Marco Morandotti Elisabetta Doria
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BUILDING SUSTAINABLE REUSE

A multidisciplinary and multiscale approach for sustainable cities and communities

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The European Campus of City-Universities (EC2U) is a multi-cultural and multi-lingual Alliance consisting of nine long-standing, education and research, locally and globally engaged universities from four diverse regions of the European Union.

This publication is promoted and financed by the University of Pavia, in particular thanks to the EC2U University Alliance, which provided financial and managerial support for the realisation of the three editions of the Summer School B.SuRe - Building Sustainable Reuse, whose evaluations and results are presented in this volume.

UNIVERSITÀ DI PAVIA

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EC²U European Campus of City-Universities

STEP

PLAY Photography and 3D Laser for virtual Architecture LaboratorY

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INSTITUTIONAL GREETINGS

Andrea Penna
Director of the Department of Civil Engineering and Architecture, University of Pavia

In the contemporary landscape of higher education, particularly within the fields of civil and architectural engineering, the ability to address complex real-world challenges requires more than technical proficiency alone. It calls for an open, multidisciplinary perspective that integrates knowledge across diverse disciplines, cultures, and contexts.

This is precisely the spirit in which Building Sustainable Reuse was conceived. The volume brings together the contributions of scholars and practitioners whose expertise encompasses architecture, engineering, urban planning, heritage conservation, and environmental sustainability.

Their collaborative work exemplifies the integrated thinking required to confront the challenges of adaptive reuse of historical buildings within the broader framework of sustainable urban development.

The Department of Civil and Architectural Engineering participates in this initiative as part of the wider mission of the EC2U Alliance. Through Work Package 6 – Sustainable Cities and Communities, the department contributes actively to advancing research, education, and innovation at the intersection of built heritage and sustainability.

In alignment with Goal 11 of the 2030 Agenda, this publication demonstrates how multidisciplinary collaboration can foster progress in shaping cities and communities that are not only historically conscious but also environmentally responsible and socially inclusive. Such an integrated approach, achieved by combining the analytical rigor of engineering with the cultural sensitivity of architecture and the strategic vision of urban planning, is essential for the education and training of future professionals.

Building Sustainable Reuse thus stands as a testament to what can be achieved when diverse disciplines converge under a shared European mission for sustainability.

Luca Perregrini
Dean of the Faculty of Engineering, University of Pavia

One of the core missions of higher education is to foster intellectual curiosity and encourage students to explore what lies beyond the boundaries of conventional understanding. In engineering education, this means preparing future professionals who are capable of addressing complex and evolving challenges, supported by a strong foundational knowledge and the ability to develop and apply innovative tools and methodologies. This vision is particularly relevant when it comes to the sustainable design, recovery, and conservation of historical and architectural heritage.

These themes are deeply intertwined with the broader objectives of the EC2U Alliance, a dynamic collaboration among nine European universities and their cities, working together to promote inclusive, resilient, and sustainable urban environments, in line with Goals of the United Nations 2030 Agenda. Within this framework, the activities of Work Package 6 – Sustainable Cities and Communities play a pivotal role. WP6 encourages interdisciplinary cooperation across engineering, architecture, environmental science, and social innovation, aiming to equip students and researchers with the tools to address the urgent need for urban regeneration and climate-conscious development. The Faculty of Engineering is proud to contribute to this shared mission.By promoting academic exchange, applied research, and cross-cultural collaboration, we aim to nurture engineers who are not only technically skilled but also attuned to the historical, social, and environmental dimensions of the built environment.

Through our engagement in EC2U, we reinforce the commitment to educating a new generation of professionals ready to shape the sustainable cities of tomorrow, cities that respect their past while embracing the future.

Ludovic Thilly
General coordinator of the EC2U Alliance of European Universities, University of Poitiers

The European Campus of City-Universities (EC2U) is an Alliance built on the conviction that universities and cities must work together to address the pressing social, environmental, and economic challenges of our time. By fostering collaboration across disciplines, national borders, and institutional roles, EC2U aims to shape a new model of European higher education, one that is inclusive, sustainable, and deeply rooted in local contexts while oriented toward global impact.

In this framework, Goal 11 of the UN 2030 Agenda plays a central role. Urban spaces are where many of today's key transformations take place, from the green transition to digital innovation, from cultural preservation to social inclusion. EC2U's Work Package 6, dedicated specifically to this topic, supports joint research, innovative teaching, and cooperation between academic institutions and local authorities.

The activities described in this volume, including the B.SuRe Summer School, are concrete examples of how this shared agenda can be implemented. They show how academic expertise, when embedded in a European network, can contribute to solving real challenges faced by our cities, such as the sustainable reuse of built heritage, digital innovation in cultural policy, and interdisciplinary training for the professionals of the future. This kind of cooperation is exactly what the EC2U Alliance was created to support: the emergence of a pan-European, civic university space, where learning, research, and local action are connected in a dynamic and responsive way. The experience of the University of Pavia and its partners in developing transnational educational and research formats demonstrates the potential of such a networked approach.

We see this work not as an isolated initiative, but as part of a growing pan-European Knowledge ecosystem based on collaboration across EC2U universities and cities. It contributes to a broader, long-term objective: to build the (EU) University of the future as an agile, open, and mission-driven structure, capable of training responsible citizens and responding to shared European challenges.

Antonella Forlino
Vice-Rector for Internationalization, University of Pavia

Building Sustainable Reuse emerges from a shared commitment within the EC2U Alliance to address the pressing challenges of conserving and regenerating historical and architectural heritage within the broader context of urban sustainability. At the heart of this initiative lies the ambition to contribute meaningfully to Goal 11 of the United Nations 2030 Agenda, which calls for making cities and human settlements inclusive, safe, resilient, and sustainable. The European Campus of City-Universities (EC2U) is a transformative alliance of nine universities (Coimbra, Iași, Jena, Pavia, Poitiers (coordinator), Salamanca, Turku, Linz, and Umeå, with the Ivan Franko University of Lviv as a strategic partner) dedicated to fostering deep collaboration between academic institutions and their respective cities. Through this multicultural and multilingual network, the alliance seeks to build an integrated pan-European campus, connecting education, research, innovation, civic engagement to promote sustainable urban development.

This publication is closely aligned with Work Package 6 (WP6) of the EC2U initiative, focused on Sustainable Cities and Communities.
WP6 supports interdisciplinary approaches to urban challenges by bridging expertise in architecture, urban planning, environmental science, and social innovation. In this context, the reuse of existing buildings is seen not only as a technical and design challenge but also as a cultural and civic responsibility, one that contributes to the preservation of local identity and the transition to greener, more livable urban environments. By leveraging the strengths of the EC2U Alliance, Building Sustainable Reuse aims to advance a holistic vision for the adaptive reuse of historic architecture. It highlights how collaborative academic frameworks can shape future professionals capable of engaging critically and creatively with the built environment, contributing to a more sustainable, active and cohesive Europe.

UN 2030 Agenda
for Sustainable Delopment
https://sdgs.un.org/2030agenda

INTRODUCTION

The sustainable management of built heritage is no longer a marginal concern, it is a global priority that demands immediate and coordinated action. In the face of climate change, urbanization, and increasing pressure on natural resources, the need to preserve, adapt, and responsibly reuse the architectural legacy of our cities has become a central theme of sustainable development policies at both national and supranational levels.

Within this evolving framework, United Nations Sustainable Development Goal 11 – Sustainable Cities and Communities serves as a key point of reference. It calls for making urban areas inclusive, safe, resilient, and sustainable, emphasizing the importance of protecting cultural and natural heritage while promoting social cohesion and ecological responsibility. This book, Building Sustainable Reuse, is deeply embedded in the vision and activities of the European Campus of City-Universities (EC2U), a vibrant and expanding alliance that unites nine universities and their cities in a shared mission for sustainable development, inclusive education, and civic engagement. Collectively, EC2U represents a community of over 160,000 students, 20,000 staff, and a broader urban population exceeding 1.6 million citizens across Europe. Within this context, the Work Package 6 – Sustainable Cities and Communities plays a pivotal role. Among its core objectives are the establishment of a Virtual Institute focused on SDG 11, with special emphasis on the preservation, retrofitting, and enhancement of historic university buildings, and the development of a European Master's Programme in Sustainable Cities and Communities. These initiatives not only promote knowledge sharing and mobility among institutions, but also seek to foster a new generation of professionals equipped with green competencies and interdisciplinary awareness, skills that are urgently needed in today's job market and policy landscape. The University of Pavia contributes significantly to this mission, bringing to the table both a rich historical building heritage and well-established research capacities in the fields of sustainable restoration, urban regeneration, environmental design, and architectural history. These dual strengths, material and intellectual, provided the fertile ground for launching a European educational initiative dedicated to the complex challenges of building and urban sustainability in historical contexts. This book is one of the outcomes of that initiative. It collects the insights, experiences, and research of a multidisciplinary group of authors, whose backgrounds range from civil and structural engineering to architecture, urban planning, conservation science, and environmental studies.

The adaptive reuse of historical buildings is a field that defies disciplinary boundaries. It demands technical precision, cultural sensitivity, and systemic thinking, qualities that emerge when different forms of knowledge are brought into dialogue. The principal goal of this collective work is to stimulate an open and multi-level debate on sustainable design and intervention strategies in historic urban environments. The aim is not only to share expertise but to cultivate a community of scholars and students who approach the topic from complementary angles and shared values. In doing so, the book aspires to support the emergence of an international academic platform, one that can continue to grow through joint research, co-teaching initiatives, and eventually, open badge recognition models that validate interdisciplinary learning in sustainability. We believe that built heritage is not just a memory of the past; it is a resource for the future. Its responsible transformation through sustainable practices can become a cornerstone of a green transition in Europe.

Research and review

In this wide section, we have collected the scientific contributions of lecturers and researchers who collaborated in the creation of the three editions of the B.SuRe Summer School's contents, training, and educational moments. These papers are largely interdisciplinary contributions, and their key principles are part of the current scientific discussion about the topic of Sustainable Reuse, widespread in different fields of application. Each contribution reflects a unique perspective rooted in the authors' disciplinary background,ranging from architecture and engineering to environmental planning and heritage studies, highlighting the richness of approaches necessary to address the challenges of reuse. Together, they offer a comprehensive and multi-voiced insight into how historical buildings can be responsibly reimagined within the framework of sustainable urban development.

Educational approach and case studies

Divided into mixed groups by university background and education, students investigated the theme of Sustainable Reuse by applying the notions of digitisation of Cultural Heritage to the case study of Palazzo Vistarino in Pavia. This section illustrates the teaching approaches of the various editions and presents some of the results of the 2024 edition.
The collaborative learning environment fostered dialogue between disciplines such as architecture, civil engineering, conservation, and digital technologies, encouraging students to develop integrated and forward-thinking solutions. The outcomes demonstrate how digital tools, such as 3D modeling, scanning, and data visualization, can enhance the understanding, documentation, and strategic reuse of historical buildings in sustainable ways.

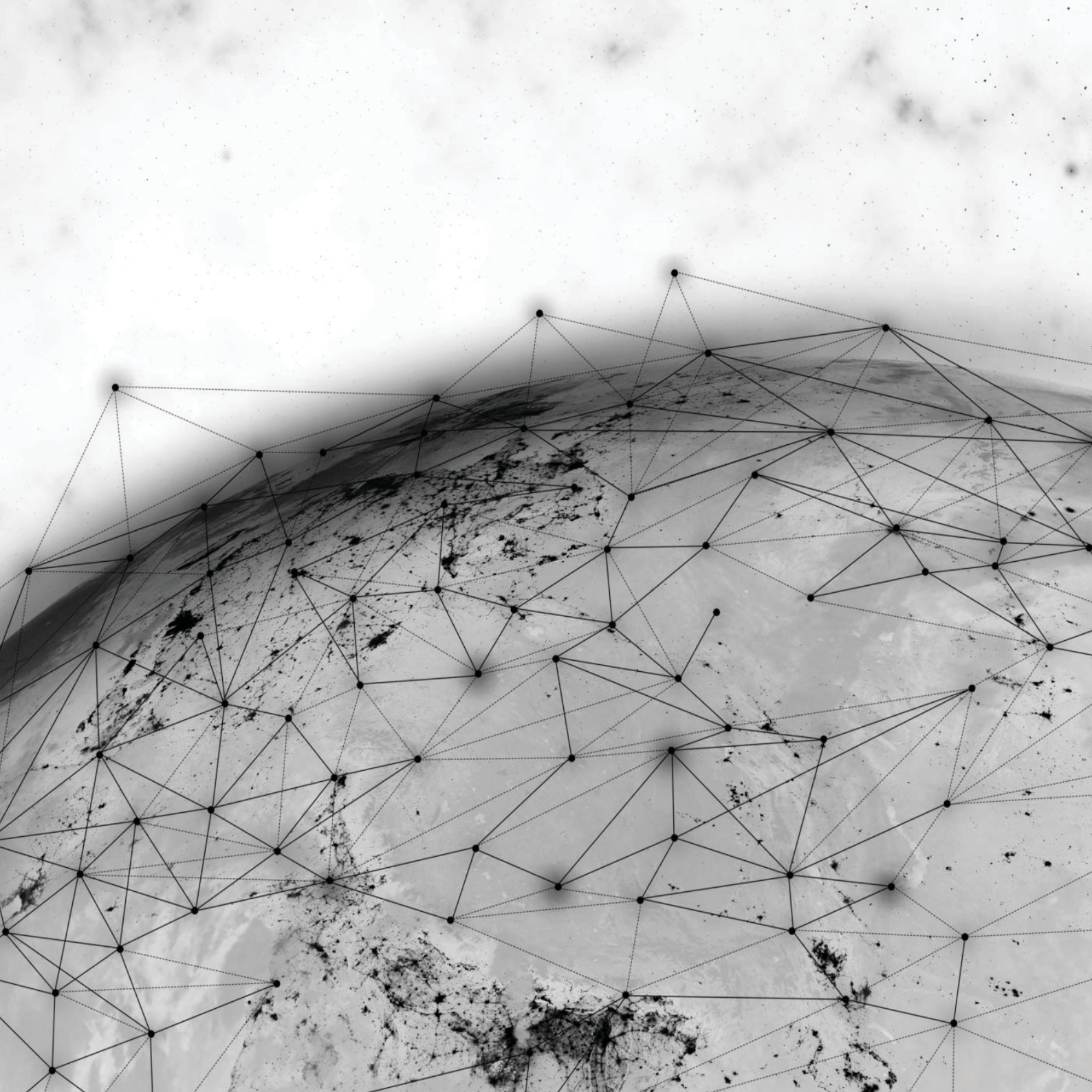
The city as a space for exploring & education

In this section are collected the contributions of the municipalities involved in the Interreg CHARME project, which was born thanks to the connections created during the activities of the B.SuRe Summer School (CultCities Project) and strengthened by the EC2U Alliance. Each municipality describes one of its good digitalisation practices, as a virtuous example for other municipalities. These contributions highlight how local administrations are approaching the digital transition on cultural heritage, using innovative tools to enhance accessibility, preservation, and community engagement. By sharing these experiences, we aim to foster dialogue and inspire replication of successful models across European cities, reinforcing the shared goal of sustainable and inclusive urban development.

Marco Morandotti, Elisabetta Doria

RESEARCH AND REVIEW

INTERDISCIPLINARY APPROACHES TO SUSTAINABLE REUSE



The potential of AI in the preservation and promotion of Cultural Heritage

Costanza Baldrighi, Stefano Denicolai, Marica Grego

University of Pavia - Italy

Abstract

How can the application of Artificial Intelligence (AI) tools benefit the management of Cultural Heritage (CH)? This work is a literature review aimed at exploring the transformative potential of AI and Big Data Analytics (BDA) in CH preservation, accessibility, and management. Emphasizing a multidisciplinary approach, the research addresses gaps in existing literature and proposes new avenues for cross-disciplinary collaboration. The study delves into the new frontiers of AI applied to CH, highlighting promising applications in monitoring, conservation, promotion, and accessibility. Additionally, the research examines the potential of BDA in CH management, emphasizing its significant role in decision-making processes. Future research applications are explored, focusing on data-driven decision-making, predictive analytics, and inclusive strategies. The integration of AI and BDA in CH management offers significant advantages, requiring ongoing research and policy development to ensure ethical and inclusive practices. The study concludes by underscoring the need for interdisciplinary efforts to harness the unprecedented opportunities at the intersection of AI, BDA, and CH.

Keywords

Artificial Intelligence, Cultural Heritage, Big Data, Preservation, Accessibility, Interdisciplinary Collaboration

AI & Big Data in Cultural Heritage

UNESCO defines Cultural Heritage (CH) as "the legacy of physical artefacts and intangible attributes of a group or society that are inherited from past generations, maintained in the present and bestowed for the benefit of future generations" (Pasikowska-Schnass & Lim, 2018, p.2). CH represents a strategic factor which, if exploited correctly and sustainably, can promote the economic and social development of a territory(Prados-Peña et al., 2023). As pointed out by Buratti et al. (2021), information and communication technology play a key role in this scientific challenge. We contribute to the debate through a literature review focused on the role of artificial intelligence (AI) and big data analytics (BDA) in the functions of preservations, use, promotion, and accessibility of CH assets. Despite the recognised importance of AI applications in this field, academic contributions remain limited (Prados-Peña et al., 2023). While considerable attention has been directed towards the technical aspects, there remains a significant research gap in understanding the implications on management and decision-making processes. The preservation, restoration, and enhancement of CH

necessitates a multidisciplinary approach due to the diverse and complex nature of cultural assets (Talamo et al., 2020). Their management requires insights from history, archaeology, anthropology, data science, law, ethics, community engagement, and other disciplines for an effective preservation and sustainable management.We argue that the development of AI applications can revolutionise the way CH is safeguarded and made available to a wider audience (Díaz-Rodríguez & Pisoni, 2020; Pisoni et al., 2021). The objective of this study is to address the existing gap by summarising current research on the intersection of AI and CH and proposing new avenues for cross-disciplinary collaboration.
In the next section, we delve into the new frontiers of AI applied to CH. Subsequently, we analyse the potential associated with BDAmanagement and CH. Then, we discuss potential future research avenues and the transformative impact such collaborations could have in the management of CH. Finally, we conclude our work with some final considerations.

The New Frontiers of AI applied to Cultural Heritage

AI is an umbrella term that has been adopted to describe a wide variety of technologies many of which can be employed in the field of conservation and promotion of CH (Boucher, 2020). Although there are still many limitations, the perspectives of AI are promising. For example, the collection of substantial volumes of information through AI-powered sensors has been proven essential for proactively monitoring environmental conditions that may pose a threat to CH. Detecting factors like humidity or temperature changes, air pollution, or excessive exposure enables timely interventions to limit potential damage (Avci, 2023). Machine learning can be applied to predict historical building integrity (Fiorucci et al., 2020). In a similar fashion, AI-based visual inspection can be used to assess surface damage on monuments and buildings (Mishra et al., 2022).
Moreover, the creation of databases with AI techniques can sensibly improve the conservation, management, and display of intangible CH (Zhang et al., 2023; Zhao & Leung, 2022) and facilitate broader access to historical and cultural assets (Díaz-Rodríguez & Pisoni, 2020; Pisoni et al., 2021). Furthermore, the use of AI in handling 3D images and videos proves invaluable in protecting delicate historical and archaeological sites that may be unsuitable for large visitor numbers (Al-Baghdadi, 2017). Another crucial aspect is the restoration and enhancement of damaged or degraded cultural items using AI algorithms. This not only ensures the longevity of these digital items but also broadens their accessibility (Díaz-Rodríguez & Pisoni, 2020). Although the collection of complex data is crucial, the possible applications of AI to CH are not limited to the analysis of pre-existing data. A new frontier, the generative AI, is able to produce on its own contents that contribute to the enrichment of CH (Guo et al., 2023) or, in other cases, make elements of CH more interesting to a modern audience that would otherwise be dated (Zhang et al., 2023). Although this entails possible issues, for example regarding copyright protection (Hazan, 2023), we have only just scratched the surface of the potential of AI in this field.

Potential of Big data

One of the pivotal issue in the application of AI techniques to CH management is the opportunity to analyse huge amounts of data coming from different sources and with specific characteristics or even elaborate predictive models based on them (Amato et al., 2017). BDA is therefore a potentially fundamental tool for the management of CH (Buratti et al., 2021).

Information generated by BDA applications, more than any other AI application, potentially inform a wider range of actions from policy decisions to management strategies, and conservation efforts.
According to a case study performed by Amato et al. (2017) BDA technology is characterised by several features that require different types of capabilities for a correct implementation.

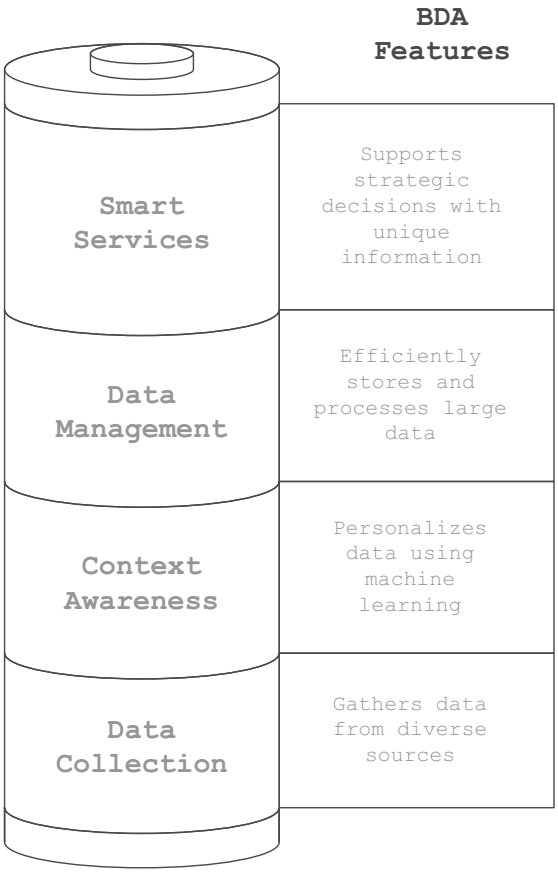


Fig. 01: BDA features range from data collection to decision support.

