Urban Regeneretion:
a Multidisciplinary Approach

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Abstract

The main objective of the DATA –Developing Abandoned Transurban Areas– research project, hosted by the University of Padua and financed by the Veneto Region, is to design innovative strategies to recover, regenerate, and enhance abandoned areas located on the margins of the consolidated city. Abandoned urban areas around Padua, the case study of the project, are a particularly important example in consideration of the fact that northern Italy contains the highest increase in land consumption in the country (8.4% in 2013; ISPRA 2015) and, in particular, the city is first in the region for the percentage of land used (49% in 2013; ARPA Veneto 2015). The objective is therefore to build transformation scenarios for development and economic rebirth in reference to sustainable living in compromised urban areas awaiting regeneration. The multidisciplinary structure of the project is organized into six distinct, complementary areas: web GIS; BIM and land information modelling; pilot scenario design; urban planning and feasibility studies; waste recycling; and data management and ICT. (G.P., L.S.).

Keywords: city, periphery, complexity, neglect, ICT.

Introduction

The main goal of the DATA research project [1] is to produce sustainable strategies for the development and economic rebirth of compromised urban areas awaiting regeneration, using the potential of efficient collection, processing, and dissemination of the related data. The project involves different sectors, including data management, ICT, and the division of urban and building transformations, considering environmental, economic, social, and cultural aspects. DATA –developed at ReLO-AD, the Research Lab of ArchitectURban Design, and other partner laboratories in the Department of Civil, Environmental, and Architectural Engineering at the University of Padua and other partner companies in the project– is therefore designed as a complex project in

which the capacity to produce visions is particularly important. (L.P.)

Designing urban transformation scenarios

Producing visions is a complex operation that, as a focus in all phases of the project, is at once theoretical and methodological foundation, a knowledge and communication tool, and formal result. In fact, visualization not only represents the final output of the project, but also constitutes a structured, complex language. It is therefore a form of thought through which reasoning is constructed and scientific argumentation is organized.

Visualization regards not only the physical forms and existing and designed spaces –as immediately expected– but also other immaterial objects that are fundamental for building the transformation scenarios that constitute the goal of the project, i.e., the data, in their complexity and variety, and the processes through which they are managed and reprocessed.

Visualization of the existing space therefore constitutes a necessary tool for knowledge and the description of reality, which is not limited to representing the visible surface of the physical buildings, but makes all material and immaterial layers that cross the complex urban space respond, in a vision that never coalesces into a final image, but extends outwards in many dimensions. As well as along the two dimensions of the scene –which in the contemporary space tends to lose the limits of a traditional frame– the vision is stratified and moves continually in its depths, also intersecting with the clouds of immaterial information that progressively thicken or rarefy, pervading the physical space. It is therefore necessary to visualize not only three-dimensional, static spaces as they are traditionally understood, but complex, multi-oriented and dynamic fields.

To appropriately address the task of representing this complex project, the technical and formal language of the visualization had to make suitably different techniques and procedures interact: sketches, digital geometrical modelling, mapping, BIM modelling, definition of the graphical interface to manage and consult the databases, BIM models and GIS systems, and virtual, augmented, and immersive reality for the informed use of the existing space and design scenarios.

The techniques used to build and visualize the design scenarios therefore lead to a variable, nonuniform representation that is always changing, sensitive to user interaction, and capable of continuously remodelling the existing space and the viewing of possible future spaces. (L.S.)

Analysis through drawing of Padua's peripheral areas

In the present research, the city is considered not as a coherent whole, but as the juxtaposition of different realities. Through graphical layers, the different urban entities were identified, the first of which was the historical skyline, followed by the industrial one, which, when overlapped, generated a new, multi-form, and more articulated skyline (fig. 1). With the drawing, quick sketches, and visual notes, this analysis was very useful for focusing attention on extremely widespread problems in the areas around Padua. In fact, a specific graphical mode was identified to document and report the critical state of the reality being observed. For this purpose, with regard to the graphical aspect, the choice was made to use a 'strong' sign to highlight the industrial city, which contrasts with the light, slight trace used for the historical city (fig. 2). The objective was to enhance the 'transurban' areas and visually superimpose them on the historical urban areas to design a representation capable of making apparently contrasting places coexist. This is not a simple representation of the city, but rather the identification of connections to reach new interpretational meanings. In other images instead, attention was focused exclusively on abandoned areas such as, for example, the Ex Foro Boario area, where the neglect and marginality of the building was highlighted (fig. 3). The goal was to represent the strong caesura created by the untended vegetation with respect to the abandoned industrial buildings. For all the images produced, a common element was the use of representation as a tool for critical analysis and reporting. (G.P.)

