edizioni, vol.2/3.