The first feature involves collecting information from diverse and distributed sources, including sensors, social networks, digital libraries, and archives, multimedia collections, and web data services. Implementation requires capabilities such as seamless integration, data interoperability, scalability, real-time and near real-time processing, security measures, and metadata management, ensuring the creation of comprehensive and reliable datasets. The second feature is centred on context-awareness and personalization, demanding capabilities like user profiling, machine learning algorithms, and real-time analytics. The third feature involves implementing advanced data management techniques to address challenges related to variety, velocity, and data volume. This includes ensuring efficient storage, retrieval, and processing. Developing these techniques demands resources such as scalable infrastructure and high-performance storage systems, coupled with the expertise of skilled data engineers. Lastly, the fourth feature of BDA systems involves the capability to provide advanced smart services that support decision-making processes. This feature of BDA is directly related to CH management because it provides decision-makers with a unique set of information to make informed and strategic decisions in different fields of application.
We contend that a multidisciplinary approach is necessary in addressing the complexity of BDA challenges comprehensively, ensuring that technical solutions align with socio-political goals, legal requirements are met, and ethical considerations are considered.The adoption of a data-based approach should generate a virtuous circle of continuous improvement and adaptabilityhence reducing the risk of ineffective resource allocation and poor decisions (Mishra et al., 2022).

Future research applications

The integration of AI in the domain of CH opens new avenues for research and innovation. Here, we explore key areas where future studies can make significant contributions. Future research should focus on adopting a data-based decision-making process and employing predictive analysis for conservation. Research should also explore the opportunities arising from a deeper understanding of CH and its interactions with both a cultural and a market perspective. Insights into user behaviour and preferences can be leveraged to create new market opportunities (Díaz-Rodríguez & Pisoni, 2020; Pisoni et al., 2021; Xie & Li, 2022).

Scholars can investigate the adoption of new strategies, such as participatory design and experiences-based learning, emphasizing collaborative approaches within the field (Pisoni et al., 2021). Future research can delve into predictive analytics for conservation, optimizing the allocation of resources to address potential risks and challenges (Mishra et al., 2022).

New studies can explore approaches leveraging AI to collect and analyse more data about customer behaviour and experience. This approach, as suggested by Pisoni et al. (2021), allows for the creation of personalized and enriched cultural experiences. Researchers can focus on efficient collection management by analysing visitors' reactions. For instance, museums can use AI to understand and improve the design of their exhibitions based on real-time feedback (Vidu et al., 2021).

Finally, new investigations can contribute to improved tourism strategies and foster a more inclusive approach to CH enhancing accessibility and engagement (Pisoni et al., 2021). Although combining CH management with AI and BDA has considerable advantages it also poses not negligible challenges that may stimulate future research and policy development.

For example, it is necessary to ensure that the AI is trustworthy, i.e. designed to be inclusive, ethical, and non-marginalising. Otherwise there is the risk of including bias and subjectivism (Pansoni et al., 2023). Another critical issue concerns copyright protection policies that can be hard to enforce in an AI-dominated scenario (Hazan, 2023). Finally, it is crucial to ensure that small cultural productions are not excluded resulting in a loss of CH (Pansoni et al., 2023).

The intersection of AI, BDA, and CH presents unprecedented opportunities for advancing preservation, accessibility, and management practices, but it also necessitates an interdisciplinary effort to address emerging challenges, ensure ethical behaviour and inclusive practices.

Characteristic	AI	Big Data
Data Collection	Collects substantial information via sensors	Collects data from diverse, distributed sources
Analysis & Prediction	Predicts building integrity, assesses surface damage	Informs policy, management, and conservation efforts
Content Generation	Generates content to enrich cultural heritage	Provides advanced smart services for decision-making
Accessibility	Facilitates broader access to historical assets	Requires multidisciplinary approach for implementation
Restoration	Restores and enhances damaged cultural items	Addresses data variety, velocity, and volume challenges

Fig. 02: AI and Big Data applications in Cultural Heritage

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Conservation and innovation: the enhancement of Cultural Heritage

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Abstract

The principal aim is to address the delicate yet complex and urgent couple between Cultural Heritage and Environment. On one side, we are faced with a Heritage that is increasingly obsolete in relation to the compliance with new needs, the gradually stringent performances and regulatory requirements, use and environmental context. On the other side, the increasingly strict environmental policies impose on the World, and in particular on the construction sector, the need for a gradually virtuous radical change and a general revision in conceiving and setting up the architectural design project respecting the environment. Therefore, designers are asked to carefully evaluate the project choices with impacts on the raw materials production, on materials choices, transport management, control of the construction phases and, finally, the behavior of the buildings over time. The main challenge is to learn how to set up heritage 'innovative' conservation actions. This apparent antinomy between Heritage and environmental challenges as a combined system, finds a response in sustainable and adaptive reuse strategies as possible intervention tools in compliance with the historical-architectural, technological and material constraints of the existing with increasingly stringent environmental dictates. This apparent dichotomy becomes the key to planning actions that set new life, new uses of the Heritage, enhance the building itself and the context while preserving environmental needs.

Keywords

Sustainable design, reuse strategies, Cultural Heritage, SDGs, compatibility.

Conservation and innovation

"There is only one planet Earth, yet by 2050 the world will consume resources equal to three planets" (UN, 2023). Overall consumption of materials such as biomass, fossil fuels, metals and minerals are projected to double over the next forty years (OECD, 2018), while annual waste generation will increase by 70% by 2050. Since resources extraction and processing are responsible for half of total greenhouse gas emissions and more than 90% of biodiversity loss and water stress, the European Green Deal has launched a concerted strategy for a climate-neutral, resource-efficient and competitive economy.

In this way, the construction area plays a fundamental role since the buildings themselves, to date, largely represent the sector that most produces global greenhouse gas emissions, estimated at around 38% of total emissions (UNEP, GlobalABC, 2020).
To realize this ambition, the EU must accelerate the transition towards a regenerative growth model that gives back more to the planet than it takes in, working towards keeping resource utilization within planetary boundaries, and therefore must do everything possible to reduce its consumption footprint and double the percentage of use of circular materials in the next decade. Within this scenario, it is therefore necessary to ask ourselves what possible answers Architecture is able to provide towards the global challenges of the present and the near future, triggering a substantial paradigm shift in the way of conceiving the Project today.
Citing the title of a recent book by the architect Mario Cucinella "The future is a journey into the past" in which the closed relationship between Architecture and the Environment is skillfully investigated, it is possible to identify some important starting points for thought: watch to the future looking back at the past, "finding the key to open the door of friendship with the Planet" (MCA, 2021).
We are certainly still in a transitional phase, a transition towards a substantial paradigm shift but this must take place primarily through the reduction of scrap, waste and wastefullness by projecting the world of construction and building towards circular economy actions, such as the recycling and recovery of materials and the adoption of sustainable production processes.
In this sense the city can - and perhaps must - become, the possible stock of the future, the privileged place from which to draw most of the raw materials useful for construction. The same city, respecting its history and tradition, becomes the place to preserve the memory and historical identity of a place and contextually a field of experimentation and sustainable innovation for the construction world. If a sustainability strategy

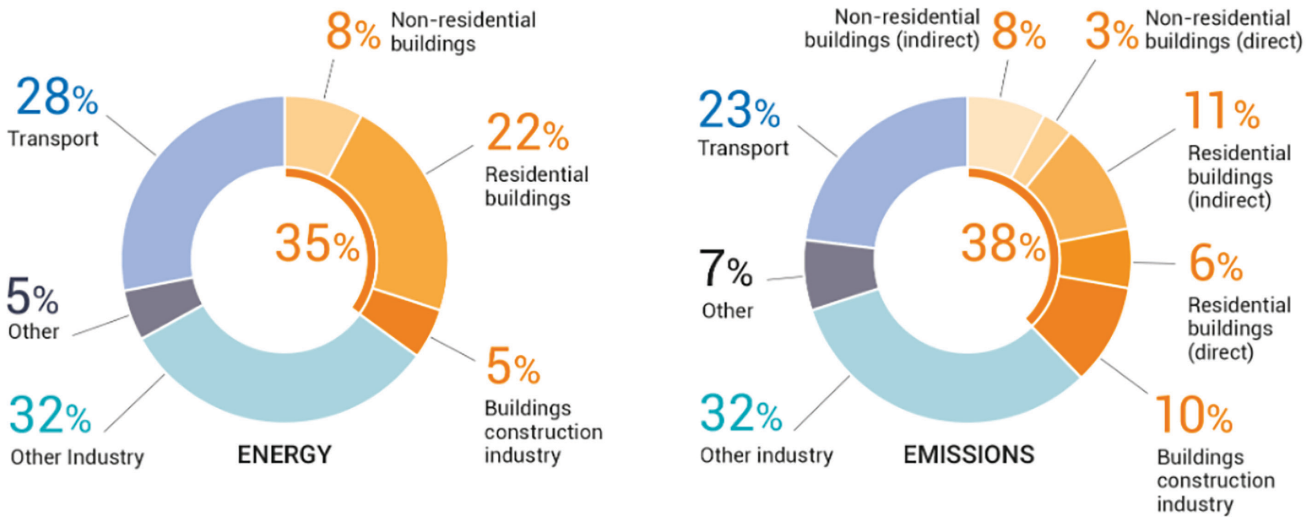

Fig. 01: Percentage impacts on energy use and percentages of emissions (IEA Report, 2020)

calls for eliminating the consumption of new soil, the city presents itself as a mine, a supply of often obsolete and inadequate buildings towards which it is necessary to operate through intervention actions. One of the possible strategies that it is believed can best respond to the challenges of our time, within the more general framework of possible intervention actions, is aimed at the reuse of the existing Cultural Heritage.

On the one hand, Cultural Heritage represents an irreplaceable treasure of knowledge and collective memory, the conservation and enhancement of which are essential for preserving the cultural identity of the society and the place. On the other hand, despite its heterogeneity, it is often characterized not only by increasing physical, structural and material degradation, but by performance, functional and typological obsolescence which makes it inadequate for new social, economic and environmental needs.

So, in respect of the case by case, it is possible to share an overall methodological vision of the approach to the design process and that this should be duly specified, expanded, deepened and studied according to the different cases.

A key role in the method to be applied is played by the important and essential phase of knowledge of the heritage with the belief that it is itself that dictates the rules of the game of the design process. Integral knowledge of the asset which requires touching with hands, knowing thoroughly and in detail the historical and architectural past of a building made up of continuous transformations of use, changes, demolitions and additions over the course of its life but also and above all know the elements of which it is composed, in terms of structural, material and technological model through an in-depth knowledge of the layers and the non-visible connections of the architecture but which substantiate its constructive feasibility. This whole phase imposes variable times depending on what is still legible and available in the archival documents, in the ancient manuals, the complexity and the role that the building has represented over time.

Only then, taking advantages of an apparatus made up of diagnostic investigations, will it be possible to acquire knowledge and proceed consciously with the project choices.

Fig. 02: Reuse and transformation of existing heritage: schematization of the historical-architectural and functional reading of a building over time (Besana, 2017).

Therefore, in the adoption of sustainable strategies for the reuse and enhancement of cultural heritage, we can glimpse a possible complex solution capable of finding a synthetic answer to the problems previously exposed. Reuse as possible intervention strategy capable of making conservation actions, in respect of the memory of the building, coexist with transformation hypotheses to adapt the changed requirement frameworks with conscious and compatible actions with the existing.

The need to "rebuild a bridge with our history, which modernity has somehow interrupted" (Cucinella, 2022) and project ourselves towards a vision of the future that must be ecosystemic, able to know how to connect knowledge, skills and technologies in a new generation of materials and design.

It is precisely the use of new technologies that is a valid tool for the conservation and enhancement of cultural

Fig. 03: The valorization of rural villages: the case study of Sarzano as a place of sharing and active participation (Bergianti, Besana, 2020).

heritage capable of finding light, reversible, flexible and compatible solutions with the existing building.
The important and fundamental technological question does not refer only to technical-constructive solutions capable of responding adequately to the framework of needs but also and above all to open a debate on the cultural and social impacts of this approach to design. It is an act that asks the designers to operate in favor of an action that does not embalm (Dezzi Bardeschi) the existing but that it is capable of attributing new vital meanings to things, of operating new life cycles to the heritage through the design action. Re-use, re-cycle as a synonym of re-inventing stories and tales, re-finding hidden meanings in the limbs of the architectural object also through courageous actions of cleaning, emptying

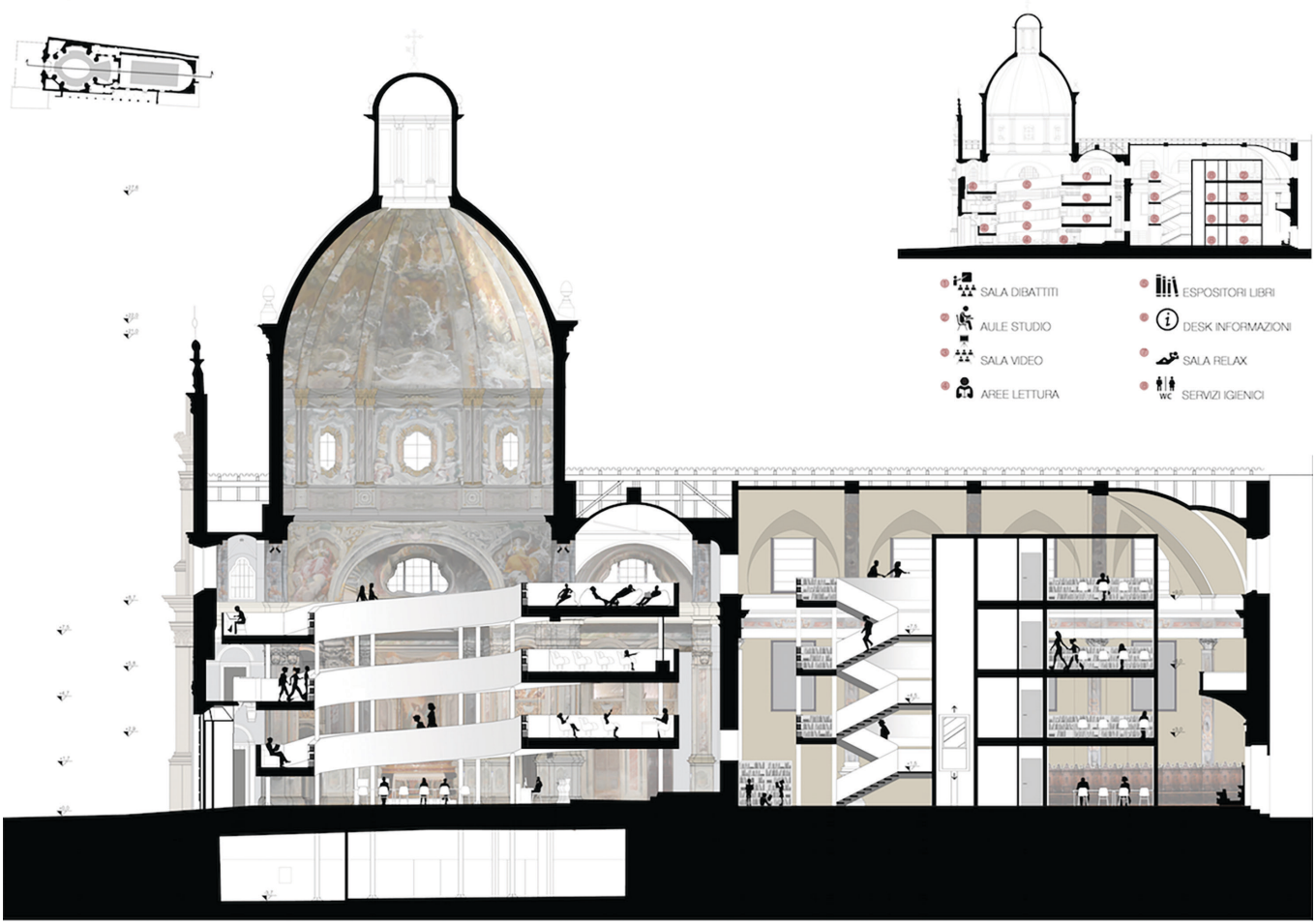

Fig. 04: Recovery of an abandoned ecclesiastical heritage. Proposal for the reuse project of the Church of Santa Caterina in Casale Monferrato in a new cultural center (Matranga & Besana, 2017).

and purifying building. Recycling as an action capable of grafting a new life cycle, a new story through the reinterpretation not only of an architecture but also of its place and territory. Through hypotheses of sustainable reuse it is therefore possible to give architecture new meanings, new uses, new tales and new stories starting from the "waste", from the residual, abandoned or empty places of our cities.
The constraints and contextually the degrees of freedom offered to the designers of the existing building are certainly always different according to the specificity and historical-architectural value of which each building bears. In fact, the existing Cultural Heritage includes within it an extreme heterogeneity of cases, from the monumental asset to the industrial heritage, to the minor asset, to rural one or belonging to modern age, etc. Everyone always imposes different solutions and intervention strategies, which can include intrusion actions inside the building shape in situations with important regulatory, formal or architectural constraints, the preservation of the front, up to solutions that are certainly more legible through external additions placed adjacent, above or hung on the existing factory. Independent of the solution proposed by the designers, in respect of their sensitivity and competence, the methodological approach to the project is constant and the proposed solutions adopt reversible technologies compatible with existing ones through contemporary languages. It is certainly shared that the important and indispensable phase of integral knowledge of the factory has to guide the project solution towards intervention strategies capable of balancing the need framework on the one hand and the memory and identity of the building and its context without distort them. Just the aspect of compatibility between the project requirements and the conservation of the constituent aspects of the existing structure is still an open topic subject to experimentation. The countless examples and case studies that adopt existing reuse strategies also trigger an important valorisation action on the building, not only of the factory itself but also in the more general concept of enhancement of its immediate context and of the impacts of a social nature, as well as environmental and economic, of the intervention. There can therefore be multiple directions, often integrated, towards which to read the existing abandoned or obsolete architectures. Firstly by activating new life cycles, new uses with the aim of continuing the stratification of time that has been interrupted "*Rebuilding instead of building: building above, around, inside, with waste materials; to inhabit the ruin instead of building; re-naturalize rather than re-urbanize*" (Ciorra & Marini, 2017, pp.27) or set up new stories.

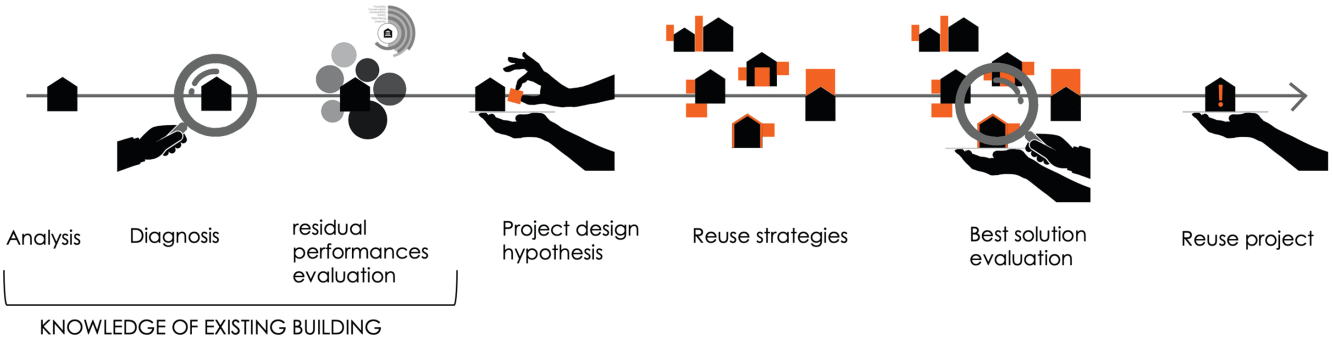

Fig. 05: Scheme of the strategy for the decision-making process for the reuse, recovery and valorisation of cultural heritage (Chiesa, 2021)

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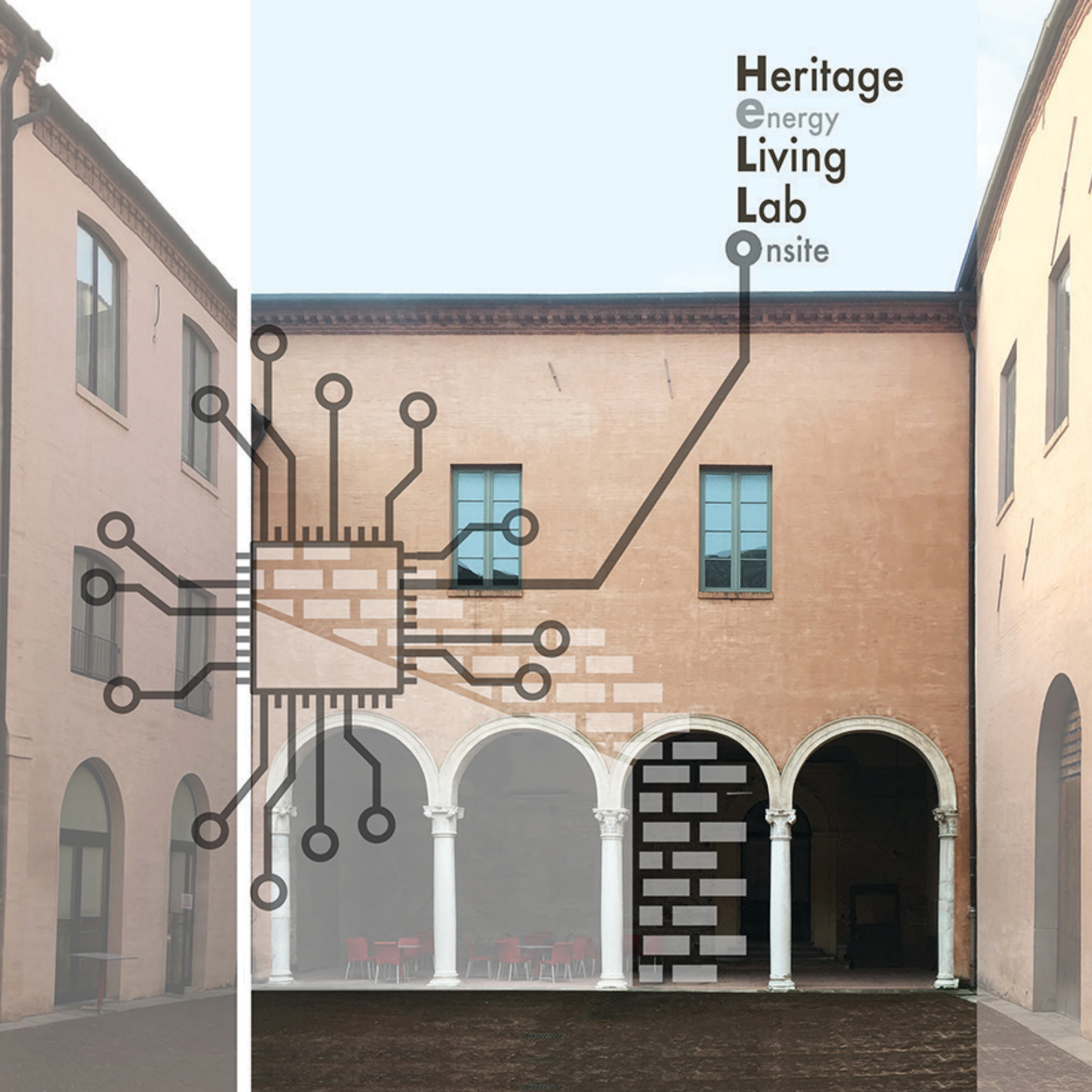
Heritage
energy
Living
Lab
Onsite

The potential of AI in the HeLLo - Heritage energy Living Lab onsite: a brief insight

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University of Coimbra, ADAI-LAETA / ISQ Group - Portugal

Abstract

The HeLLo project, a Marie Skłodowska Curie action, was developed at the University of Ferrara (Italy) with Professors Pietromaria Davoli and Marta Calzolari. It addressed the critical issue of energy refurbishment in heritage buildings, using Palazzo Tassoni Estense, a UNESCO-listed 15th-century building, as a case study. The main research objective was to raise awareness of energy retrofit solutions for historic buildings, emphasizing compatibility and effective dissemination.
A novel in-situ climate chamber was constructed, and a new monitoring system was developed utilizing non-intrusive technologies (NDT) to assess the hygrothermal behaviour of insulation technologies in historic buildings. The resulting technology followed conservation criteria, measuring hygrothermal parameters at different layers. HeLLo also executed an extensive dissemination programme, targeting diverse audiences, for better engagement and knowledge exchange beyond the traditional academic boundaries.
In brief, the research demonstrated the effectiveness of the selected insulation technologies in historic buildings. The dissemination programme was equally successful as various stakeholders were reached, and the collaboration and knowledge transfer between academia, public authorities, enterprises, and the general public were promoted.