State of the art (ICT)

An essential aspect of the work presented was the analysis of multiple case studies pertaining to the vast sector of the enhancement of cultural, architectural, and urban goods using digital supports. In the present study of the state of the art, two different but related areas are considered: i) the management and dissemination of data and ii) visualization, communication, and Information and Communication Technology (ICT). With regard to the former, among numerous existing case studies, those presented during the INU Study Day, held in Naples in 2017 in the *New computer technologies for the territory* session were analysed [2]. During the meeting, the most up-to-date research regarding urban regeneration was examined, particularly the communication of complex realities by constructing specific interactive GIS and web GIS platforms. The various studies demonstrated the need to create such integrated systems since "it is estimated that by 2050, 6.4 billion people will live in cities, with significant consequences regarding resources and services. It is therefore necessary to investigate the complexity of the

urban phenomenon in an integrated way, considering the city as an open, malleable, and complex system that evolves over time and in space'' [Mangialardi 2017, p. 606].
With regard to the second topic related to communication and ICT, only some of the many case studies [Allen, Lupo 2012] investigated are presented, in particular those characterized by an interactive relationship between the user and cultural good. The following cases are examined. The *Culture Clic* project (Paris 2011) is an application that aims to promote cultural goods in France. High-resolution data, visible in augmented reality with an iPhone, bring up sites of cultural interest as they were in the past. The *You Are Not Here* project (New York and Tel Aviv 2006-2007) allows participants to become 'meta-tourists' and highlights the strong relationships between the two cities. Participants can activate audio descriptions simply by calling a dedicated phone number and inserting the code they find on stickers located throughout the city. The *AMNH explorer* project (New York 2011) is an ap-

plication that provides detailed information regarding the American Museum of Natural History. Via the app, visitors can create a personal virtual tour. Finally, the *Street Art View* project (Mountain View 2011) is a collection of sites characterized by works of street art drawn from *Google Street View*. Users can select and share their favourite works, helping to build the 'world's largest' art collection. For all cases examined, a common element is the desire to make the user the main character, becoming the focus of the designed cultural experience. (G.P.)

Abandoned urban areas and ICT

The multidisciplinary structure of the project is organized into six distinct, complementary areas: web GIS; BIM and land information modelling; pilot scenario design; urban planning and feasibility studies; waste recycling; and data management and ICT. The *Data Management and ICT*

Fig. 1. Graphical representation of the historical and industrial skylines of the city of Padua. Freehand drawing (pilot pen and felt-tip pen).
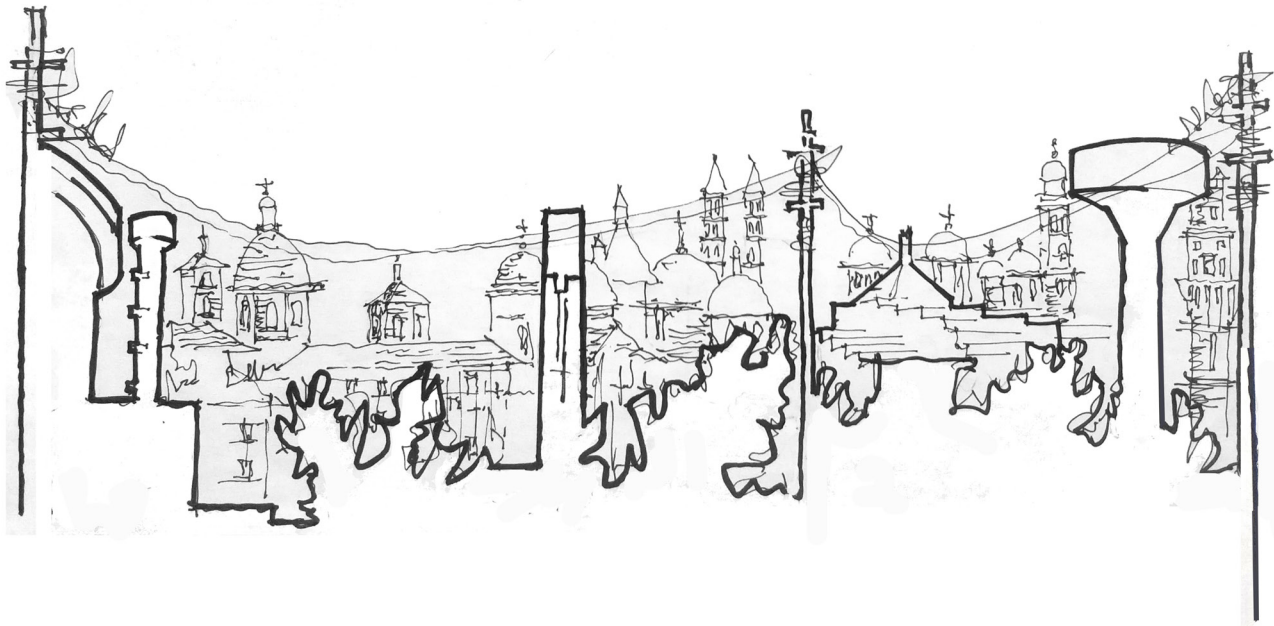
area is the focus of the present article. ICT plays a central role in cognitive, research, and dissemination processes, as well as in design processes, where it acts as an interface between different technical skills. These technologies have experienced significant development in the area of cultural heritage, in which they perform particularly complex tasks such as communication and popularization in extra-disciplinary fields.