Keywords
HeLLo, historic buildings, hygrothermal measurement, dissemination.

An MSCA action

HeLLo stands for Heritage energy Living Lab onsite. HeLLo was a Marie Skłodowska Curie action (Individual Fellowships Standard) that was developed at the University of Ferrara with the supervision of Professor PhD Pietromaria Davoli and PhD Marta Calzolari (European Commission, 2019). "The Marie Skłodowska-Curie Actions fund excellent research and innovation and equip researchers at all stages of their career with new knowledge and skills, through mobility across borders and exposure to different sectors and disciplines" (European Commission, 2023).

How did it all start?
With a lot of brainstorming! After the initial contact with the members at the Host Institution (HI), various themes amongthe researcher and the HI expertise were discussed: what could the fellow learn? What would the fellow bring the HI? What novelties could be brought to the ongoing research?

The application
The application was composed of two main parts: Part A and the Technical Annex. Part A contained the administrative information about the proposal, the researcher, the supervisor and the HI. It was filled out online, on the Participant Portal (PPSS, today called Funding & Tenders Portal); the Technical Annex (Part B1 and B2) containedtechnical-scientific information. It had to be downloaded in Word format, filled out in and further uploaded in the PPSS. It was composed of Part 1 (core of the proposal), and Part 2, which contained the CV of the fellow, the capacities of the ethical aspects.
The abstract of the proposal addressed four main

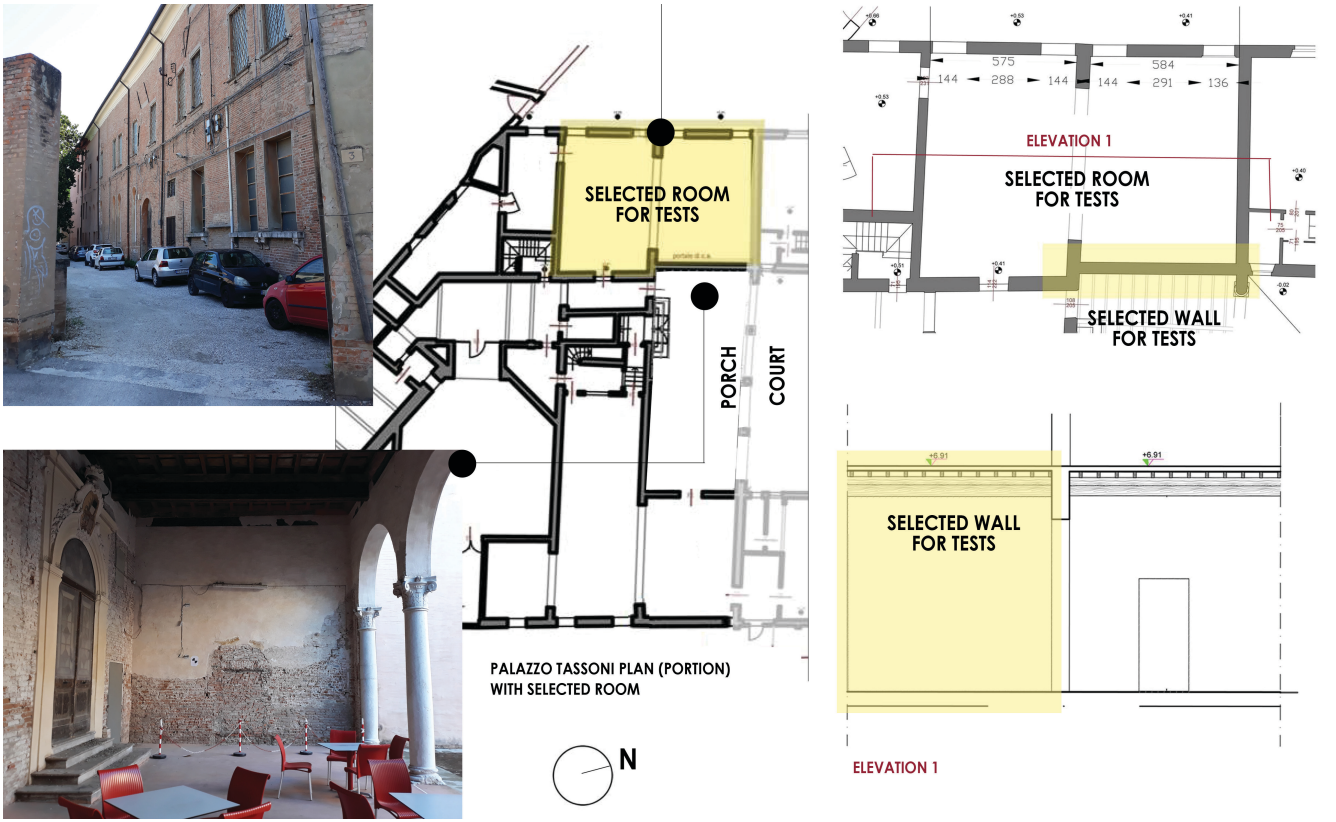

Fig. 01. Palazzo Tassoni Estense: ground floor plan with the identification of the room where the experiment is carried out. Views of the external walls of the selected room: the one on the top left represents the front view from via Cammello, the one on the bottom left is a view of the wall under the porch (selected to be studied). The yellow shape underlines the selected room and the corresponding wall selected for the tests [source: (Andreotti, Bottino-leone, et al., 2020)].

aspects: (i) State of the Art; (ii) Innovative aspects; (iii) Why us and now; (iv) EU return (relevance to the work programme). Here the first paragraph is shared:
"The energy refurbishment of heritage, field of the HeLLo proposal, is a priority of the EU policies to reduce fuel consumption. Historic buildings constitute a great amount of the EU existing stock, whose richness, coupled with a social and cultural value, especially in the Italian context, justifies the fellowship location. However, the lack of specific tools for the intervention on this kind of buildings and the scarcity of data about their energy state-of-the-art, make them mostly excluded from core strategic plans of the Member States, losing a great chance towards a net zero-energy future." (European Commission, 2019)

Research description, what & why

As stated in the abstract, HeLLo was developed within the field of energy refurbishment of heritage buildings, which has been one of the priorities of the EU policies to reduce fuel consumption:

- EU energy strategies stress the importance of retrofitting existing buildings, starting from the recognition of the "exemplary role of public bodies' buildings" (art.5 2012/27/UE);
- 35% of the existing building stock is more than 50 years old;
- low rate of new building construction: 3%.

Theenergy efficiency in existing/ historic buildings (HB) is one of the greatest opportunities towards asustainable future andone way of preserving built heritage for the future is to keep it in use. Rethinking a HB to accommodate new uses, enhances preserving it in the memory of all, avoidingits transformation into a museum, making mandatory their adaptation to today's comfort requests for indoor human activity. The general objective of HeLLo was to spread awareness about the most common energy retrofit solutions and cumulatively increase their knowledge when applied in historic buildings. Two specific objectives were defined:

- to check the compatibility of existing technological solutions (addressed to new buildings) for the energy refurbishment of HB;
- to create a dissemination programme that opened thedoors of the lab to the outside of the academic boundaries.

A two-way strategy was developed: (i) through the creation of an experimental laboratory in which totest these technologies and quantification of real performances; (ii) a programme of 'dissemination laboratories' to live the laboratory.

Where
HeLLo was developed in Palazzo Tassoni Estense, located in Ferrara, Italy. "This 15th century listed building is part of a UNESCO site (UNESCO, 1995) (...). Since 1997, the Palazzo has been the subject of several studies, which resulted in an architecture project and a scientific restoration intervention (Davoli, 2017). The complex of the Palace is located in the NW part of a block, currently housing almost exclusively the Department of Architecture of the University of Ferrara, near the ancient walls of the city" (Andreotti, Calzolari, et al., 2020). The 700 m^3 room and the wall beneath this study were a part of this complex, situated on the ground floor of an unrenovated, vacant space without an HVAC system, Figure 01.

How
When it came to evaluating the hygrothermal behaviour of the historic wall – because of the experiment's sustainability (less energy used or wasted) and operational risks (limited the intervention on the historic structure, which lowered risks and impacts on historical elements), the project team opted through the creation of an in-situ chamber that mimicked the conditions of a smaller room with the original historic wall serving as its external boundary. This in-situ hot-box type (climate chamber) was built

a. b. c. d.

Fig. 02. Box construction during SCHOOLab activity with cstudents [source: (Andreotti, Calzolari, et al., 2020)]

during the 2018 SCHOOLab activity. Here, students in the 2nd year of the Architecture Degree Programme were involved in the construction of the box. The walls were made of small timber elements (platform-frame construction system), composed of OSB panels (18 mm) on each side of a structural wooden beam (section 90 x 90 mm), Figure 02 and Figure 03.
After contact with several industry companies and involving the Heritage Authorities, three insulation materials/ technologies were tested. The sensor distribution of the monitoring system respected Cultural Heritage laws, using non-destructive techniques (NDT): the three proposed systems assured compatibility with the HB features. This study resulted in a noteworthy contribution to the scientific community, as it led to the "Development of a Compatible, Low Cost and High Accurate Conservation Remote Sensing Technology for the Hygrothermal Assessment of Historic Walls" (Lucchi et al., 2019). The achieved sensing technology respected the main conservation criteria: legibility; compatibility; reversibility; and minimal intervention. Two main parameters were measured: Temperature (ºC) and Relative Humidity (%), of the air and at the various surface layers (Figure 4).In the end, the results were also compared with calibrated simulations (Andreotti et al., 2022).

The dissemination Labs

Through a programme of dissemination laboratories, HeLLomadeknown, also out of the academic boundaries, the world of experimentation through the practice of the living lab. Twotwo main groups were targeted: (i) the Scientific community and professionals (e.g. students and/or designers); (ii) the Public authorities (e.g. superintendents and public administrations) and enterprises (e.g.companies in the private sector, end-users). For each group different dissemination tools/labs, time and strategies were foreseen. This programme was composed of:
1) the ONLINELab
In other words, the project website. It was updated with news, videos, photos and upcoming activities' agenda (https://hellomscaproject.eu), Figure 5;
2) the SOCIALab
The social network disclosure: HeLLo Facebook and Instagram pages were created and also served the project dissemination of relatedactivities;

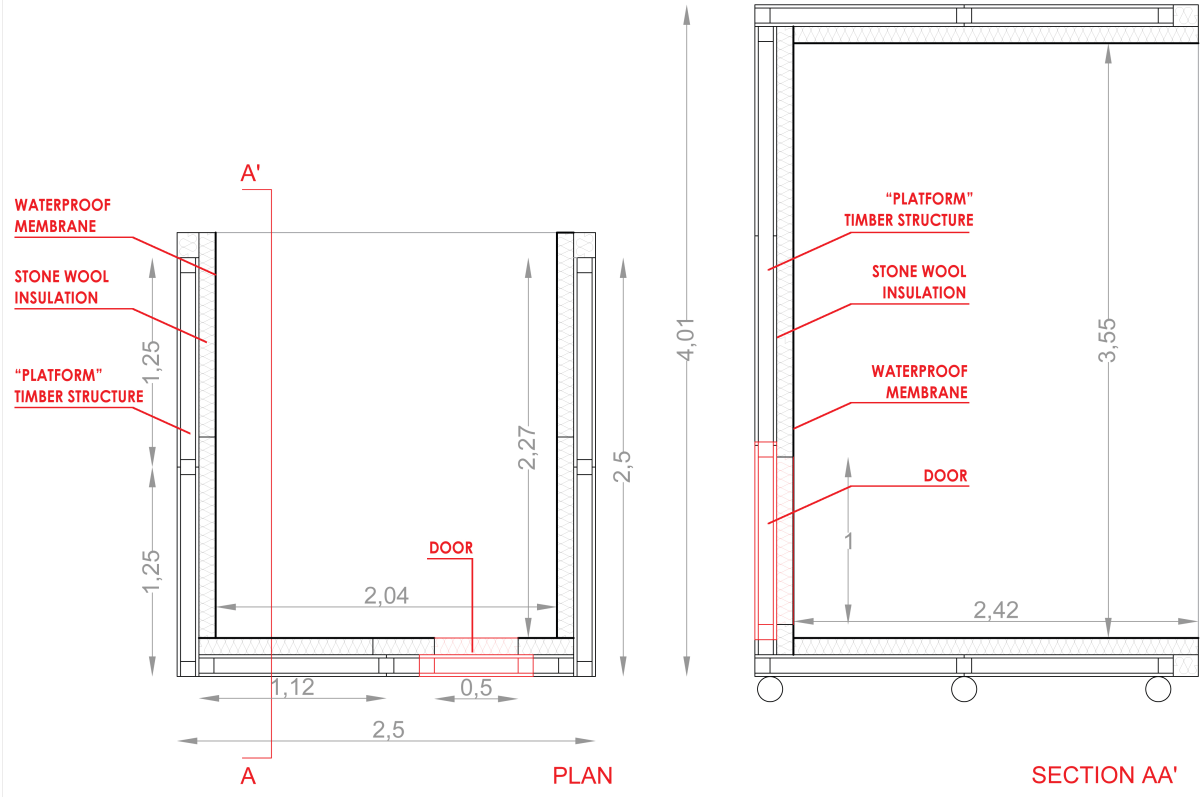

Fig. 03: Above. Drawing of the metering box (horizontal plan and vertical section). Measurements expressed in meters [source: (Andreotti, Calzolari, et al., 2020)]

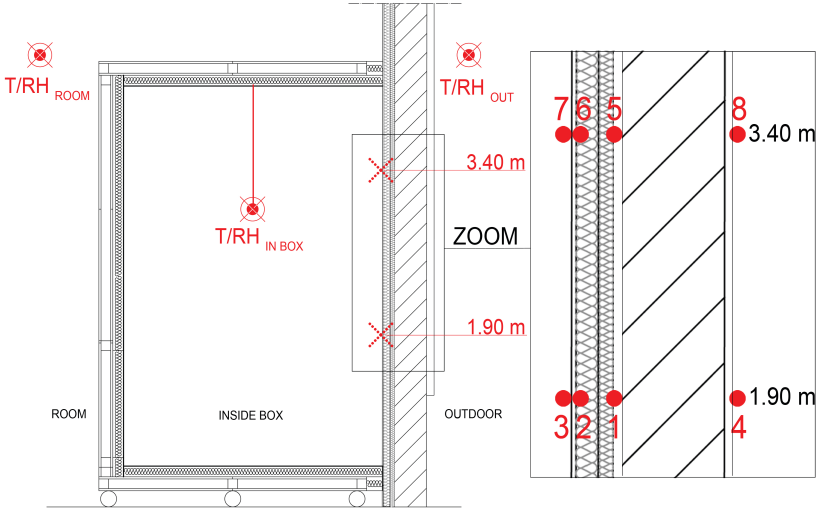

Fig 04: Scheme (vertical section) of the position of the monitoring sensors: (a) environmental conditions (room, inside box, outdoor); (b) wall stratigraphy [source: (Andreotti, Bottino-leone, et al., 2020)]

3) the PRESSLab
The PRESSLab related all press events, e.g., local press releases, articles and papersin journals. E.g. the interview on FILO digital magazine (Venturi, 2019);
4) the PUBLab
The PUBLab was linked with the dissemination of the project results through papersin scientific journals, conference proceedings, and posters. Some outputs can be cited:

- A Poster presented within the "REACH Final Conference. Designing Participation for Cultural Heritage", Pisa2020 (https://www.reach-culture.eu/events/pisafinal-conference/call-for-posters-andvideos);
- An OpenAccess paper published in Electronics by MDPI (May 19): 'Development of a Compatible, Low Cost and High Accurate Conservation Remote Sensing Technology for the Hygrothermal Assessment of Historic Walls' (Lucchi et al., 2019);
- An OpenAccess paper published in Energies by MDPI (June 20): 'Applied Research of the Hygrothermal Behaviour of an Internally Insulated Historic Wall without Vapour Barrier: In Situ Measurements and Dynamic Simulations' (Andreotti, Bottino-leone, et al., 2020).

5) the VIDEOLab
This lab was related to presentations and videos (multimedia content) about the project activities;
6) the CONFLab
Organisation of scientific events as well as the participation in external events withpresentations about the lab's activities.A few events can be listed:

- The Seminar "Energia,riqualificazione e restaurosostenibile del costruito" with in the 2018 edition of the "Settimana della Bioarchitettura e Sostenibilità", organized by the AESS;
- At the "EfS 2019 - 4th Energy forSustainability International Conference – Designing a sustainable future",the fellow chaired the session "Built Environment I",and presented the paper "The HeLLo project: riskanalysis and mitigation strategies" at the session "Built Environment III".

7) the ONSITELab
It included the organization of study tours within the lab for professionals andpeople interested in the field, often organized in association with the CONFLab. One relevant event was the international visit of students andprofessors of theUniversity of Sharjah, UAE. Anothermoment was the organization of the conference "I sistemi per l'isolamento dall' interno nell' architettura storica monumentale: criticità, soluzioni e l'ONSITE Lab tour del progetto HeLLo" at the Department of Architecture of the University of Ferrara.
8) the SCHOOLab
This lab could also be named "construction site school": it embracedthe organization of the fieldwork in the classroom for students and PhDstudents (often in association with the on-site tour and the CONFLAB).
9) the EXHIBITLab
Participation in exhibiting events with presentations about research activities and experimental laboratory testing. One example was the presence at "Scienceis Wonderful!" at the European Research & Innovation Days in Brussels.

Acknowledgements

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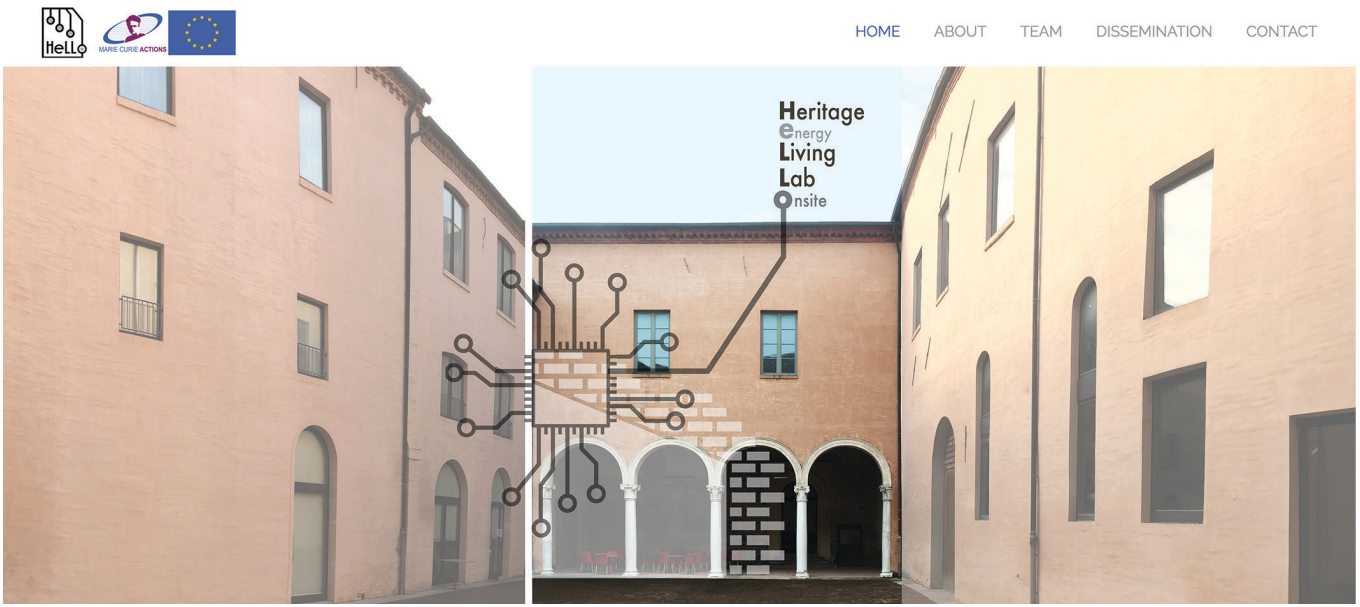

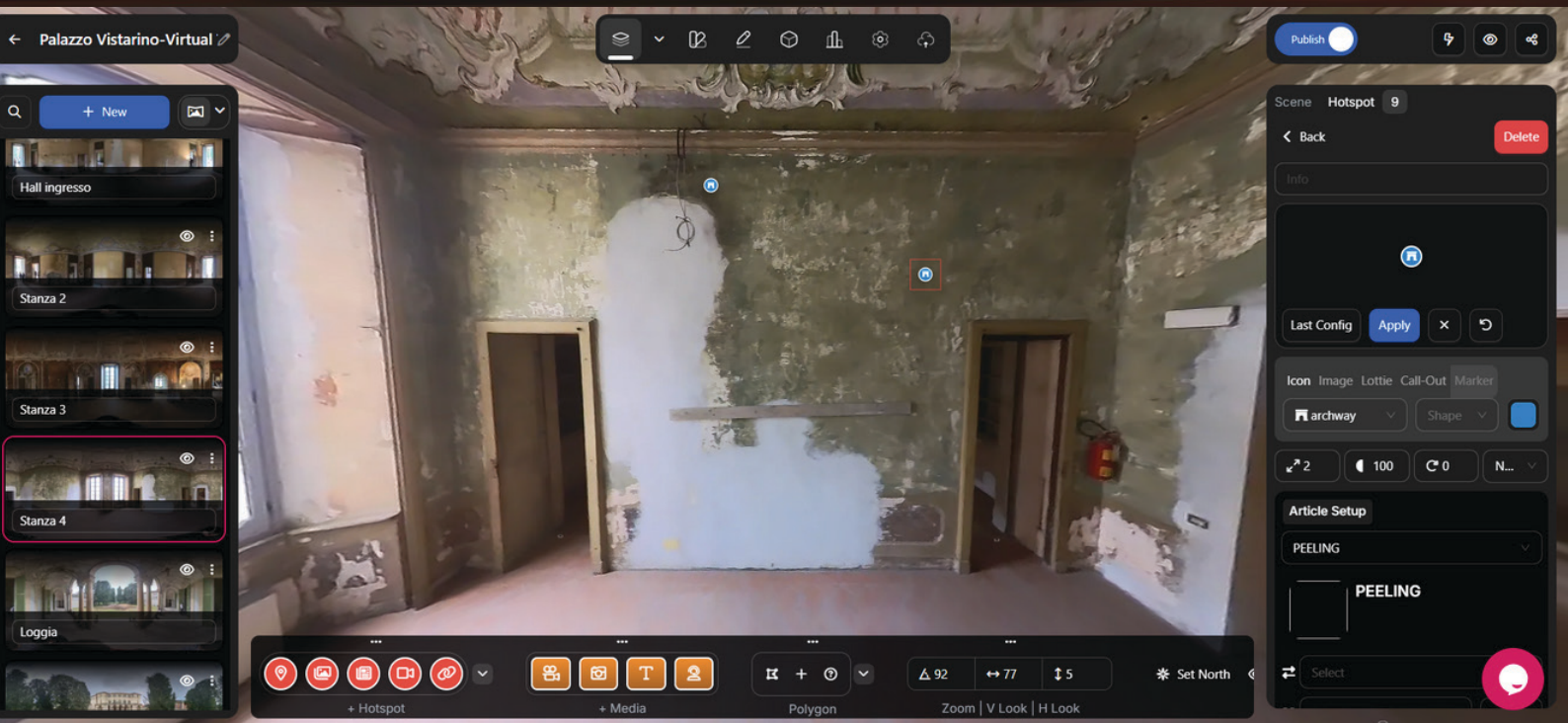
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Immersive technologies for Building Sustainable Reuse: a Virtual Reality-based inspection paradigm

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Abstract

The sustainable reuse of cultural heritage (CH) structures presents a pressing challenge within conservation, engineering, and architectural disciplines. Traditional visual inspection methods often fall short in providing comprehensive and repeatable documentation for degradation diagnostics. Recent advances in immersive technologies, particularly virtual reality (VR) and artificial intelligence (AI), offer innovative approaches to structure monitoring and preservation planning. This paper explores a VR-assisted inspection methodology as a pathway toward sustainable reuse, examining the technical foundations, integration with structural health monitoring (SHM), and the broader implications for conservation strategy, interdisciplinary collaboration, and public engagement. Drawing from an extensive review of recent case studies and the state-of-the-art in digital heritage documentation, the study critically assesses the strengths and limitations of immersive inspection systems and proposes a roadmap for their expanded adoption.

Keywords

Cultural Heritage CH, Virtual Reality VR, Artificial Intelligence AI, SHM, structure monitoring

Introduction

Sustainable reuse of built cultural heritage demands a multidisciplinary approach that balances structural stability and modern usage requirements. Visual inspections serve as the first line of defense against decay but are limited by subjectivity, accessibility, and lack of standardized digital records. The evolution of immersive technologies, including VR, augmented

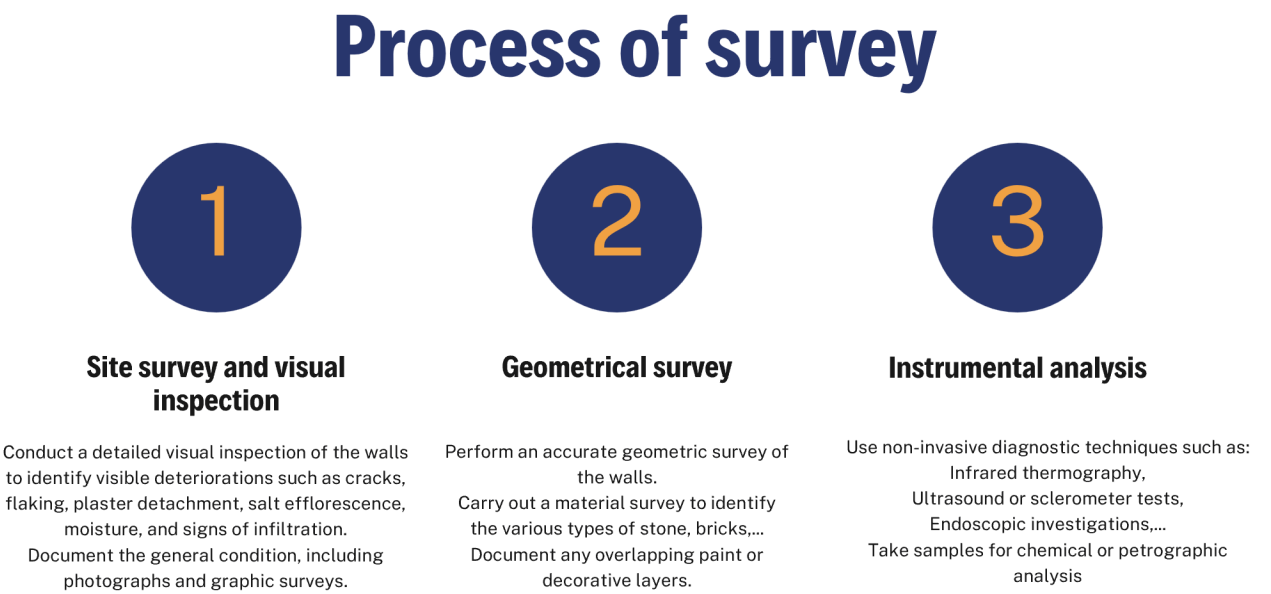
reality (AR), and mixed reality (MR), provides tools to visualize, annotate, and share structural conditions in three-dimensional (3D) space. These tools support the development of a comprehensive digital memory essential for planning restoration and managing decay progression. This study examines immersive inspections as a strategy to support building reuse through more efficient, accurate, and collaborative methodologies.

Background and state of the art

Recent literature highlights the increasing role of digital documentation in heritage management. Mishra and Lourenço (2024) provide a comprehensive review of AI-assisted visual inspection for CH, emphasizing object detection models applied to crack classification and facade deterioration. However, these models remain constrained by dataset limitations and image-based workflows. The integration of immersive environments resolves many of these issues by contextualizing damage in situ and linking visual, spatial, and historical data. Cross-disciplinary applications have demonstrated the potential of VR to support collaborative inspections (Henstrom et al., 2023), automated damage assessment (Mohammadkhorasani et al., 2023), and training programs for engineers and conservators (Vora et al., 2002). Further, the combination of UAV photogrammetry, LiDAR scanning, and structure-from-motion (SfM) workflows enables highly detailed 3D reconstructions that support immersive walkthroughs.

Methodological Framework

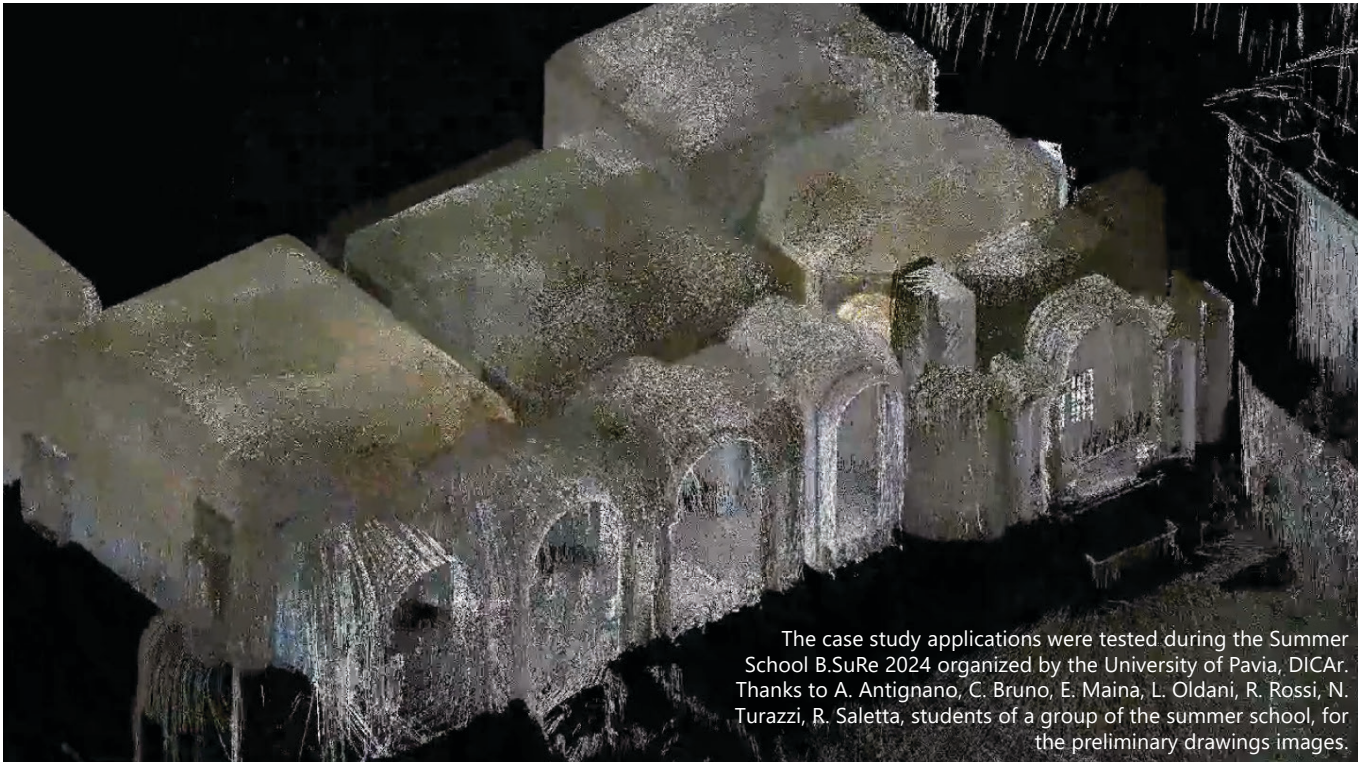
This paper proposes a five-stage methodological framework for implementing VR-assisted inspection digital systems:
Digital Survey and Modeling - Acquisition through



terrestrial laser scanning (TLS), UAV-based photogrammetry, and spherical imaging.
Damage Assessment and Classification - Visual inspections using ICOMOS-ISCS standards to identify decay typologies (Anson-Cartwright et al. 2008).
VR Platform Integration - Importing 3D models into a VR interface with annotated metadata, geotagged deterioration zones, and access-controlled user informative layers.
Interdisciplinary Collaboration - Enabling experts from conservation, engineering, and design to annotate and review conditions in real-time.
Educational and Public Engagement - Deploying virtual tours for awareness, tourism, and heritage education using lightweight platforms.

Immersive Technologies for inspection: case studies and background applications

Numerous studies illustrate the practical benefits of immersive inspections. Liu et al. (2023) combined AR and computer vision (CV) for earthquake related damage assessment. Fabbrocino et al. (2021) developed VR environments to catalog and analyze masonry bridges deterioration for various damage typologies. Mascarenas et al. (2021) used AR for real-time crack measurement and geometry documentation. Additionally, mixed reality systems allow for human-



The case study applications were tested during the Summer School B.SuRe 2024 organized by the University of Pavia, DICAr. Thanks to A. Antignano, C. Bruno, E. Maina, L. Oldani, R. Rossi, N. Turazzi, R. Saletta, students of a group of the summer school, for the preliminary drawings images.

machine collaborative inspection, as demonstrated by Al-Sabbag et al. (2022), where holographic displays visualize spalling, corrosion, and related metadata. These approaches surpass AI-only systems in adaptability and contextual understanding, supporting sustainable reuse by aligning diagnostic precision with long-term monitoring.

Advantages of inspection VR based for reuse planning

Key advantages of VR-assisted inspections include: Reduced Environmental Impact - Fewer on-site visits lower carbon emissions and physical degradation risks. Geospatial Accuracy - Defects are geolocated within the 3D model, enhancing the precision of interventions. Repeatability and Archiving - Inspections are stored for future reference, enabling time-series analyses.
Scalability: Applicable across a wide range of heritage typologies and sizes.
Integration with SHM - Results from NDTs such as IR imaging and ultrasonic testing can be visualized within the same VR environment.

Limitations and Challenges
Despite these benefits, immersive systems face barriers such as the high initial cost; in fact, equipment and skilled labor for scanning, modeling, and VR programming are expensive.
Technical Complexity: Workflow integration requires multidisciplinary coordination and custom software.
Data Management: Large datasets from point clouds and high-resolution textures require optimized storage and cloud-based access.
Limited Real-Time AI Integration: Most systems rely on manual input for damage labeling within VR; automated real-time detection remains experimental.

Toward a sustainable framework for digital built Heritage reuse
A sustainable reuse strategy must consider lifecycle documentation, stakeholder collaboration, and accessible visualization. VR inspections provide a platform to address these goals by:

- Supporting decision-making through immersive diagnostics;
- Facilitating stakeholder engagement through digital storytelling;
- Empowering training and education with interactive modules.

Future developments should integrate generative AI to assist with semantic segmentation of damage, link historical archives with geolocated annotations, and automate early warning alerts based on environmental data (IoT sensors).

Conclusions

The adoption of immersive technologies in building reuse offers a robust framework for sustainable heritage conservation. VR-based inspections empower professionals to collaborate across disciplines, visualize complex decay phenomena, and maintain a living record of structural health condition. Though challenges remain in scalability and automation, the integration of VR with AI, IoT, and Building Information Modelling (BIM) technologies signals a transformative shift in how heritage buildings are assessed, documented, redesigned and revitalized.

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Characteristic	North America	Italy	Denmark	Germany
Origin	1940s	N/A	N/A	N/A
Focus	Functionality, energy management	Cultural heritage preservation	Landlord-tenant dilemma	Reducing emissions
Incentives	Tax credits for retrofitting	Tax benefits after implementation	Green" incentives for landlords	Tax reduction for homeowners
Challenges	Adapting buildings to modern use	Confusing laws, economic viability	Landlord-tenant disagreement	High rental rates
Regulations	US Green Building Council directives	Energy Performance of Building Directive	Danish Housing Act	Energy Saving Ordinance (EnEV)
Market Impact	Retrofit offset system since 2006	Increased demand for retrofitted buildings	Demand for retrofit services	30% retrofits in buildings

The international experience in the urban retrofit policies: the impacts in the real estate market and public governance

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Abstract

The general objective of this article is to parameterize, through the demonstration of international experiences, the application of normative instruments for the readaptation of buildings - called Retrofit - and the main challenges faced. The interdisciplinary approach ranges from the analysis of retrofit as an instrument of sustainability; to the economy, as it evokes a certain independence from the public budget and impact on urban planning. The experiences demonstrated to address the real estate market as it behaved in the face of public retrofit directives, property owners, and the attitude of the Public Sector of the countries that were summarized as the United States of America, Italy, Denmark, and Germany.

Keywords

Real state, retrofit, sustainability, property.

Where and in what context did the term "Retrofit" come from?

The term retrofit appeared in the United States around 1940 (Dixon, 2014) decade, in the context of renovation of existing buildings to readapt the use to the contemporaneity of the time present in the North American urban laws.

In the context in which it emerged, the word was not synonymous with conversion, renovation, or reform, but rather had in its understanding the integration of possibilities caused by legislative apparatuses and urban public infrastructure together with the directives applicable to the private sector, with the public power having the condition to parameterize and control the economically and socially sustainable metrics (in the environmental and urbanistic sense).

The experiences of other cities with the adoption of public retrofit policies are varied. In this article, we will describe in which areas they have been applied and what objectives they have had with the adoption of various counterparts to private property owners.

Fig. 01: Opposite page, retrofit policies across different countries

The North American experience

North American town planning codes have cohesion between them: they aim for the functionality of the city. At the same time, the urgencies of post-modernity demand this practicality of the city and the proper management of environmental energy resources.
To this end, the U.S. Green Building Council is a council whose mission is to transform how buildings are designed, built and how they operate when in use.
The directives established by this council are briefly focused on making the use of these buildings less expensive in energy consumption, reducing water use, and making them independent in the sense of using natural light, rainwater harvesting about equipment derived from the urban infrastructure in which the building is located. In 2009, about five million commercial buildings in the United States occupied 670 million square meters (Lockwood, 2009) of North American territory. And, among all this occupied space, the useful time of these buildings planned at other times differed from the uses required for today, making it possible to apply retrofit measures to save resources and territorial space.
This cohesion makes sense both from an economic, environmental, and urban management point of view: buildings designed and approved by the Government, based on the control of construction licenses and that fit into the North American retrofit term make the dependence on urban infrastructure less evident. From an environmental point of view, there will be less consumption of non-renewable resources, since the building has a clean energy source for the use of electricity for lighting or heating, is properly designed for the local cold or heat, conditions a better indoor air quality and at the same time has its water collection, making independent management of consumption while the emission of polluting agents can also be controlled, as well as waste.
Since 2006, the North American offset system has focused on commercial and residential buildings that apply retrofitting equipment. In 2011(Neuhoff, K.; Stelmakh, K; 2012) the counterpart was set through tax credits - benefits - at 10% of the retrofit equipment's cost. For commercial properties, tax incentives are applied to each square meter that is retrofitted, which, if it incorporates a combination of energy and water use improvements, credits can be achieved for the reduction in each category applied to federal taxes.

The Italian experience[1]

Historic buildings are part of the European landscape. The enjoyment of these assets by tourism and as identity factors of local cultures are some of the mandatory factors contained in the normative instruments of the countries that make up this continent through the protection of these cultural assets.
Buildings account for approximately 40% of Europe's total energy consumption, many of them becoming energy inefficient and technically obsolete. More than 14% (fourteen percent) of existing buildings in Europe were built before 1919 and 12% (twelve percent) between then and 1945 (Bastian, Z.; Troi, A., 2015). Notably, these were buildings erected under the directives and urban planning laws of each era, which did not keep pace with the economic dynamics by which man appropriates the space in which he lives. And, due to the increase in energy consumption in the construction sector and buildings in operation, the European community defined through the directives contained in the Energy Performance of Building Directive 2002/91 / EU, but these were initially not entirely applicable to buildings declared as cultural heritage. However, the International Energy Agency (IEA), in a union of thirteen European countries, including Italy, joined forces in studies for the application of retrofit in historic buildings and were able to list the main barriers to readaptation faced: social, economic, and technical feasibility (Herrera-Avellanosa, D. et all,

2020). Social viability reflects the role of owners of properties classified as cultural heritage or inserted in areas of cultural interest designated by the Government. The motivations of the owners range from improvement of comfort, reduction of costs with consumption of public services (such as energy and water), and improvement of the aesthetics of the facade of the property. And aesthetics was mostly the factor taken into greater consideration by the owners, which highlights the cultural, social, and identity values of these owners. Social barriers include convincing property owners, real estate investors, or construction companies to adopt retrofit measures. Regarding technical issues, the barriers encountered were the very laws protecting these real estate assets, often confusing and inconsistent, which depend on the discretion of the competent public agency.