With regard to ICT, two projects were developed in the present research: the first, *Extensive Project*, regarded the creation of a web platform; the second, *Focal Project*, regarded the creation of two technological 'applications' meant to investigate and interactively communicate the new design scenarios created over the course of the research. Among the many decommissioned areas present

around Padua, attention was focused mainly on the Ex Caserma Romagnoli and Ex Foro Boario zones (fig. 4).

As mentioned above, the *Extensive Project*, consists in creating a web platform designed to organize the data collected and to make its use possible by any type of user, from everyday citizens to professionals. In order to facilitate the use of the web platform, it was built into a website containing all the data deriving from the six areas of research. With the platform, which is based on the My-SQL database, it is possible to connect directly to the GIS 'container' built using Geonode (a web-based application and platform for developing geospatial information systems). Geonode is based on the Postgres database and enables access to the multiple interactive maps created (fig. 5). The objective of the system is twofold: to create

Fig. 2. Graphical representation of the historical and industrial skylines of the city of Padua. View of the Cathedral dome. Freehand drawing (pilot pen and felt-tip pen).
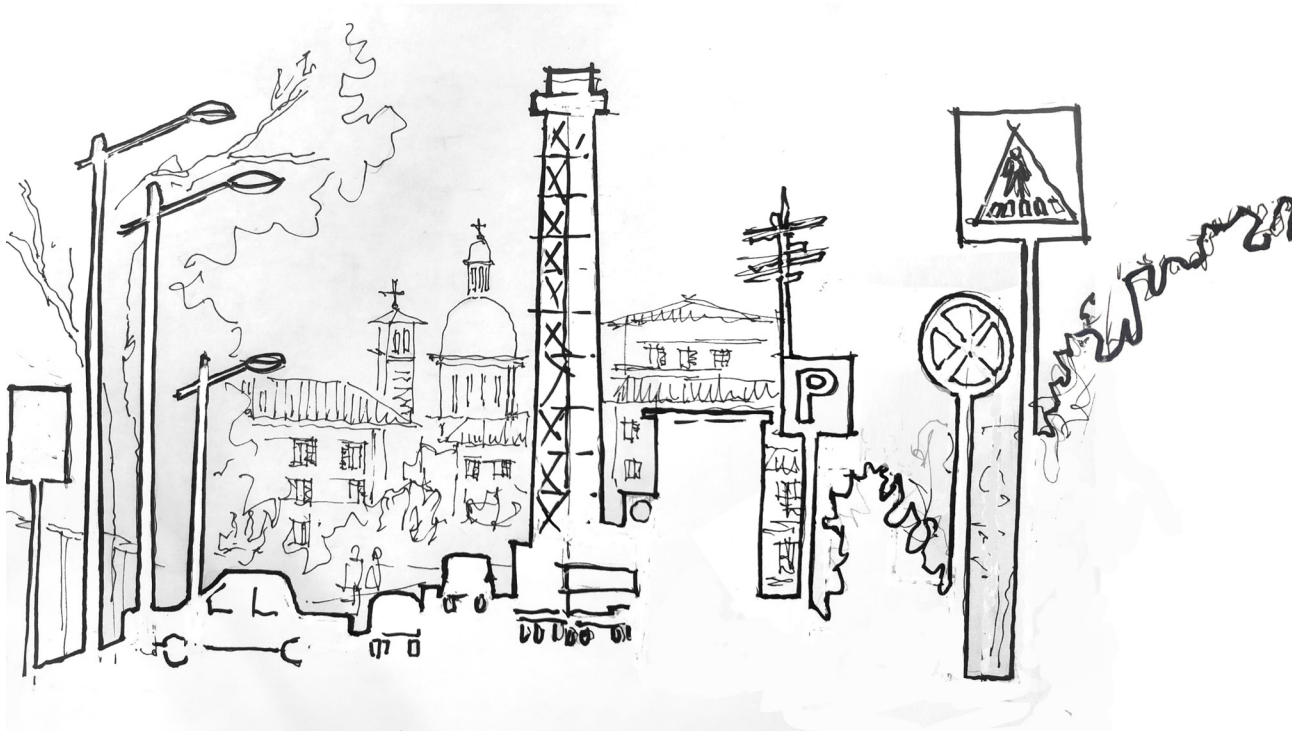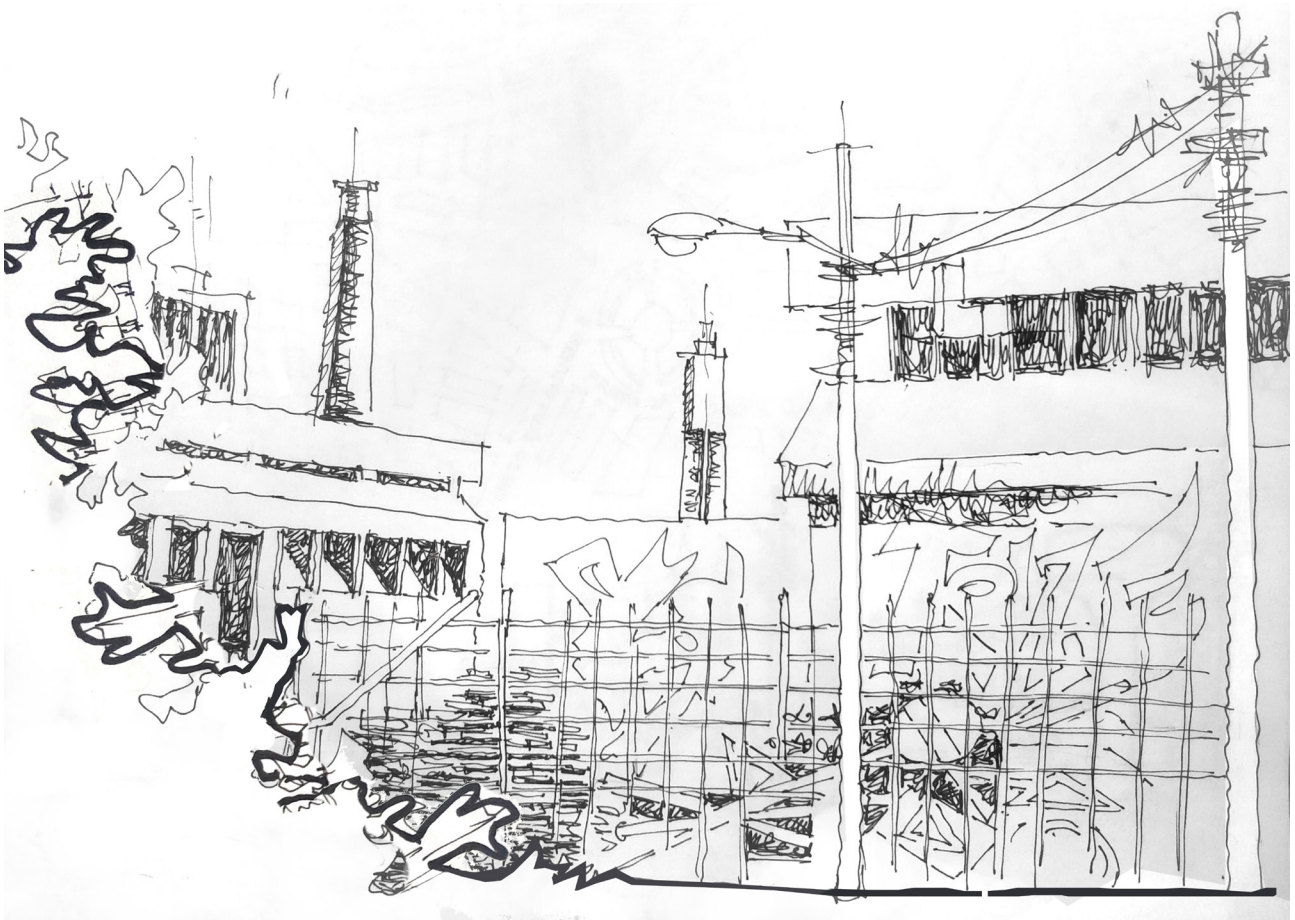
Fig. 3. Representation of a portion of the Ex Foro Boario in Padua. Freehand drawing (pilot pen and felt-tip pen).

an ordered archive of the data and an easy-to-use interrogation mode to rapidly explore and use any content present in the database. The web platform is therefore of fundamental importance in that it makes the various data processed during the research interoperable, facilitating its constant and continuous updating.