And as for economic viability, this is highlighted, since the optimization of costs allows to achieve lower overall costs with investment, maintenance, and operation until the end of the useful life of the construction. As well as, the implementation of financing for these reforms or the adoption of financial policies to encourage retrofitting.

The retrofitting of buildings in Italy ranges from the installation of energy consumption improvements, and structural reform to avoid the loss of these buildings of cultural value in the event of natural disasters such as earthquakes, to the improvement of use and comfort for today's way of life.

The Italian real estate market for buildings with retrofit measures or renovations experienced a 66% increase in demand from 2006 to 2013 (Cantatore, E.; De Fino, M.; Fatiguso, F, 2015). Most of the properties that have been retrofitted were residential buildings that were built before the Italian energy consumption regulations of 1976. Claims for tax benefits in 2009 alone (Neuhoff, K.; Stelmakh, K., 2012) amounted to about two hundred and forty thousand requests, which could be realized after the retrofit measures were implemented.

The experience of Denmark

The main problem with the implementation of retrofit measures in old buildings is the dilemma between landlord and tenant in Denmark (Ástmarsson, B.; Jensen, P.; MASLESA, E., 2013). In this country, approximately 46% of residential properties are rented (Winther, P., 2020).

It is the tenant who uses the property and pays for the energy consumption. And, as the landlord (owner) does not use the property, the benefits visualized by him are not so attractive to invest in the readaptation of his property for energy efficiency to reduce energy costs. Although such functional improvement of the building is indirectly supported by the tenant since he pays monthly rent for the use of the property, it is this reasoning that is used by the owners to increase the rental value of the property.

The tenant has the intention to reduce the cost of energy use, while the landlord does not want to invest in energy efficiency, since he will not use it. However, the energy use caused by the building is conditioned by the structure of the building and how it is used, which we refer to as the form of operation. Danish legislation on the rental of buildings provides that the general maintenance of the building is the task of the owner. Whether a financial incentive measure or other legislative apparatus could make the issue solvable is what experts say. Another solution put forward is a lease agreement, called "green leases", in which landlord and tenant make an agreement to lower the cost of electricity and water consumption, in which the tenant agrees in advance to pay more expensive rent for a while, to indirectly finance this investment and get the benefits of the low financial cost.

This factor, although it seems symptomatic, also reflects the demand for retrofit services to the real estate market and the services it adds. Added to this, is the absence of financing incentives from the public authorities to implement these devices. And it is these deficiencies that cause repercussions on

the increase in the use of public energy services for the public sector, and thus, of environmental resources, generating macroeconomic aspects in the combination of these issues.
The mismatch in the insistence on the consumption of energy derived from non-renewable resources, such as oil, has stimulated public authorities to adopt increased taxation on the use of non-clean energy services. In contrast, the adoption of renewable energy building equipment experiences lower tax rates.
In 2020, the Danish Housing Act adopted "green" incentives for landlords who rent out properties that have not yet been retrofitted, and upon verified retrofitting if a certain degree of energy efficiency is achieved, grant tax incentives.

Germany's experience

Germany uses almost a third of its energy supply for residential buildings, mainly for heating. In 2007, for example, less than 30% of building retrofits were implemented in buildings constructed between 1900 and 1979 on German territory (Achtnicht, M.; Madlener, R., 2012). Consumption of non-renewable energy such as fuel oil or natural gas is still prevalent in Germany.
The country has adopted a policy to reduce greenhouse gas emissions by 80% by 2050 compared to 1990 levels. The average heating energy consumption per household in Germany has fallen by about 20% since 1990, due to the replacement of old dwellings with new ones. Of residential buildings, 12.5% were built in 1990 under the auspices of sparsely measured urban planning legislation in 1995, which was only renewed and became mandatory in 2002.
The standards to be followed by buildings are present in the Energy Conservation Law which was based on the Energy Performance of Buildings Directive of the European Union Parliament, already mentioned above. This law also introduces a zero-energy standard for new buildings. The directive is mandatory for buildings owned by public authorities from 2019 and for all other buildings from 2021.
The Energy Saving Ordinance[2] know as EnEV - Energieeinsparverordnung - has also been in force since 2009. It has applications for buildings in the use of energy for thermal issues and equipment in the building, installed for heating, cooling, air conditioning and lighting technology, and hot water supply. Adoption by German urban planning legislation and compliance by German property owners is measured every year through a report by the Federal Ministry of Housing (Bundesministerium für Verkehr, Bau und Stadtentwicklung - BMVBS) to estimate the effects of federal subsidies for energy retrofit projects.
The funding is provided by the German Development Bank (Kreditanstalt für Wiederaufbauung-KfW) and is granted for approved projects with an energy performance below the standards set by the Green Economy Ordinance (Energieeinsparverordnung - EnEV), as well as not only for partial retrofits of the building but for the entire building. The public retrofit policy is applicable throughout the country, mandatory in nature, and voluntary in other respects with the adoption of compliance of buildings in perspective and performance levels.
The social issues of who directly benefits from retrofitting for energy efficiency that we have presented from Denmark, occur similarly in Germany. More than half of the buildings in residential use were rented, according to 2015 data (Weber, I.; Wolff, A. 2018). To facilitate the adoption of retrofit measures, the German Rental Property Act allows the landlord to allocate 11% of the retrofit costs to the annual rent of the property according to the German Civil Code[3]. Thus, landlords allocate a maximum of 11% of the rent until the rent is equal to the local index value. Even with the adoption of these legislative measures, landlords had no other financial incentive until 2020. In any case, with the completion of the renovation

of the building and the attestation by the public authority that the adoption of energy retrofitting equipment has been met, the intention is to adopt the claim for tax incentives by the owners of the properties, which have proved to be very fruitful when adopted in Italy.

From January 2020, homeowners who have installed measures to improve their heating systems and use renewable energy will receive certain benefits. The so-called German Income Tax Act (Einkommensteuergesetz (EStG)) in its § 35c provides for a tax reduction for energy measures in buildings used for own residential purposes[4].

Up to 20% of the costs for retrofitting measures (up to a maximum of EUR 40,000 per residential property) can be deducted from the annual income tax return for three years, and the requirement is that the building must be at least ten years old. In addition, the owner can either adopt the measures already described of financing through the Development Bank (Kfw) or choose tax incentives, which present the option of the cost of retrofit measures being deductible in his income tax return for the base year 2020.

And how does the owner prove the expenses implemented to be entitled to the tax incentive? The adoption of the building retrofit measure is certified by companies specialized in the sector, and able to do retrofit projects for buildings. This certificate, attached to the income tax return, makes it possible to grant the benefit.

This measure demonstrates that, due to the low uptake by owners of the German government's financing options, a change in attitude towards using tax incentives and granting tax benefits has taken place, but because it is so recent, we are unable to parameterize it adequately in this article.

Using tax incentives has been a measure applied by the United States and Italy, as we have shown in this article, which has received significant uptake by property owners and has boosted the construction market and indirect real estate services in these countries.

Conclusions

Given the international experience exemplified in this article, we can conclude that the motivations for the application of the Retrofit policy are based on the sustainability of buildings or on reducing dependence on public services and urban infrastructure equipment.

Many policies have used tax breaks to nudge the population to adopt the policy more quickly. In some countries, such a measure is still being evaluated, as in Germany, which with the right methodology, we plan to produce a future article on the topic.

Retrofit initiatives are still being implemented in countries that are undergoing increasing urban development such as Brazil, which has a recent policy in the city of São Paulo.

Note

1. This subtopic came from another publication that was produced by the author of this work. To comprehend the Italian experience fully, you can access the publication: SCHWENDLER, A. (2023) The private property qualified as cultural heritage: the legal framework in Italy and the sustainable enforces through the retrofit. In RASTROLLO, J. Cities and communities across Europe: governance design for a sustainable future. Spain: Arazandi, 2023, 281 pp., ISBN 9788411249836

2. Gebäudeenergiegesetz (GEG) Artikel 1 G. v. 08.08.2020 BGBl. I S. 1728

3. § 559 from German Civil Code (BGB).

4. Income Tax Act (EStG). § 35c Tax reduction for energy measures in buildings used for own residential purposes. (1) For energy measures in a building located in the European Union or the European Economic Area and used for own residential purposes (beneficiary property), the collectively agreed income tax is reduced upon request, reduced by the other tax reductions, in the calendar year in which the energetic measure was completed and in the next calendar year by 7 percent of the taxpayer's expenses, but not more than EUR 14,000 each, and in the following year by 6 percent of the taxpayer's expenses, but not more than EUR 12,000 for the beneficiary property. The prerequisite is that the beneficiary property is more than ten years old at the time of the realization of the energy measure; The start of production is decisive for this. The energy measures within the meaning of sentence 1 are: 1 Thermal insulation of walls, 2 Thermal insulation of roof surfaces, 3 Thermal insulation of floor slabs, 4 Renovation of external windows or doors, 5 Renewal or installation of a ventilation system, 6º Renewal of the heating system, 7º Installation of digital systems for energy operation and consumption optimization and 8º. Optimization of existing heating systems if they are more than two years old. Expenditure on energy measures also includes the costs of issuing the certificate in accordance with sentence 7 as well as the costs of energy consultants qualified by the Federal Office of Economics and Export Control (BAFA) for the funding program "Energy advice for residential buildings (on-site advice, individual renovation schedule)". "are allowed if the energy consultant was engaged by the taxpayer with the support of planning or supervision of the energy measures according to with sentence 3; the collectively agreed income tax is reduced, in contrast to sentence 1, by 50 percent of the expenses of the energy consultant. The funding can be used for several individual measures in one beneficiary property; The maximum amount of tax reduction for each beneficiary property is 40,000 euros. The prerequisite for the funding is that the respective energy action has been carried out by a specialist company and that the requirements of the statutory decree pursuant to paragraph 7 are met. Tax reductions can only be claimed if a certificate issued by the specialist company carrying out the work according to an officially prescribed sample proves that the prerequisites of sentences 1 to 3 and the requirements of the statutory decree pursuant to paragraph 7 have been met in terms of reason and value.
(2) The tax reduction pursuant to paragraph 1 may only be claimed if the taxpayer uses the property exclusively for own residential purposes in the respective calendar year. Use for own residential purposes also exists if parts of an apartment used for own residential purposes are given to other persons for residential purposes free of charge.
(3) The taxpayer may not benefit from the tax reduction according to paragraph (1) if the expenses have been taken into account as business expenses, commercial expenses, special expenses or extraordinary charges. The tax reduction according to paragraph 1 shall also not be granted if a tax reduction according to § 10f or a tax reduction according to § 35a is used for the energy measures or if it is a public financing measure for which low-interest loans or tax-exempt grants are used to be taken.
(4) The prerequisite for using the tax reduction for energy measures is that 1 the taxpayer has received an expense invoice, which states the eligible energy measures, the work carried out by the specialist company and the address of the beneficiary property, and which is written in German and 2 the payment was made on behalf of the service provider.
(5) Paragraphs 1 to 4 apply accordingly to parts of buildings that are independent immovable property and to condominiums.
(6) If the ownership of the recipient property belongs to more than one person, tax reductions according to paragraph 1 may only be claimed once for the recipient property. The expenses underlying the tax reduction according to paragraph 1 may be determined uniformly and separately. The provisions applicable to the separate determination of income pursuant to Section 180 (1) no.2a of the Tax Code shall apply accordingly.

(7) The Federal Government is authorized to determine the minimum requirements for energy measures pursuant to paragraph 1 sentence 3 as well as the requirements for a specialist company pursuant to paragraph 1 sentence 6 by means of an ordinance with the consent of the Bundestag and the Bundesrat. The original text in german language: Einkommensteuergesetz (EStG)

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Sustainable strategies to design and regenerate University spaces

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Abstract

The University of Pavia was established in 1361 and during the last 662 years the history and the development of the town is strongly linked to the destiny of the University. Nowadays the Academic Community is about 29.000 persons (26.500 students and 2.500 professors, administrative staff and technicians) in a town of 70.000 inhabitants. Moreover, in Pavia there are also 17 Colleges (11 public and 6 private) that host 2.500 students coming from different regions and countries and 4 canteens.

The University Governance's approach to the building heritage is based on a largescale and systemic vision that takes into consideration all areas and buildings.

The planning and design activities described in the paper, are therefore oriented towards the enhancement of the available heritage (especially of the buildings in the Historic Centre) and the construction of innovative and sustainable buildings, according to a unitary approach which has the regeneration of real areas of the city as its ultimate goal. The projects that the University is developing are aimed to:

- ensure adequate, comfortable and safe environments;
- ensure functionality;
- optimize management and maintenance;
- encourage collaborative interaction.

It has also to be remembered that the academic life is characterized by dynamism and by some factors of variability; the paper describes how the University of Pavia is facing these challenges.

Keywords

University Buildings, Research Buildings, Sustainability, Reuse, Urban regeneration.

Introduction

The University of Pavia was formally established in 1361, when imperial vicar Galeazzo II Visconti asked Carlo IV, the Bohemian king and Emperor of the Holy Roman Emperor, to found the Studium Generale, which had the same rights and dignity of the University in Bologna, Paris, Orleans, Montpellier and Oxford.

Fig. 01: The buildings of the University in Pavia (by Alessandro Greco and Francesca Pelini). The differences are between heritage built before 1900; building realized between 1900 and 1975; buildings after the 1975; blue: colleges

During the last seven Century, the University and its students have had a big impact on the urban structure and evolution, especially in the last 90 years, when a part of the University and the main Hospital (Policlinico San Matteo) left the city center to move in the north-western part of the town, creating a scientific campus (the University realized buildings for Physics, Chemistry and Pharmacy). This process increased in the Seventies of the last century when the University asked to Giancarlo De Carlo to improve a project for its development. The result was a masterplan organized in "Hubs": central hubs, intermediate hubs and outlying hubs, depending on the interaction with the urban and social environment. Moreover, De Carlo designed a new Campus for the scientific disciplines further north-west than the one realized in the Thirties: Campus Cravino (where the Faculty of Engineering, Natural Sciences, Mathematic and some Departments of the Faculty of Medicine have a new home).
The first buildings of this Campus (realized between 1985 and 1992) respected the De Carlo's idea of a modular construction, able to increase respecting a grid defined by the vertical connections, but later in the Nineties and at the beginning of the Third Century the University of Pavia abandoned this masterplan gradually. For several years the University's achievements were sporadic, carried out thanks to its own resources or the ability to obtain funding from Institutions but without the support of a structural ministerial program.
Then in 2019 and in 2021, finally, the Ministry of University and Research published two different Ministerial order (n. 1121, December 2019 Fondo investimenti edilizia universitaria 2019-2033 and then n. 1274, December 2021 Criteri di riparto del fondo investimenti 2021-2035, destinato al cofinanziamento di programmi d'intervento di ammodernamento strutturale e tecnologico presentati dalle Istituzioni universitarie statali) which allowed financing for more than 1.8 billion euros (400 million in 2019, more than 1.400 million in 2021) to Universities capable of presenting projects already underway or which quickly led to the opening of construction sites.
Moreover, the PNRR (National Recovery and Resilience Plan) and several ministerial decrees, which in recent years have reserved funds for the adaptation of learning buildings both from the point of view of fire safety (i.e. DM n. 455, May 2023) and of the accessibility and removal of architectural and sensorial barriers (DM n. 752, June 2021), offered the Universities the chance to develop a program both to increase the quality of their building and to restore the existing heritage. The University of Pavia, thanks to these different opportunities, is now developing a program of more than 200 million euros concerning the full academic community.

Pavia as a City Campus

Nowadays the University of Pavia is organized in 18 Departments, with more than 90 Courses (Bachelors, Masters, Ph.D) with an academic community of more than 29.000 persons (26.500 students, more than 2.500 professors and researchers, technical and administrative staff).
The 53 buildings of the University are located in three different Campus:

- Historic Centre (10 buildings), where the Humanistic Departments are placed and there are also some of the most representative buildings (Museums, Libraries, Rector's Office);
- Istituti Universitari (24 buildings), at the north-west side of the city center, between the railway line and the highway, with buildings realized between 1930 and 1980 hosting some Scientific and Medicine Departments and a big area for sports and leasure;
- Campus Cravino (19 buildings), in the north-west side of the city center but beyond the highway, entirely built after 1980, hosting other Scientific and Medicine Departments and big area for sports.

Overall, the University manages about 250,000 square meters to which significant green areas must be added including a forest (Bosco Negri, 20 hectares) a few kilometers from Pavia.
Additionally, there are 12 Public Colleges and 5 Private Colleges that offer more than 2,500 beds for students coming from different regions and countries; in these structures there are cultural activities and courses that are additional to the academic courses, offering the students the chance to improve their skills.
Thanks to the financing possibilities mentioned above, the University of Pavia decided to develop three different strategies for its three Campus: conservation and valorization of the historical buildings in the city center, urban regeneration and innovation for the Istituti Universitari and efficiency and upgrading of safety conditions for the Campus Cravino. However, these three different approaches are developed in a coordinated way and considering the repercussions that each choice has on the entire built heritage, because the academic activities (research, didactic and third mission, the activities through which the university interacts with its community) are continuous and dynamic.

Conservation and valorization of the historical Heritage

The approach to the building heritage is based on a systemic vision that takes into consideration all areas and buildings, with the awareness that a multidisciplinary University (with a vocation for internationalization) must have buildings and spaces

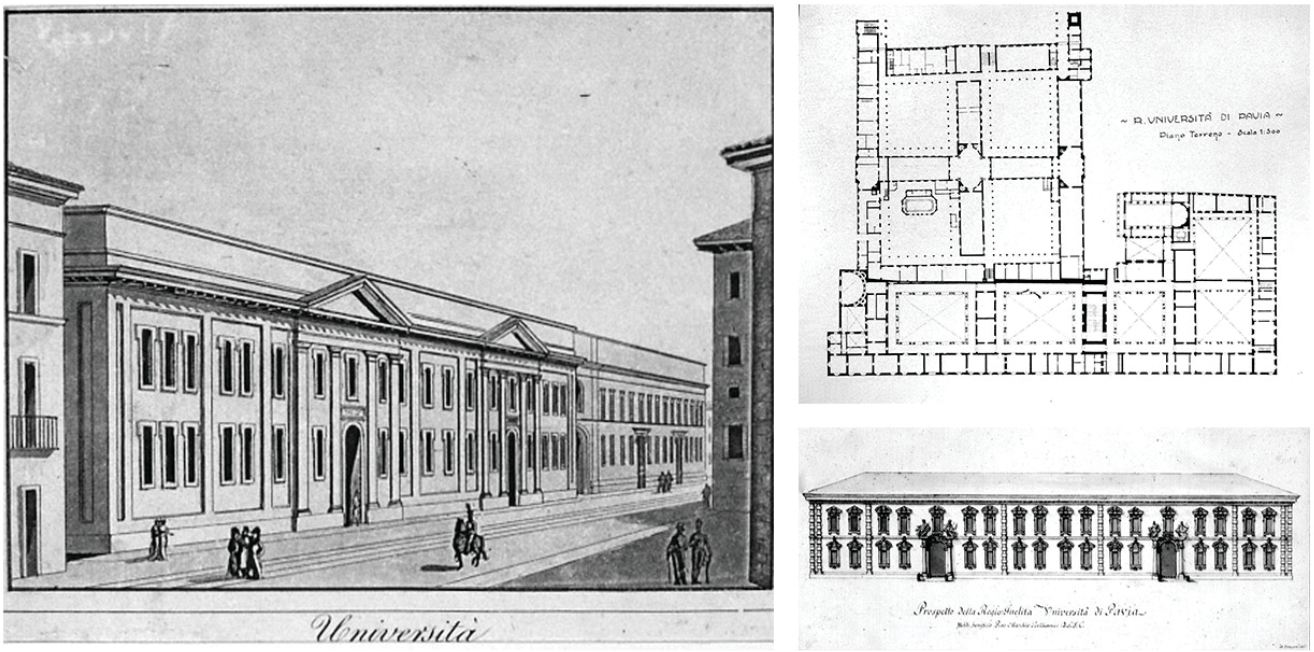

Fig. 02: Front and floor plan of the 1945 historic building complex in the centre of Pavia. Below, design proposal of the front on Strada Nuova never realised (Archive of the Pavia Civic Museums, in doi.org/10.3280/oa-548.142).

where research and quality teaching can take place.
The first goal is to improve the quality of the environment, taking care of the buildings in every way, from the safety (considering fire and seismic topic) to the accessibility and usability; every project is developed not only considering the single building but all the 10 buildings of the Historic Center, because the needs of the Humanistic Disciplines are the same.
The projects for San Tommaso (Department of Human Sciences), San Felice (Department of Economics and Management), Palazzo Centrale (where there are the Departments of Law and Political Sciences together with the Rector's Office and some of the most beautiful historical Halls) have been worked out preserving and enhancing the historical layout of the buildings, eliminating outbuildings, introducing solutions for overcoming architectural and sensorial barriers, increasing the plant equipment for safety and comfort and trying to increase the spaces for teaching in a weightily built context.
Sometimes departments have occupied spaces not originally assigned to them; this happened to satisfy the needs of new research groups or to exploit occasional funding for research activities. The interventions are therefore also aimed at rationalizing their use, bringing closer the groups of the same Department.

Fig. 03: Palazzo San Felice, Department of Economics and Management (by Alessandro Greco).

Fig. 04: Campus della Salute, Faculty of Medicine (by Alessandro Greco).

Regeneration and innovation of Istituti Universitari

The Istituti Universitari Area is subject of the most ambitious urban regeneration operation undertaken by the University on its Campus. In this context, interventions to adapt the built fabric to the new teaching and research needs alternate with new buildings which will also allow a renewal of the University's image. Campus della Salute (Faculty of Medicine), the new Studying Hall and Scientific Library and the improving of the green area to facilitate the urban water permeation and to mitigate the climate change of the Istituti Medico-Biologici fully express the University's attention to that part of the buildings which deserves to be redeveloped and adapted to the needs of academic life: each intervention is based on construction and system choices aimed at limiting energy consumption and respecting the environment and comfort of users. On the other hand, when the investigations and studies conducted on the needs of the Dep. of Chemistry and of Pharmaceutical Science demonstrated the complete inadequacy of the structures that host them, the University began the design and construction of new buildings, inspired by flexibility, transformability and environmental sustainability principles. A first building (3,400 square meters for didactic laboratories) has already been built and a second one (21,000 square meters for the research laboratories and the offices of the two Departments

Fig. 05: The new building for the didactic laboratories of the Department of Pharmaceutical Science (by Alessandro Greco).

and with halls for lessons) is in the design process. Once completed, it will be possible to proceed with selective demolition which will free the area from obsolete buildings and allow the creation of equipped green spaces open to the entire community.

Efficiency and upgrading of Campus Cravino

The Campus Cravino is characterized by buildings realized in the last 40 years; they are still able to satisfy the needs of the academic community because they have already been inspired by principles of adaptability and transformability. The interventions were therefore aimed at the regular maintenance and to improve comfort conditions (replacing dated systems with new plants directed at energy saving and ease of management and maintenance, renewing the classroom furnishings and research equipment) and safety (to fully respond to the new regulations). These projects are aimed to ensure adequate, comfortable and safe environments for the academic community; to guarantee functionality accompanied by a rationalization of their use, improving research and learning processes; to optimize management and maintenance, making use of renewable and sustainable energy sources.

Fig. 06: The intervention on the roof of the Faculty of Engineering (by Alessandro Greco)

Structuring shared digital repositories and strategies for urban and landscape census

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Abstract

In the digital age, the methods and techniques for managing documents and tools for analyzing and understanding a place have increased, as has the amount of data that can be acquired in a given time frame. This takes on particular relevance when dealing with representations at territorial scale, which involve a necessarily multidisciplinary approach. The structuring and use of collaborative digital repositories, organized and usable for different levels and by different categories of users, is configured as a fundamental step (and continuum) to ensure control, verification and validation of the entire research operation. This contribution deals with the topic of large-scale digital data census, cataloging and sharing, trying to synthesize methods, technologies and results of two international research projects, 3DBETHLEHM and H2O MAP. Both projects have been an opportunity to test and systematize collaborative digital repositories that can be used by teams that are broad and heterogeneous in cultural background, with constant comparison between academies, schools, businesses, associations and administrations. The goal is to understand if and how technological advancement in the development of such systems can significantly facilitate and speed up the work of research and scientific dissemination, while still keeping the role of the operator central in the design and verification of data.

Keywords

collaborative repositories, territorial scale, digital data census, 3DBETHLEHM, H2O MAP.

Introduction

A project for documentation and reuse at the urban or landscape scale, from its ideation to the achievement of its goals, follows a precise structure and methodological organization. These guide the research activities and are reflected in the cataloging, preservation and updating of the data acquired and processed. In this sense, archiving processes

Opposite page: 3D model of the city of Bethlehem digitally built during the project "3D Bethlehem" by the research team of the laboratories DAda-LAB and PLAY

constitute a fundamental aspect not only for the development of research, but also for the future sharing of methodologies and achieved results (Audisio, 2011).
In the digital age, along with the types of projects possible, the methods and techniques available for managing documents and tools for analyzing and understanding a place have also increased, as has the amount of data that can be acquired in a given time frame. This aspect takes on particular relevance when dealing with representations at the spatial scale, which involve a necessarily multidisciplinary approach. In the study of a landscape or city, in fact, reference must be made to the historical, geometric, morphological, conservation, economic and social aspects that have defined over time the specific condition to be investigated. The structuring and use of collaborative digital repositories, organized and usable for different levels and by various categories of users, is configured as a fundamental step (and continuum) to ensure control, verification and validation of the entire research operation. (De Marco, 2017). However, the speed of progress, coupled with decreasing costs and in some cases simplifying processes, related to technology and network sharing, should not generate the illusion of increased ease of management of the archiving phase. In fact, counterbalancing the benefits brought by technology are the new challenges it poses. Particularly relevant among these are the necessary ongoing effort that must be made to ensure the accessibility of data over time, combating technological obsolescence, and a management capacity (economic, personnel, and hardware and software) to ensure the operation of computer services that are always up-to-date and upgradeable (Bogdani, 2016). Addressing and overcoming these challenges may in some cases mean the preservation and communication, through digital, of a Cultural Heritage that no longer exists and is therefore otherwise lost. This is why the construction, maintenance and development (in terms of connections and modes of use) of a digital repository, or even better a digital archive (Guercio, 2008), is a topic that animates academic debates, seeking insights, experimentation and resolutions. A digital repository is a virtual warehouse (Sisto, 2020), constrained by well-defined rules of access, uploading, sharing, and data use, where digital resources, information, and documents of different nature and format, as well as data related to their use, can be stored. It is precisely the variety of formats, on the one hand, that is an undoubted asset for the researcher to make use of, not least because moving from one format to another (from text, to photographs, to three-dimensional models) within the same container makes the repositories dynamic. Moving around in digital storage thus allows for a significant increase in the relationships between content and facilitates the researcher in making connections between the information available. At the same time, this fluidity also presents a difficulty for organizing the archive over time. Questions therefore arise, for example, as to what is the most effective way of cataloging and managing interrelated information, or what discretizations and choices need to be made in loading, searching for data, and its current or future use (Feliciati et al., 2018).

Two international case studies

During the past three years, two international research projects in particular, on the topic of documentation and digital census of the built heritage at urban and landscape scales, have been an opportunity to experiment and systematize collaborative digital repositories. Both projects, 3DBETHLEHM and H2O MAP, involved large and heterogeneous teams, with constant confrontation between academies, schools, businesses, associations, and administrations. The different cultural backgrounds, as well as the various skills of the actors involved, made the communication

and data organization and sharing aspect central to achieving the goals. The construction of the online digital repository represented a continuum of projects, from initial design, to accessibility and sharing policies, to data uploading and updating, to changes (of platform and storage structure) functional for use, to the need to maintain the repository over time . In fact, the availability of the contained data, whether simple or integrated with each other and in any case of completely

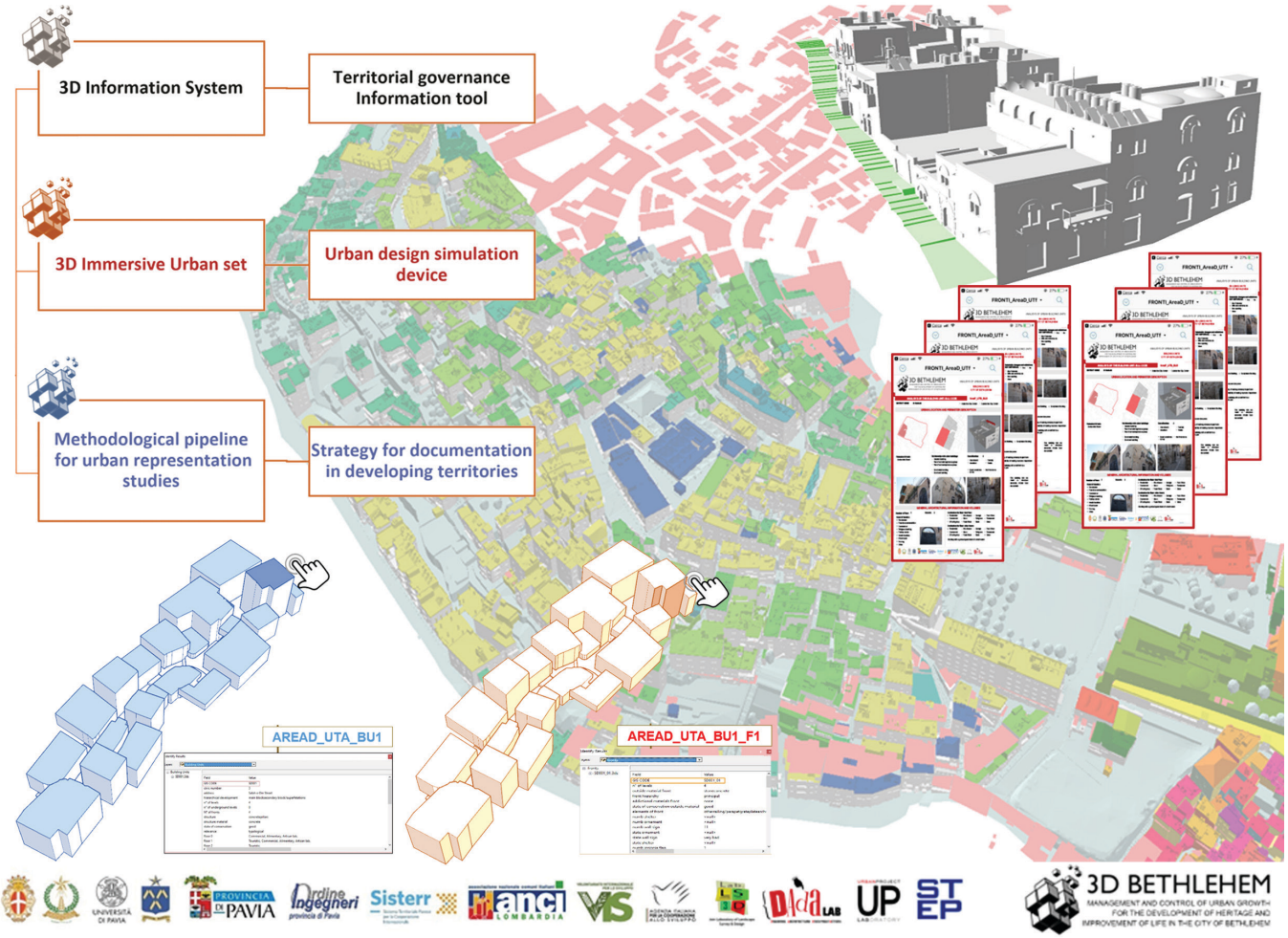
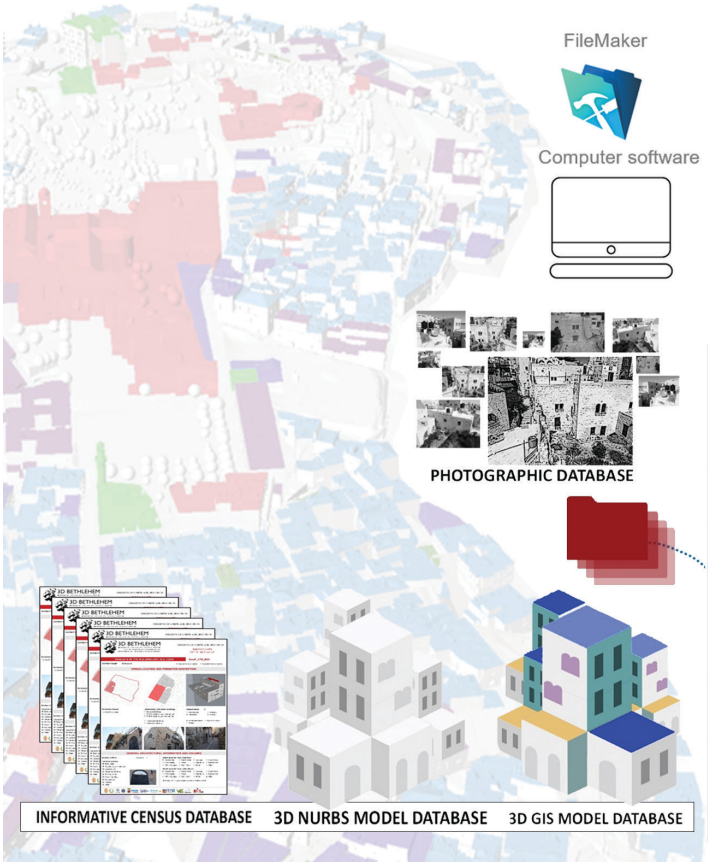


Fig. 01: Graphic synthesis of the digital information system for urban management of the Bethlehem city centre.

heterogeneous formats, makes it possible to review, check, verify and re-propose or modify the research phase by phase and, above all, even at the end of the project. The container thus becomes as fundamental as the content, at the point when it makes possible its preservation and transmission over time, to the benefit of scientific advances, knowledge and the enhancement of the built heritage (Parrinello & Picchio, 2017).

Digital repositories at urban scale: 3D Bethlehem Cooperation Project

The methodologies and processes of digital documentation and three-dimensional informative modeling developed by the University of Pavia within the 3D Bethlehem project, promoted by AICS - Italian Agency for Development Cooperation and scientifically coordinated by Prof. Sandro Parrinello, were immediately subjected to organized cataloging.

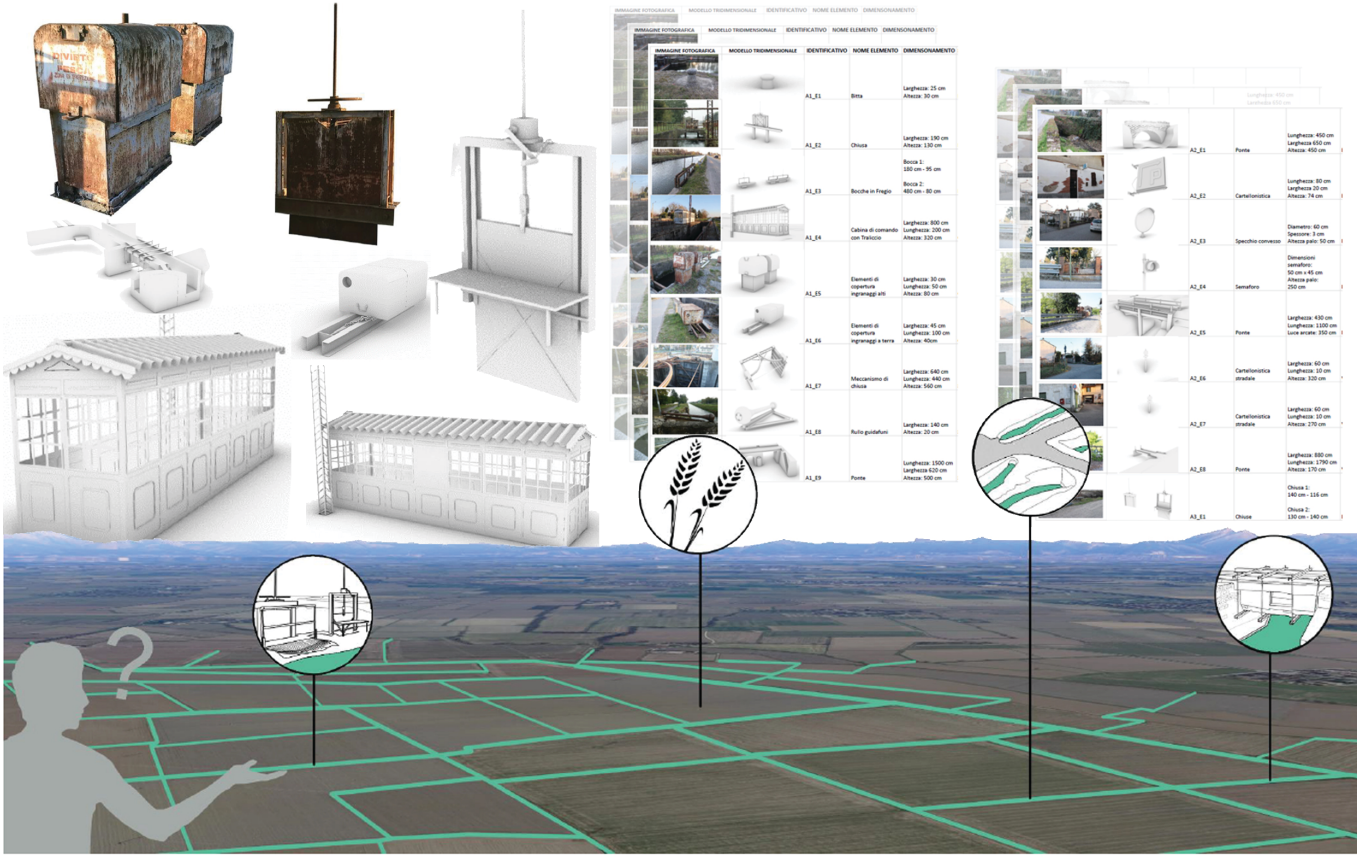


	Weight	Type of data	Numbers
Point Cloud from Laser Scanner	244,55 GB	Scans	2.234
		Points	2 Billion
Drone Database	107 GB	Flight Plans	26
		Photos	14.044
Photographic Database	39,28 GB	Photos	15.473
Global Hybrid Model	875 MB	Surfaces	18.074
		Polysurfaces	19.813
		Extrusions	24.322
		Mesh	12.364
GIS Model	210 MB	Linked census sheets	2.433
		Shapefiles	42
Informative Census Sheets	7,77 GB	BU Sheets	652
		BU Sheets pages	1.956
		Fronts Sheets	1.781
		Fronts Sheets pages	7.124

Fig. 02: Shared digital repository of the infographic database obtained as a result of the data acquisition campaigns and post-production processes.

The objective of the project was to build a multi-scale information system, from street layout to technological details on building covers, that would facilitate the Municipality of Bethlehem in managing urban growth. For this reason, from the initial stages of the project, a strategy of duplication was implemented to protect architectural, technological, and urban information of any kind and format collected. The copy of this data and their organization in a shared deposit were not created to replace the existing system but to facilitate remote access to the data, to track the development and stratification of buildings over time, to attempt to safeguard the heritage in its current state, and to facilitate predictions for the development and management of the historic center. (La Placa, 2022).

The construction of an organized and accessible online container (Fig.1), shared among the work group to store



H2O Map
Co-funded by the Erasmus+ Programme of the European Union

Fig. 03: 19th-century hydraulic elements of the irrigation and navigable system of the Pavia plain. From above, photogrammetric and NURBS reality-based models and associated census sheets, for the construction and populating of a three-dimensional GIS information system.

the duplicate of high-quality and informative detailed information (Parrinello et al., 2020), was a necessary step, especially considering the issues related to the unregulated urban growth of the center of Bethlehem (Picchio et al., 2020). Within the digital repository, an unlimited space Google Drive with protected access, the image of the city is divided and recomposed, in a folder arrangement that reflects the graphic breakdown

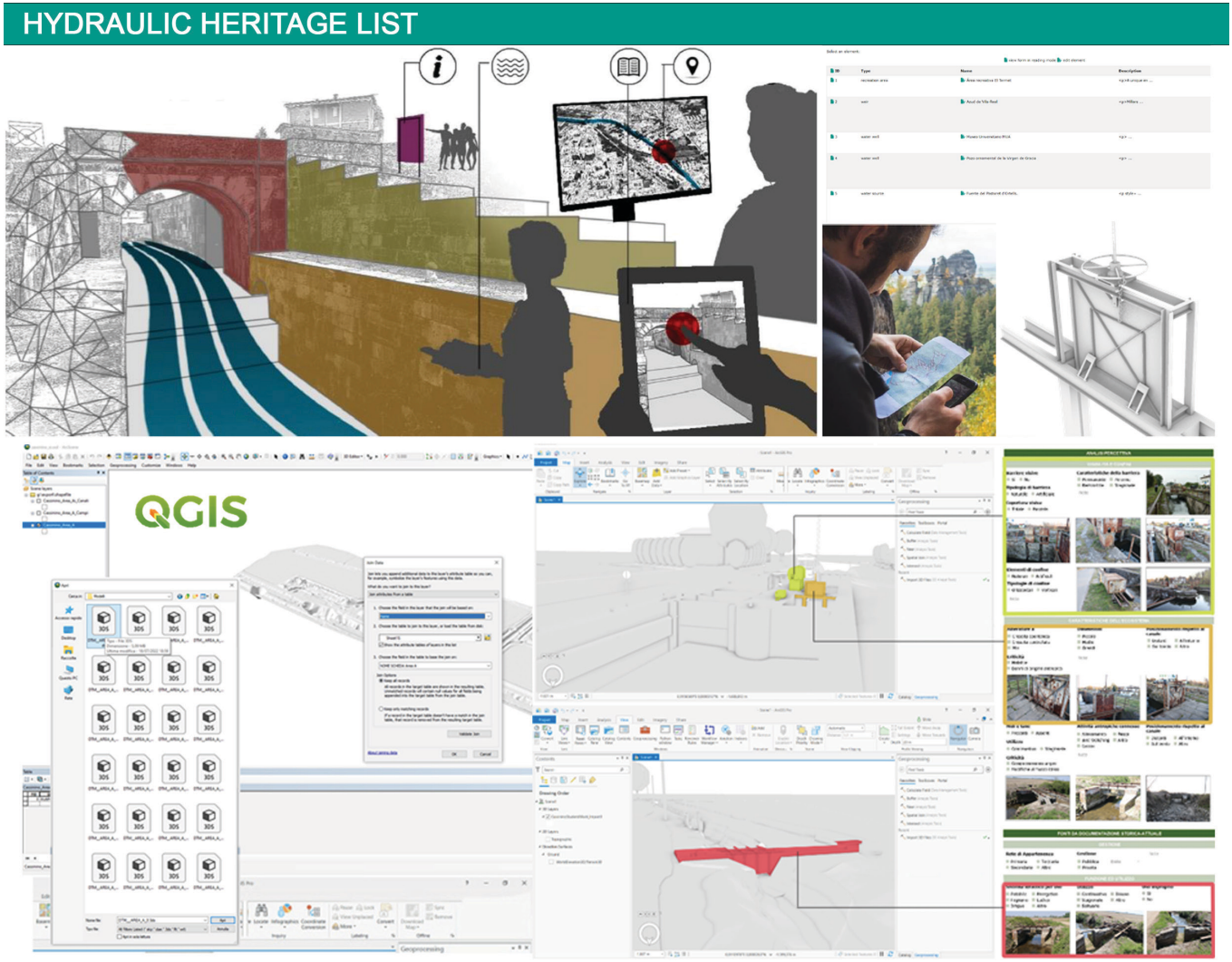


Fig. 04: Process of entering models and census sheets on a 3D GIS platform to build a digital duplicate of the amphibian landscape for easy management.

carried out to analyze the urban complexity, from squares to streets, to individual buildings, down to the technological element that is present (Fig.2).
The desire to define a partnership system, structuring of alphanumeric associative codes for the urban fabric (from element to building, building to building unit, building unit to area, etc.), has motivated the order and systematic organization of the repository, allowing to focus attention on the signs that characterize the city and, at the same time, to quickly identify the priority intervention areas (Doria & Picchio, 2020).