As mentioned above, the *Focal Project* consists in creating two digital 'applications' designed to communicate the regeneration project for the periphery. The first application regards the urban scale and the design of a 'virtual observatory'. With this tool in fact, it is possible to visua-lize the transformation of specific degraded extra-urban areas. With use of the 3D visor (a 3D smart visor in particular) and by activating hot spots, users have real-time 'access' to future scenarios of the city thanks to a 360° panoramic view. With the creation of a 3D model, it was possible to reconstruct a large part of the areas surrounding Padua. The reconstructed scene was then equipped with interactive tags. The functioning of the hot spots was made particularly intuitive. Indeed, simply by observing these points for an extended time (about 2 seconds), it is possible to activate and thus visualize the design scenario.

Fig. 4. Model made during research carried out in ReLOAD (Research Lab of Architect URban Design). Coordinator: L. Stendardo.
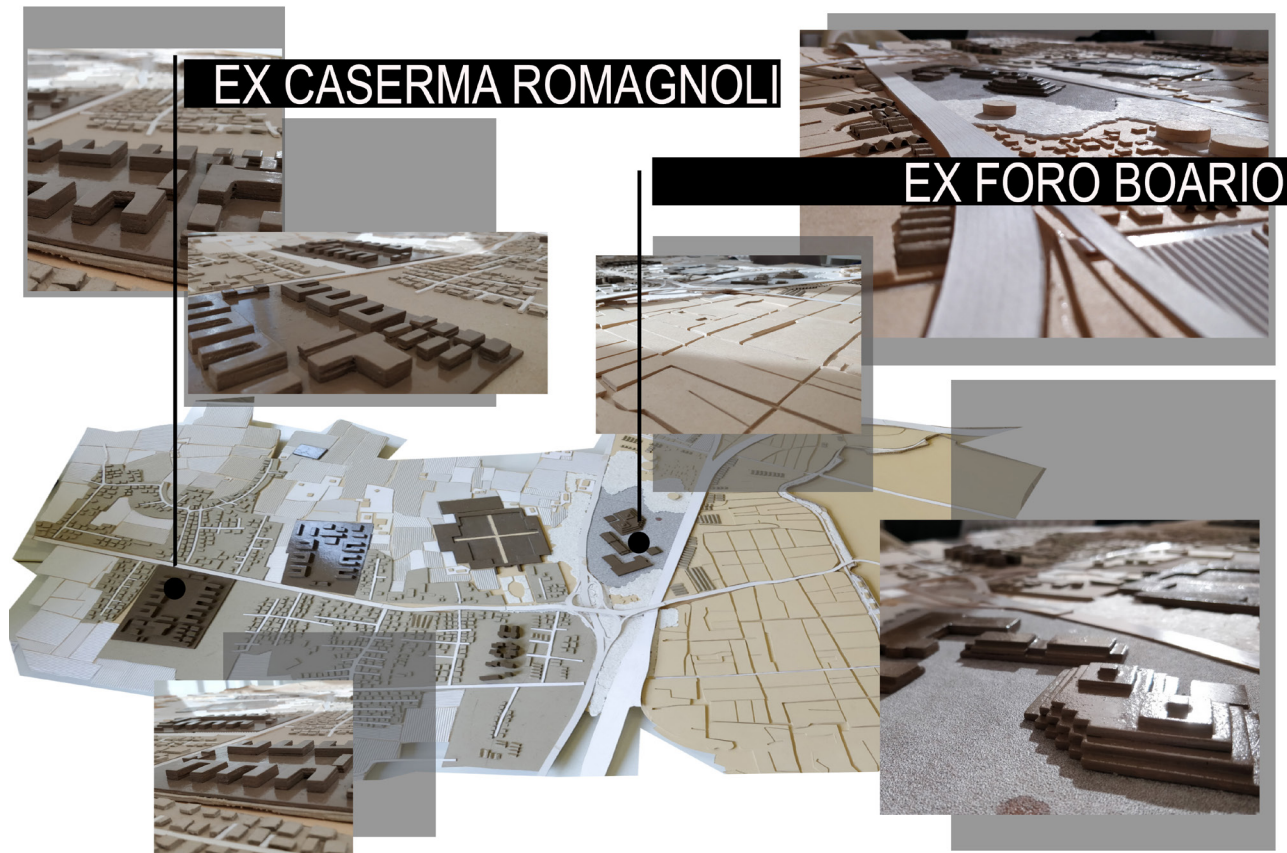

EX CASERMA ROMAGNOLI

EX FORO BOARIO

Fig. 5 Representation of the Web GIS Database searchable and available for consultation with the web site. Selection and analysis of different layers. Maps' realization: G. Pristeri, E Redetti.
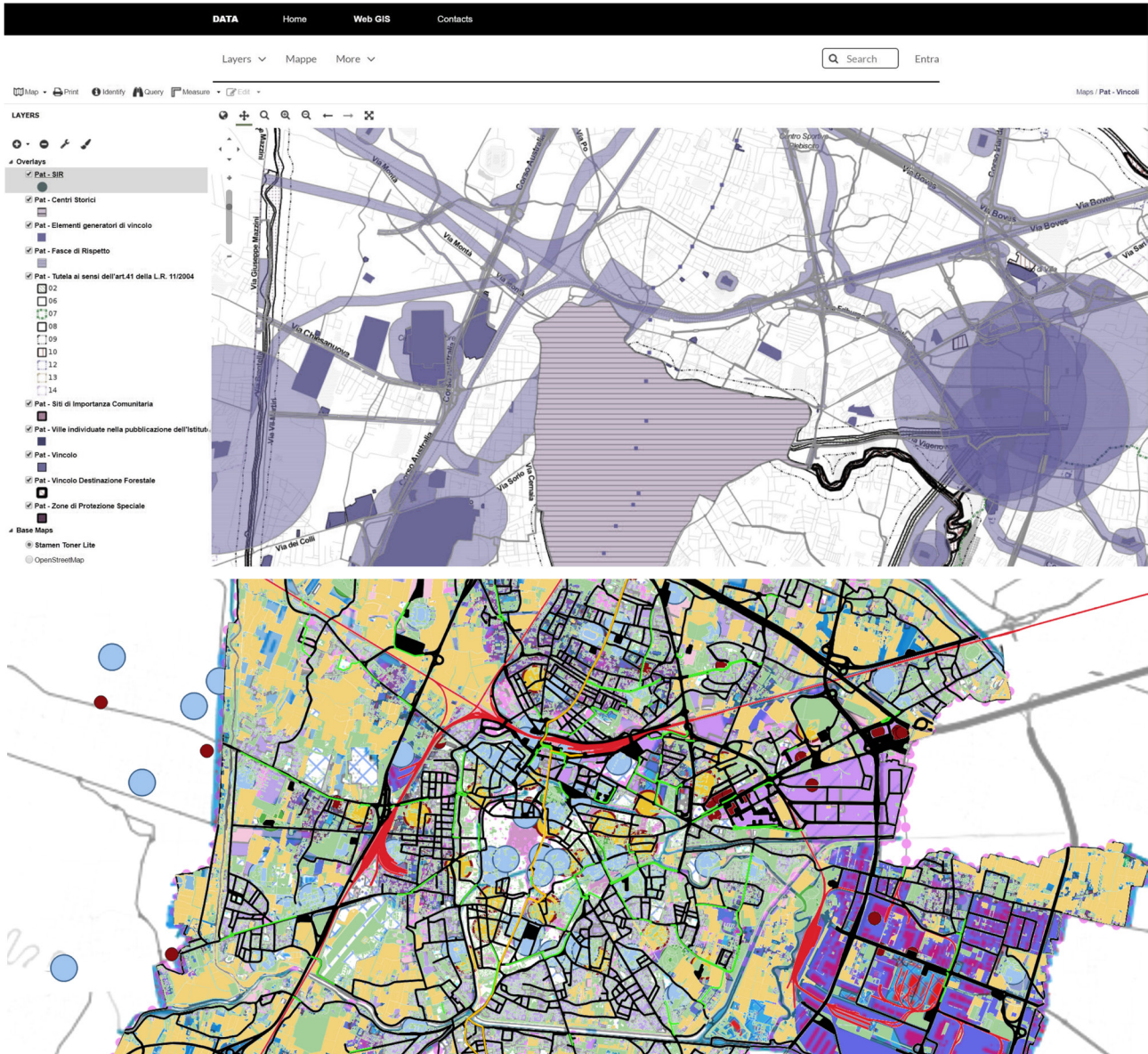
Fig. 6. Realization of digital application: G.Pettoello. 3D volumetric representation of the periphery of Padua: D. Barbato. Rendering image credits: Ex Foro Boario Padova. Serena Vianello, Mix and Match. Transformation scenarios for the Ex Foro Boario area, Corso Australia, Laurea thesis in Building and Architectural Engineering, University of Padua, 2014. Instructor: L. Stendardo. Rendering image credits: Workshop 'The Canal of Babel'. Instructors: L. Stendardo, L. Siviero, S. Antoniadis. Students: M. Barison, A. Quijada-Garcìa, G. Pozzato, S. Reverenna. Location: Idrovia Padova-Venezia.