Territorial-scale digital deposits: the H2O MAP project
The European project "H_2O Map: Innovative Learning by Hydraulic Heritage Mapping," coordinated by Jaume I University (Spain), was started in 2020 and is now reaching its conclusion. Developed in partnership with the University of Pavia (scientific responsible: Prof. Carlo Berizzi) and Italian, Portuguese, and Spanish higher institutions, H_2O Map aims to promote the use of technology for quality education, analysis of water resources, and enhancement of hydraulic heritage. Over the course of three years, peculiar hydraulic elements related to each city involved in the partnership have been recognized, cataloged, and mapped, covering territorial extensions of several kilometers per site (Fig.3). The data acquired during field surveys have been added to a multi-platform, a digital repository specifically designed by the research group and based on the open-source software Open Street Map (Fig. 4). The use of the multi-platform allows for georeferencing the cataloged hydraulic heritage elements and making them available and accessible online (https://h2omap.uji.es/project/). In this case, the multiplatform from a digital container becomes a true interactive educational tool. Its use through an app, which is free and can be downloaded to any type of mobile device, allows anyone interested to enrich and update the heritage map, inserting new elements or adding information to those present. The research group (manager of the platform) then has the possibility, via pc, to create routes and story maps with which to promote knowledge, and therefore conservation, of the hydraulic heritage included. Free access to the maps is intended to ensure replicability of the method and product for all European cities, just as the use of a smartphone application is intended to allow wider and more immediate use of the platform and data even by a non-expert audience. Both aspects support the dissemination of scientific research, but also impose constant monitoring by the project team to verify and validate the data entered and thus avoid any unpleasant issues.

Discussion, conclusions and future developments

The structuring of digital repositories from the earliest project stages and the proper cataloging of data are essential tools especially when dealing with the analysis of urban or landscape heritage, however large-scale. In fact, the collection of such a significant and diverse amount of data in a single, orderly container gives a way to have an awareness of the complexity of the whole of the case study, to the benefit of a more effective development of preservation, management and reuse actions. Increasingly up-to-date surveying tools and data-processing software now enable the construction of three-dimensional databases, which in turn constitute true 3-D digital archives. Such models, as in the case study of 3DBETHELHEM, not only faithfully reproduce the geometric configuration of urban space, but also serve as the very containers of numerous types of information.
The creation of duplicates and informative digital maps, such as those made for the hydraulic infrastructures analyzed in H2O MAP, forms the basis for the construction of virtual products aimed at the

attractive and interactive use of heritage for scientific or diptych-museum purposes. The well-established potential of individual collaborative systems for information gathering, digital processing, and study and simulation on urban centers or landscapes directs the development of increasingly articulated and diversified databases in relation to the objectives of maintenance, database searching, and (limited or open) data fruition.

The benefits of sharing and collection are at the same time balanced by the challenges of security and technological obsolescence that still threaten current heritage containers. Open access removes economic barriers to scientific information, supporting technological and cultural progress.

Digital diffuses information and disseminates it, maximizing its impact on the community, to the point of constituting the concept of "collective intelligence" (De Robbio, 2007), and generating new demand and thus renewing supply. In this direction, there are also a number of issues that are still open and could disrupt (perhaps improve?) the current ways in which repositories are structured and used. These include, for example, the concept of dialogue and interaction between databases, or the design of a network of digital repositories supported by Artificial Intelligence and thus potentially capable of self-managing links, transformations and updates to the data themselves. Such perspectives invite consideration of a very different future, in terms of structure and use, for current digital collection spaces. Technological advances in the development of such systems could significantly facilitate and speed up the work of scientific research and dissemination. However, in this evolution, attention to the security factor must not be lost, lest archives end up being managed by technological automatisms and instead the role of the operator be kept central in the design and verification of data.

Acknowledgements

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H_2O Map is a 3-year (2020 – 2023) strategic partnership project for school education (Erasmus+ KA201) coordinated by the FACSA chair of Innovation in the Integral Water Cycle from the Jaume I University. KA2 Actions are all about enabling organizations to work together in order to improve student learning and share innovative practices. H_2O Map's purpose is to promote the use of new technologies using ICT and STEM to increase the quality of education, analyze water resources and value hydraulic heritage, as well as the ethical and civil responsibility which we must all protect. Partnership, form Spain: Universitat Jaume I (Coord.), Universitat d'Alacant, and IES Peñagolosa; form Italy: Università degli Studi di Pavia, and Istituto Superiore Taramelli-Foscolo; and from Portugal: Agrupamento Escolas de Campo Mayor, and Agrupamento de Escolas No. 3 de Elvas.

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1976

Italy introduces energy consumption regulations

1993

Introduction of the SAVE directive

2010

Introduction of the Nearly Zero-Energy Building (NZEB) model

2002

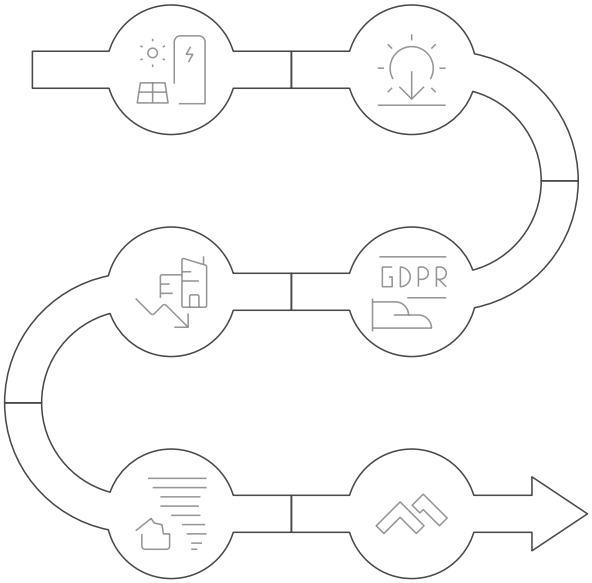
Series of European directives on energy performance

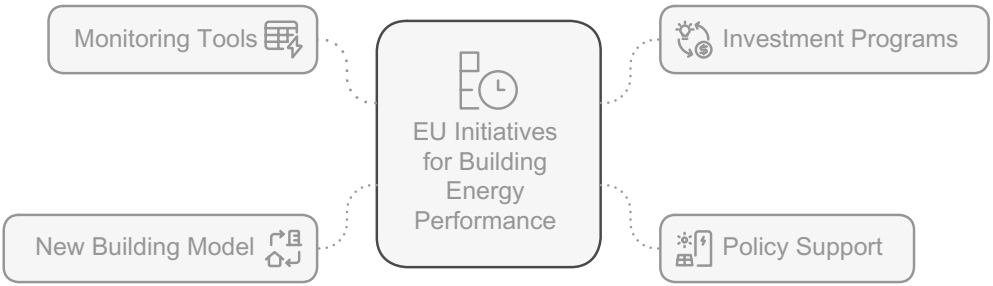
2020

Publication of the Renovation Wave strategy

2023

Updated directive for climate neutrality by 2050





Energy sustainability of existing buildings

Anna Magrini, Valentina Leoni

University of Pavia - Italy

Abstract

Buildings account for approximately 40% of energy consumption and 36% of greenhouse gas emissions in the EU, primarily due to an aging building stock constructed before modern energy efficiency regulations. To achieve climate neutrality by 2050, the EU has adopted multiple strategies, including directives promoting energy retrofitting, the use of renewable energy, and the development of Nearly Zero-Energy Buildings (NZEB). Key initiatives include the Renovation Wave, Energy Performance of Buildings Directive (EPBD), and monitoring tools like the Building Stock Observatory. These efforts are aligned with the UN's 2030 Agenda and aim to reduce emissions, enhance comfort, and support sustainable urban development. Cost-optimal renovation strategies and harmonized climate data are also essential for effective implementation and performance evaluation.

Keywords

Energy efficiency, Building renovation, Nearly Zero-Energy Buildings (NZEB), European directives, Climate neutrality

Heritage knowledge

Buildings are responsible for around 40% of the energy consumption: the largest single energy consumer in the EU, while emitting 36% of energy-related greenhouse gas emissions. The age of buildings in Europe is at least 70% before the 80s and therefore built before important laws on energy saving limited their consumption.

Improving the energy performance of the building stock is therefore a necessary crossing point in the path towards full decarbonisation, by means of improving energy efficiency of thermal systems, and promoting renewable energy use and good thermal insulation. This is the goal of the 2030 Agenda for Sustainable Development, a global program, which aims to supportenvironmental comfort and protection, and economic prosperity. Approved by the United Nations in September 2015, the Agenda consists of 17 Goals (Sustainable Development Goals, SDGs) that address the economic, social, and environmental dimensions of sustainable development. These goals are supported by an action plan that includes 169 specific targets to be achieved by 2030.

Fig. 01: Above. EU's Journey towards energy-efficient buildings. Below. EU initiative for Building energy performance

Within the 11th goal of the 2030 agenda,regarding sustainable cities and communities, the sustainable improvement of thermal behavior of existing buildings can be discussed from two points of view:

- The existing building sustainable behaviour;
- The energy retrofitting strategies and tools.

The goal concerns various aspects, with three key areas specifically related to energy-efficient buildings.
n.7 concerns the production of clean and affordable energy, n.12 concerns responsible consumption and production, n.13 concerns the climate action and the effects of the measures to adopt to reduce the energy consumption.

State of the art of european directives

Europe has approached the energy performance of buildings by means of regulatory measures starting in 1993 with the introduction of a directive called SAVE, primarily aimed at curbing carbon dioxide emissions.
CO2 emissions from the building sector are the highest ever recorded. While the total final energy consumption of the global buildings sector remained at the same level in 2019 compared to the previous year, CO2 emissions from the operation of buildings have increased to their highest level at 28% of total global energy related. The emission increase of the buildings sector is due to a continued use of coal, oil and natural gas for heating and cooling, combined with higher activity levels in regions where electricity remains carbon-intensive.
This highlights the significance of a triple strategy aimed at effectively reducing energy demand in the built environment, simultaneously decarbonizing the power sector, and implementing material strategies that minimize lifecycle carbon emissions. By combining these efforts, we can effectively decrease both energy demand and emissions.

Since 2002, a series of European directives have been issuedwith the aim to indicate energy performance requirements, introducing also the energy certification of buildings, and the need of renewable sources to cover partially the energy needs of buildings. This Directive represents an important starting point for the change in building design. The objectiveis not only related to new buildings but also to the energy restorationof the existing building stock, towards low-consumption buildings mostly supported by renewable energy sources.
Incidentally, Italy had anticipated these indications more than twenty years earlier. Already in 1976, in fact, a law regarding "Regulations for the containment of energy consumption for thermal uses in buildings" introduced criteria on the thermal insulation of buildings and on the thermal systemsdesign.
In recent times, on December 2021, the European Commission published its proposal for the revision of the Energy Performance of Buildings Directive (EPBD). It upgrades the existing regulatory framework to reflect higher ambitions and to face more pressing needs in climate and social actions. The EPBD is the main EU legal instrument aiming at improving the energy efficiency, while fostering renewable energy in buildings, andit puts in evidence the need to adopt a long-term renovation strategy for all the EU countries. To assess the overall energy performance of a building, the European Commission has established a set of standards and accompanying technical reports to support the EPBD.European Committee for Standardization (CEN) has developed all of these standards.

Evolution of EU directives

Unfortunately,the existing framework is not enough to be in line with the higher EU 2030 climate ambition. For this reason, under the European Green Deal, the Commission published in October 2020 the so-

called Renovation Wave strategy, an action plan of regulatory, financing and enabling measures aiming at boosting rates and depth of renovations over the next decade.
The Renovation Wave identifies 3 focus areas:

- Address energy poverty and worst-performing buildings;
- Public buildings and social infrastructure;
- Decarbonising heating and cooling.

The strategy and action plan were published in 2020, accompanied by a document, which presents available EU funding budget solutions that could support it.
In 2021 the European Commission has published a preliminary analysis of 13-member state long-term renovation strategies (LTRS), aimed at disseminating good practices from the policies and measures put forward by national governments.
In addition to the policies, strategic measures and financial instrument simplemented by more than two thirds of the Member States to facilitate the spread of energy efficient homes.The 8th European Framework Program for Research and Innovation "Horizon 2020" was started in order to promote "smart, sustainable and inclusive" economic growth for the sectors of science, industry and society.

Monitoring tools

To provide a better understanding of the energy performance of the building sector through reliable, consistent and comparable data, in 2016 the EU Building Stock Observatory (BSO) started its activity. . It makes available a web tool to monitor the energy performance of buildings across Europe.
By means of the Construction 2020 program, investments in building renovation, with a focus on energy efficiency and infrastructure development have been promoted. The European Construction Sector Observatory (ECSO)from 2018 provides regular information and analysis on stakeholders, industry developments, policy impact, and analytical support, all aligned with the Construction 2020 action plan.
It facilitates the exchange of best practices among the 28 EU countries, with an emphasis on enhancing the competitiveness of construction enterprises and their contribution to sustainable development goals.
A useful tool for understanding the European situation in the field of energy performance of buildings has been activated through the "Concerted Action". It represents a platform for discussing European Commission initiatives regarding energy performance of buildings and for collecting all the necessary information both prior to the issuance of a directive and during its implementation.
The Buildings Performance Institute Europe (BPIE) is a European no-profit research and think-do-tank, been in operation since February 2010. BPIE promotes policies and measures to increase the energy performance of buildings, leading to a reduction in CO2 emissions. Itsupports a multifaceted approach to achieve efficiency improvements in buildings, promotes regulatory measures and financial incentives that lead to the construction and retrofit of net-zero or low-energy buildings. The BPIE Data Hub is the first open data portal of its kind for statistical data on Europe's building stock and information on policies and regulations which aim to reduce energy consumption.

New building model

The introduction of the Nearly Zero-Energy Building (NZEB) model in 2010 represents a further development of the particular focus on energy consumption of the building stock since 2002 with the first EPBD.The EU has also proposed to move from the current nearly zero-energy buildings to zero-emission buildings by 2030, that means completely avoiding on-site carbon emissions from fossil fuels.

A NZEB means a building with a very high energy performance: the nearly zero or very low amount of energy needs should be covered to a very significant extent by energy from renewable sources produced on-site or nearby. In the EPBD, numeric thresholds or ranges are not clearly defined to identify the NZEB characteristics, therefore several interpretations both for the NZEB definition and limits are available in the EU Countries. The different choices could be justified by specific climate conditions, local targets, or building traditions, that allow different national targets.The energy label of a NZEB can look a little different from country to country, but generally the energy class is the highest.
Some general criteria, usually adopted also in the bioclimatic architecture, have contributed to define the NZEB target that should guarantee not only a very low energy consumption, but also a good level in terms of thermo-hygrometric comfort and air healthiness, as well as visual and acoustic comfort:

- the building position and orientation help to control the solar radiation contributions on the opaque and transparent envelope and the wind exposition;
- the building thermal mass allows to reduce the temperature variations due to the outdoor climatic conditions;
- the thermal regulation is finalized to maintain the design indoor conditions, with the aim both to guarantee the internal comfort and to limit energy consumption;
- the solar shading is fundamental to avoid overheating in summer;
- the solar greenhouse can support the thermal systems in the heating season and can cover a part of the energy needs;
- heating and cooling systems should be used to cover the extremely low energy needs and should be driven mainly by renewable energy.

The common denominator of all these aspects is the climate. In fact, the primaryaspect to consider when studying energy consumption is the local climatic conditions. An affordable climatic dataset is indispensable to estimate the energy performance of buildings, as it represents one of the main inputs to simulate the thermal behaviour of buildings, and it has a significant impact on the output obtained by the simulation.
The National Standardization Body of each country should have a plan of climate data updating to assure the use of the same data for all the energy evaluations. As a direct consequence, the results of the calculations should be more easily comparable each other, and they should be a more reliable reference for the cost-benefit evaluations.

Renovation towards nzeb

In the building renovation, in addition to the analysis of the strategies to be implemented in terms of thermal insulation, reduction of thermal loads and efficiency of the technical systems, it is also important to analyze the costs associated with the renovations. The importance of the cost optimal approach is stated by several documents of the European Commission on strategical indications for the energy performance improvement of buildings. To evaluate an effective energy redevelopment intervention, it is necessary to estimate the costs associated with the interventions.
After defining the characteristics of the building and the potential measures to be taken in the restoration actions, it's necessary to calculate the cost associated with each possible scenario, to identify which one may be the most convenient.
The Global Cost equation must be calculated using the initial investment costs, the annual maintenance costs, the price development, the discount factor, the costs related to decommissioning, deconstruction and disposal in the last year of lifecycle and the residual value. A further step should be defined

depending on national indications, to find the most suitable financial tools for the selected intervention.

Future development

"Energy performance of buildings: climate neutrality by 2050"is the updated European directive released in February 2023. Its main objectives are to achieve a reduction in greenhouse gas emissions and energy consumption within the EU building sector by 2030, ultimately leading to complete climate neutrality by 2050.Like the previous directives, all new buildings, both public and private, are required to belong to the NZEB category. Additionally, there is a focus on increasing the renovation of energy-inefficient buildings. Specifically, by 2030, residential buildings should reach at least energy performance class E, while non-residential and public buildings should achieve the same objective by 2027. Improving energy performance will lead to emissions reduction and an overall improvement in indoor air quality.

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THE JENA DECLARATION

Humanities and Social Sciences for Sustainability.

Cultural and regional dimensions of global sustainability

SUMMARY

Humanity is very close to missing a last chance to reach the broadly agreed Sustainable Development Goals (SDGs) in time. This insight is shared by most experts. Top-down approaches often face significant obstacles to implementation. To increase the speed and depth of the needed societal transformations the key change agents must be reached. These are the everyday actors, ordinary citizens, with their routines and habits. In order to reach them, cultural and regional diversities must be respected. In this context, the design and implementation of culturally and regionally differentiated pathways towards global sustainability calls for a stronger engagement of the humanities, social sciences, and the arts.

The Transcultural dimension in Heritage Conservation

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Abstract

The transcultural dimension in heritage conservation challenges conventional, often Eurocentric frameworks by emphasizing the central role of human life and culture as the core of all heritage. Drawing on the lessons of the global pandemic, this paper argues for a paradigm shift in conservation practices, one that recognizes the complexity and plurality of cultural expressions worldwide. Transculturality encourages inclusive dialogue among communities, fosters mutual understanding, and calls for heritage policies rooted in local knowledge and cultural diversity. Cultural diplomacy emerges as a key strategy to support this approach, ensuring the sustainable and ethical management of both tangible and intangible heritage. By prioritizing encounter, exchange, and shared values, transcultural conservation offers a path toward more equitable and context-sensitive heritage practices.

Keywords
Transculturality, Cultural Heritage, Sustainability, Cultural Diplomacy, Community Empowerment

Introduction

The global pandemic has certainly changed our perception of the world. If until a few years ago there was discussion about the universal values of cultural heritage and the role of a unitary and globalized vision, all this has taken on a different meaning that today helps us to observe the world with new paradigms. In fact, the pandemic helped us understand that we were losing the important battle against climate change, ethnic inequalities, religions, and conflicts between different cultures, moving away from the fundamental issues that underlie the development of humanity. These problems, especially in recent years, have become more urgent and the economic devastation that the pandemic has produced has unmasked many problems that afflict the world: poverty, lack of education, scarcity of food resources, environmental crises, social crises.
Meanwhile, the pandemic, despite having produced a serious global health crisis, has unmasked many negativities, and has allowed humanity to open new horizons. Perhaps for the first time, after so many years, so many people, so many communities have come together to work for the common good, that is, to guarantee life on earth. Perhaps for the first

Opposite page: The Jena Declration first page, the summary.

time many communities have perceived that the first important heritage is the human one, it is life and therefore our existence on earth. Perhaps for the first time shared and participatory actions have been activated to save a common good that is not easy to circumscribe within generic categories such as "tangible" or "intangible" but which is extraordinarily called "life". Generally, we are not used to thinking of the concept of heritage as a "human good" and therefore a "vital common good" and above all we are not free from conceptualizations that do not let us observe the world as it really is, always forced to entrench ourselves behind a universal norm or convention, but not universally possible. Paul Schafer, Canadian educator, expert in cultural law says that:
[...] While we seldom think about this in a systematic and concentrated manner, every person in the world is compelled to combine all the various parts of their lives together to form a "whole" or "total way of life" made up of many parts. It doesn't matter if they are carpenters or prime ministers, where they live in the world, what their educational circumstances are, or where they work. Every person must combine all the different parts of their lives together to create a holistic entity, regardless of whether this is done in terms of their bodies, minds, brains, souls, spirits, and senses or all the economic, social, political, artistic, technological, recreational, spiritual, scientific, and environmental activities they are involved in over the course of their lives. This is a necessity that all people must confront and come to grips with in life. There is no escaping it, regardless of whether this is done well or badly It is this holistic necessity and process that Edward Burnett Tylor, the British anthropologist, may have had in mind when he defined culture formally as "that complex whole which includes knowledge, belief, art, morals, law, custom and any other capabilities and habits acquired by man (woman) as a member of society." (Tylor, 1958) Tylor defined culture this way in the latter part of the nineteenth century, although his principal concern at that time was to apply this all-encompassing definition of culture to societies and countries rather than to individuals and institutions which is occurring much more frequently today (Schafer, 2022a).