The real-time transformation of the observed portion of city makes communication of the architectural renovation project particularly dynamic and involving. With regard to the technological aspect, the program *Revit* was used to create the 3D model; *3D studio Max* was used for the rendering. To create the user-interactive interface (responsive hot spots), specific scripts were created and then applied to the points of interest in the 3D environment. From the 'volumetric' 3D representation of the city, it is therefore possible to immerse oneself within the 360° reconstructed panorama. The following image shows, in particular, the work related to the Ex Foro Boario area (fig. 6).

The second application regards the architectural scale. In this case as well, the object of study regarded the Ex Foro Boario area; however, the degree of user involvement was increased. In fact, with the 3D visor, not only is 360° immersion within the scene possible, users can also explore the reconstructed environment personally in real time by virtually walking through it (fig. 7). Three-dimensional modelling was also used in this case to construct the portion of the city under study, and with specially designed scripts, users can move among the various points of interest situated within the scene. An audio recording of city sounds was inserted in the application in order to involve the sense of hearing as well, to make the experience even more involving. In both digital applications described, the user becomes the main character and plays an active role within the reconstructed virtual environment.

The DATA project addressed not only the fields of communicating cultural goods and user involvement, but also and more specifically the theme of urban regeneration of marginal areas. ICT was therefore called to face a different, even more difficult challenge through the use of multiple layers of communication. The role and challenge that ICT is called to support is of reconverting stored 'waste'. (G.P.)

Conclusion

Within the overall DATA project, the segment of research related to visualization –intended as structuring data and complex structures that are not only spatial and described in the project as data management and ICT– is continually addressed. This is true on multiple planes simultaneously with all the other segments (*WebGIS*, *Data mining*, *Building and Land Information modeling*, *Pilot scenarios design*, *Urban planning*, *Feasibility studies*, *Urban mining*), constituting a fundamental structure of relationships which allows all active skills in the project to interact in a complex way.

The synergy among the different actions that have assumed a visible form through data management and ICT has given rise to different research products. Starting with the point clouds obtained by laser scanner and photogrammetric surveys, integrated with thermal camera images taken both from land and on drones, and through SCAN to BIM processes, BIM were produced that were then interfaced with web GIS built based on data mining. Through synergy with the segment of pilot scenarios design, visualizations of the design scenarios were produced by developing virtual, augmented, and immersive realities.

In sum, the different forms of visualization produced different output. In particular, the following were developed: a database that organizes the information gathered; a web GIS platform [3] that can be updated and integrated with new content; interoperable BIM models for some decommissioned areas and design scenarios; pilot scenarios on the architectural and urban scales; design strategies on the territorial, urban, and local scales; a collection of environmental data as well as a quantity and quality assessment of waste produced in relation to possible scenarios of intervention; high-tech multimedia ICT products [4] including software interfaces for mobile devices that use virtual and augmented reality; and a website [5] (fig.8) to disseminate on the Internet the results that integrate the web GIS platform. (L.S.)

Notes

[1] DATA *Developing Abandoned Transurban Areas* is a research project in the Department of Civil, Environmental, and Archietctural Engineering at the University of Padua. Duration 12 months (26 June 2017–25 June 2018). Financed through competitive call under ROP Veneto – Social European Fund 2014-2020 (Regional Council Decision. no. 2216 13/12/2016), and cofinanced with FESR funds. The scientific committee

of the project includes: L. Stendardo, *Principal Investigator* (*Pilot Scenarios Design*, *Data Management* e *ICT*); M. De Marchi (*WebGIS* e *Data Mining*); A. Giordano (*Building and Land Information Modeling*); M.C. Lavagnolo (*Urban Mining*); M. Savino (*Urban Planning* e *Feasibility Studies*). The research team consist of: G. Pristeri (*WebGIS* e *Data Mining*); D. Barbato (*Building and Land Information Modeling*); S. Antoniadis (*Pilot Scenarios*

Fig. 7. Virtual-reality view of the city with a 3D visor. Real-time exploration of the future scenario. Creation of digital application: G. Pettoello.
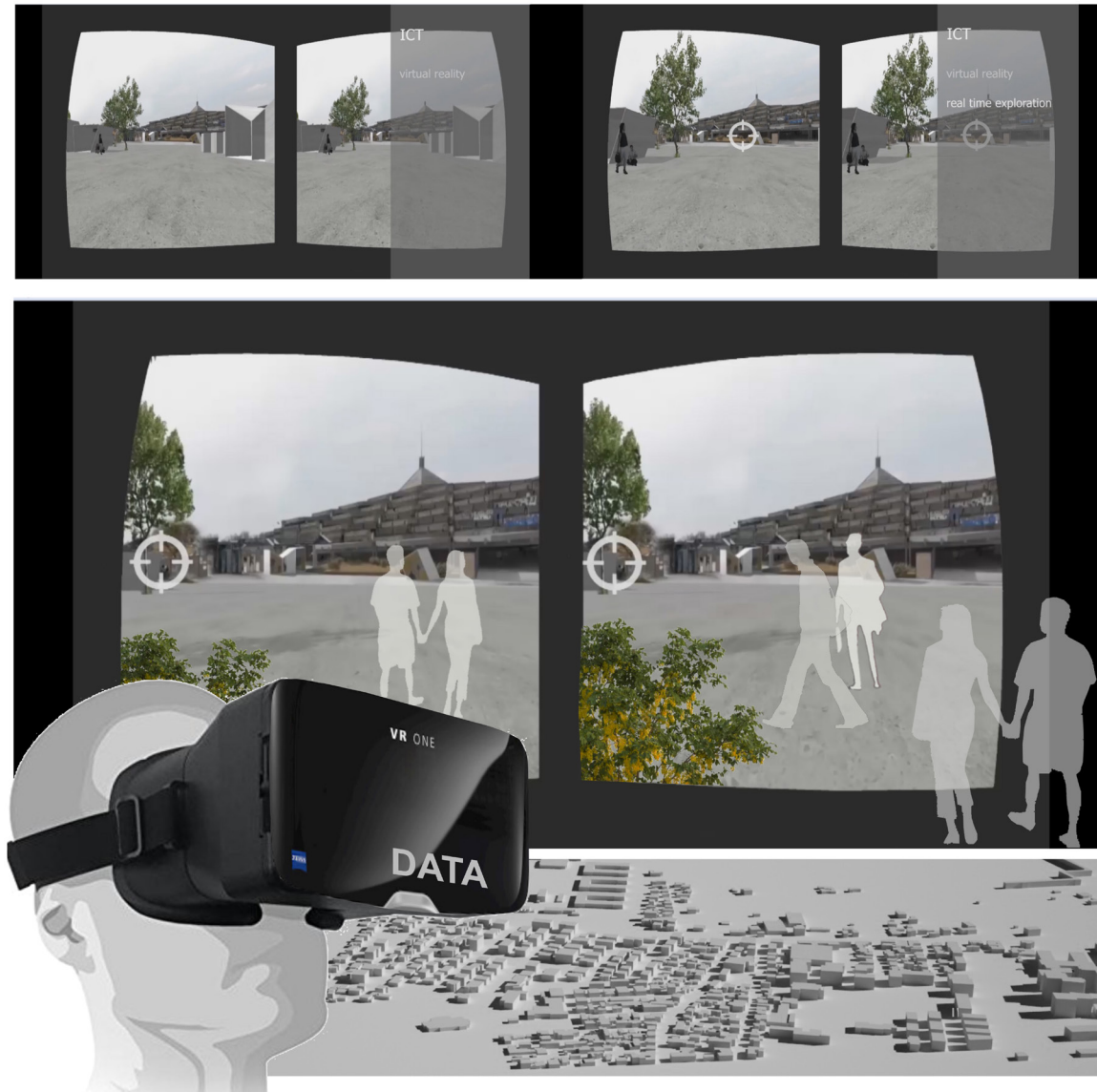
Fig. 8. Home page of the web site realized by the team during the year of activity. The web site shows the synthesis of the whole DATA project.

DATA designs sustainable future scenarios and develops ground-breaking strategies for the development and economic boost of jeopardised urban areas awaiting regeneration, exploiting the potential of more effective data collection, processing and dissemination.

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