Fig. 01: The International Conference of UNESCO Chairs that took place at the University of Jena from 11 to 13 May 2022. The transcultural committee dialoguing on culture and sustainability (Font, Olimpia Niglio, 2022)

All this helps us to introduce a very important concept: culture is the foundation of man's existence and without culture there is no life and therefore there is no heritage. Being aware of this assumption is a fundamental step if we intend to continue constructively our path for the development of humanity. In fact, it is difficult to imagine social developments without a cultural basis and history bears witness to this reality. No development will ever be possible without a paradigm shift in human life capable of putting the values of culture back at the center. As Pope Francis affirms, we must now work for a "culture of encounter", where every community, every person is able to build dialogues, to carry out shared and useful projects for all and above all to broaden our gaze to a broad horizon, as well as to know how to look at and appreciate the world in its extraordinary variety (Galantino, 2015).
All this helps to understand that the main cultural heritage is human life but also to outline the different meanings of this heritage in dialogue with local cultures. So, a topic that is certainly very complex, but fascinating is represented precisely this research that we must undertake to know the new dimension of cultural heritage.

Culture and new paradigms

Werner Heisenberg, Nobel Prize for the Physics in 1932, affirms: *[...] It is probably true quite generally that in the history of human thinking the most fruitful developments frequently take place at those points where two different lines of thought meet. These lines may have their roots in quite different parts of human culture, in different times or different cultural environments or different religious traditions: but if they actually meet, that is, if they are at least so much related to each other that a real interaction can take place, then one may hope that new and interesting developments may follow (Niglio, Fukui, 2021).*

This statement is an important example of how culture without encounter cannot produce development. Even the theologian Romano Guardini affirmed that the existence of man has meaning when he is able to open himself to knowledge and sharing; otherwise, man freezes, stiffens and remains closed in on himself with the direct consequence of becoming culturally poorer and poorer (Guardini, 2009).
This implies an important exercise that requires man not to close himself within his own certainties, but to be open and free to know, to create and to develop together with others. This capacity for encounter and freedom of thought helps us not to be colonized, and above all not to colonize because in the last century even the process of cultural colonization that has affected the sector of conservation of inherited heritage has not favored the development of culture. In fact, an important issue that many countries in the world have addressed in recent years is the full awareness of the value of their cultural heritage, regardless of the international declarations and norms that have imposed a Eurocentric vision. These actions on the one hand have also produced huge losses with destruction especially of tangible heritage, but on the other hand has favored the development of numerous initiatives, both institutional and private, aimed at enhancing local cultures and the different meanings of these cultures.
There is no doubt that especially since the 70s of the twentieth century also with the publication of the Convention on the Protection of the World Cultural and Natural Heritage, adopted by UNESCO in 1972, the indications have been very precise and clear in giving a definition of heritage also related to the political events of the time. Meanwhile, in the last fifty years the geopolitical conditions have changed a lot and with these also the approaches to cultural heritage. Recent studies and research show how conservative procedures and methodologies have evolved and above all how these have contributed to opening new scenarios towards new paradigms (Labadi, 2022). The

theme of heritage has taken on a different dimension; if until a few years ago the reference categories were those of "cultural heritage" (monuments; groups of buildings and sites) and "natural heritage" (natural features, geological and physiographical formations, natural sites or precisely delineated natural areas) to which in 1992 the category of "cultural landscape" was associated, today the latter categories are joined by many other references: living heritage, community, climate, mankind, environment, development, creativity, cultural diversity, sustainability, etc.....

Although lagging behind other countries, the Convention for the Safeguarding of the Intangible Cultural Heritage (2003) and the Convention for the Protection and Promotion of the Diversity of Cultural Expressions (2005) also laid the foundations for a revision of the concept of cultural heritage in dialogue with the different cultural and methodological approaches that certainly make this field of research very fascinating. So, in recent years we are witnessing a revision of the concept of heritage in dialogue with local cultures and putting communities at the center. This different approach demonstrates how successful local policy efforts are when they aim to build on existing cultural elements and creative resources. Knowledge of local creative assets is often held by local communities; thus, local governments should seek out such local and indigenous knowledge to inform policy making.

This new approach helps us to introduce a holistic dimension of the concept of cultural heritage, as a result of a creative process that is based on the intersection of humanities and legal sciences and therefore on a transcultural vision of human heritage. Meanwhile, precisely this transcultural intentionality gathers the different instances of the concept of heritage in the world and opens the doors to the role of cultural diplomacy that must face the intolerances that govern international relations. (Niglio, Lee, 2021). Thus, cultural diplomacy contributes to protecting the diversity of communities and enhancing their heritage, as already anticipated by the Mexico City Declaration on Cultural Policies (1982) and art. 46 states:

[...] International cultural cooperation must be based on respect for cultural identity, dignity, and value of each culture, independence, national sovereignty, and non-intervention. Consequently, in cooperative relations between nations, any form of subordination or substitution of one culture for another. It is also essential to rebalance cultural exchange and cooperation so that lesser-known cultures, in those of some developing countries, are more widely disseminated in all countries.

Indeed, the cultural diplomacy is the cultural soul of a nation and aims to promote the exchange of research, education, local traditions, and then the culture in all its aspects and thus promote mutual understanding of cultural processes. The cultural diplomacy is essential so that the people of a foreign nation can learn more about the ideals and cultural policies of the nation they intend to visit in order to also leave broad support for the economic and political objectives of the countries (Lee, Niglio, 2019).

Conclusion

The word Culture must always be analyzed in its vitality and should not be closed in an abstract contextualization because history evolves and with it also culture, and the expression of communities. It is precisely this vitality of culture that must return to animate our daily actions, often increasingly dry of the misuse of technologies. Differently, wise and conscious use of these information technologies can help to precisely understand the mobility and versatility of different local cultures and therefore our way of expressing ourselves, communicating, and meeting other cultures. The concept of the encounter between cultures has been elaborated by many scholars who expertly analyze the dialogue between culture and community, introducing the concept of Culture with reference to the encounter with each

other. In this vision the word Culture means knowing how to meet, knowing how to open dialogues. In fact, the word Culture represents the essence of a people, and thanks to this Culture people dialogue with each other (Niglio, 2021). The International Conference of UNESCO Chairs that took place at the University of Jena from 11 to 13 May 2022 (Fig.2), with the important support of the Jena Declaration (2021) also highlighted the close relationship between culture and sustainability because:

[...] Humanity is very close to missing a last chance to reach the broadly agreed Sustainable Development Goals (SDGs) in time. This insight is shared by most experts. Top-down approaches often face significant obstacles to implementation. To increase the speed and depth of the needed societal transformations the key change agents must be reached (The Jena Declaration, 2021).

Meanwhile, all the experiences carried out in the world by individual communities are the lifeblood to understand that transculturality is our future, or this will end up crushed by global homologation. The diversity of cultures represents the present of the world, its timeliness and, at the same time, its richness. When we use the adjective "cultural" this is always manifested individually: a language, an era, an environment, a thought, a tradition... (Jullien, 2018). This well-established singularity is the one that characterizes communities, people and that makes possible the encounter and therefore the dialogue with other cultures. When, on the other hand, homologation is imposed, then conflicts arise. However, to pursue this important transcultural objective it is essential to know how to distinguish the different dimensions of being and logic and above all to get out of a Eurocentric vision by developing, instead, actions that are the result of languages and thoughts received from "elsewhere".

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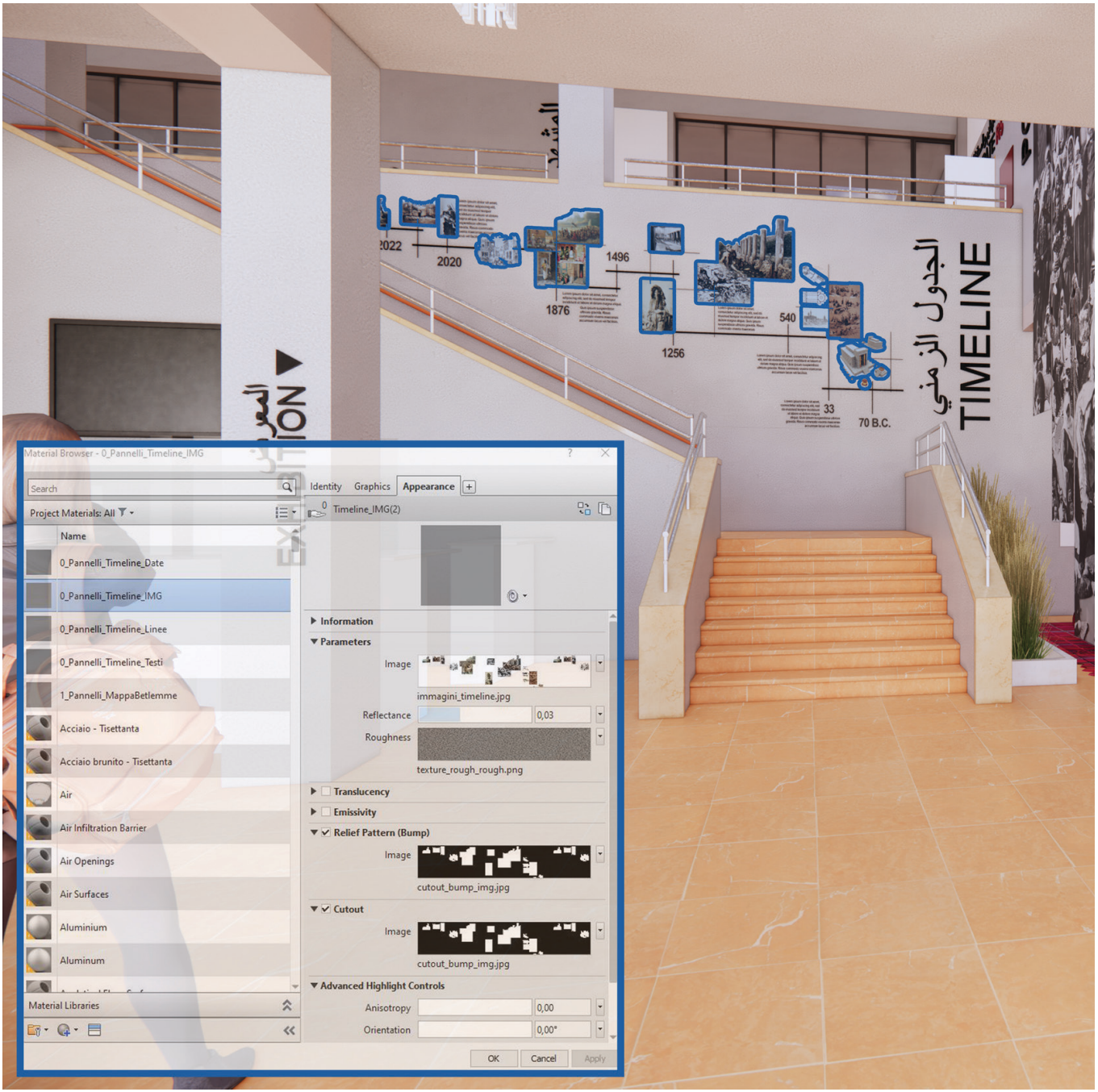
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HBIM strategies for design, management, and scheduled maintenance of Cultural Heritage

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Abstract

In response to a lack of unified approaches in existing research on digitising the built environment, this contribution highlights the essential collaboration in architectural engineering processes (AEC) for preserving Cultural Heritage. The proposed workflow centres on implementing the Building Information Modelling (BIM) methodology to standardise information modelling for cultural heritage. It emphasises creating a digital archive, systematising data, and fostering interoperability. The methodology outlines a three-phase structure: Data Collection, BIM Modelling, and Data Sharing. Additionally, the BIM Modelling phase comprises four recursive steps: Georeferencing (GEO), 3D Modelling (3DM), employing model federation with shared coordinates (FSC), and enhancing information granularity (LOIN). Visual Programming Language (VPL) can support Historic BIM (HBIM) modelling due to its user-friendly interface and effective management of parameters. The operational workflow was tested for refurbishing the Peace Center as a city museum in Bethlehem as part of the "SMART Bethlehem". Scientifically coordinated by the DAda-LAB of the University of Pavia, this project aims to promote sustainable urban and territorial development in the Bethlehem Governorate. Namely, the dual purpose of the proposed research is to engage in a dialogue with the community and municipality through capacity-building actions and provide a viable support framework for the management of the Peace Centre.

Keywords

Cultural Heritage, BIM, Information System, digital archive, data collection.

Introduction

Nowadays, for the maintenance of Cultural Heritage (CH), it has become essential to break down the barriers between all the actors involved in the Architectural Engineering (AEC) processes by data creating an environment open to collaboration and thus ensuring dialogue between the information systems that manage these processes by defining systematisation strategies that focus on interoperability.

Although the current literature shows a great deal of

research on the digitisation of the built environment, either implemented by manual segmentation of survey data and direct modelling over it (Dell'Amico et al., 2024; Parrinello et al., 2020) or using semi-automated procedures (Barazzetti et al., 2016; Croce et al., 2023), a unified and common formulation has not yet been defined.

For this reason, the proposed research outlines a workflow to standardise the information modelling process for cultural heritage. By implementing the BIM methodology, it is possible both to structure a digital repository and to systematise the stored data upon an initial effort to define the type and format of the linked information and the set of rules to implement such a strategy.

Digital technologies represent the future of museums, whether they are defined by a tangible perimeter or, more often, open-air museums; through user-friendly interfaces, it is possible to promote the communication and dissemination aspects of CH, effectively overcoming what, for various reasons, appears to be a cognitive, physical or even economic barrier for the end user (Bonacini, 2014; Picchio & Fu, 2024), and opening up to stakeholders with different cultural backgrounds and objectives.

In the field of AEC, information systems have long since opened up to interoperate with both online monitoring and management systems realised through georeferenced platforms (Matrone et al., 2023), and advanced virtualisation systems oriented towards managing and enhancing CH (Russo, 2021). For this purpose, we cannot disregard the delineation of a digital ecosystem allowing access to all stakeholders involved in architectural processes (Giovannini et al., 2023), implemented through a user-friendly approach so as to attract the largest number of users to investigate the digitised heritage. As a matter of fact, the latest applications in the field are more and more oriented towards the integration of Extended Reality (XR) tools and diagnostic

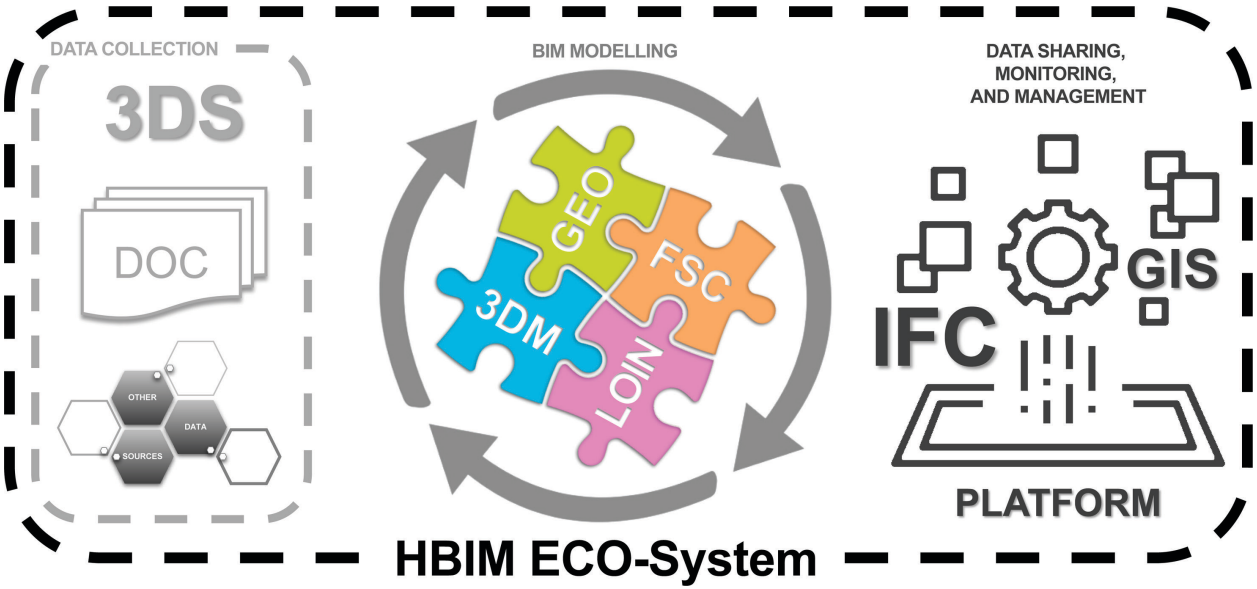

Fig. 01: Infographics presenting the successive steps for the implementation of an HBIM ECO-System.

activities, thus overlaying layers of information on the physical reality or on the digitally surveyed one in a straightforward way, and consequently favouring the understanding of cause-and-effect relationships in the reading of the pathologies that affect the cultural heritage, thereby defining a valid support tool for monitoring and maintenance assessments (Amoruso et al., 2010; Doria et al., 2022)

Methodology

According to the second principle of thermodynamics, a closed system naturally tends towards a state of higher entropy, where entropy is a measure of the disorder or randomness of the system itself. In physical systems, matter and energy tend to reach a state of maximum disorder (entropy) in the pursuit of uniformity; to counteract this tendency, the system can become increasingly ordered or complex by providing two inputs in the form of a work or energy source and some form of instruction or intelligence (Planck, 1926). In parallel with physical systems, to manage built heritage exploiting the full potential of Digital Twins, it is essential to establish a monitoring Digital ECO-System – intended as Enriched COoperative System (Parrinello et al., 2023).
This requires the system used to be interoperable, namely able to relate to different systems and scales, such as BIM and GIS. The exchange of information, now scientifically known as GeoBIM, contributes to blurring the boundaries between BIM and GIS (Bortot & Paolo, 2020; Di Benedetto et al., 2021).
For these reasons, a workflow aimed at the efficient implementation of an HBIM ECO-System is presented below, based on the so-called scan-to-BIM approach and comprises three main phases (Fig. 1): i) Data Collection; ii) BIM Modelling, which further consists of four iterative steps: Georeferencing (GEO), working in a federated environment where a common set

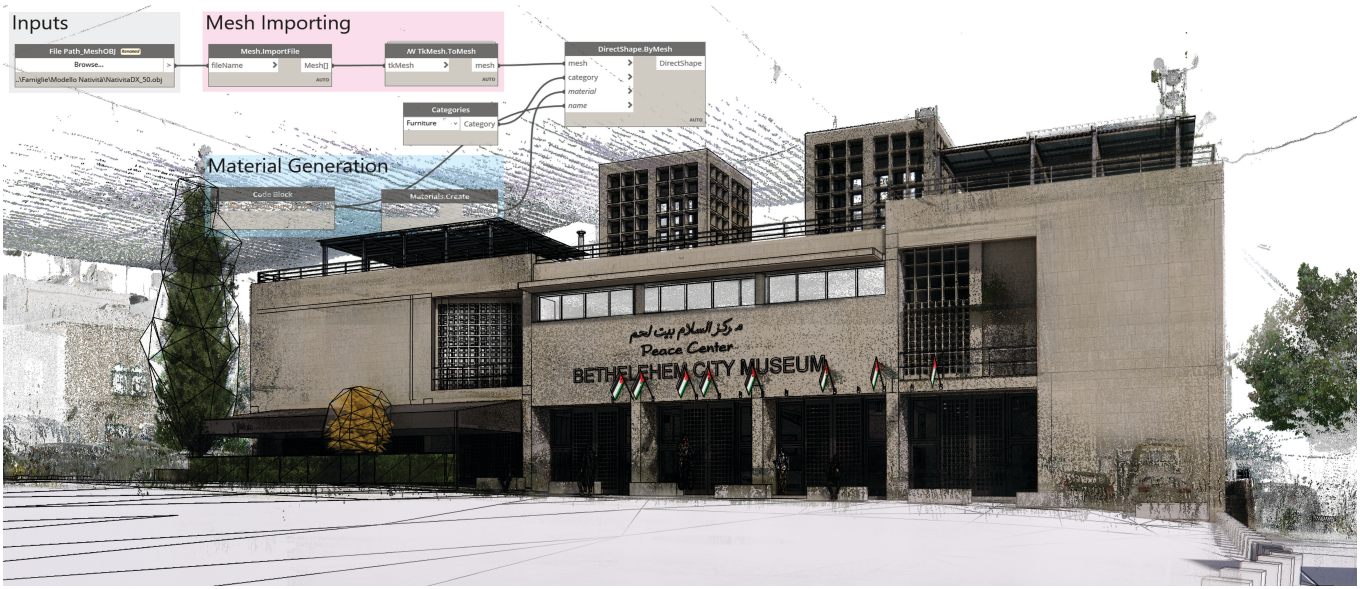

Fig. 02: Photobashing of the HBIM modelling process employed for the Peace Center.

of standards has been defined (FSC), 3D geometric modelling (3DM), paying particular attention to the granularity of the information to be added, as specified by the current legislation – European legislation ISO 19650-1:2018 (ISO 19650-1:2018 – Part 1, 2018), adopted via the Italian UNI EN 17412-1:2021 (UNI EN 17412-1:2021 – Parte 1, 2021) – in the definition of the "Level of Information Need" (LOIN); iii) Data sharing for monitoring and management.
For a monitoring system to work properly, these phases must work synergically, possibly requiring ongoing iterations; furthermore, just as a physical ecosystem, a digital ecosystem must be designed to receive continuous external feedback and be able to respond to such stimuli.
It is also worth noting that the entire BIM modelling process can benefit from implementing a Visual Programming Language (VPL). The user-friendly interface of VPL allows the direct manipulation of parameters governing both geometric design and non-graphic information, which is useful for populating the BIM database.

Results

The research proposal is part of the project "SMART BETHLEHEM – Sustainable Management And Renewal of the Technology in the City of Bethlehem", co-funded by AICS – Italian Agency for Development Cooperation, which aims to promote sustainable and resilient urban and territorial development

Fig. 03: Elements of the museum project layout modelled as parametric families and optimised for virtualisation using PBR materials.

in the Bethlehem Municipality area . Its main objectives include the sustainable renovation of the city at various levels, from urban planning to the analysis of construction practices in the area and the development of an intelligent mobility plan for the historic centre. Specifically, the methodology presented has been applied to the design of a city museum within the Peace Center, a building located in the heart of the historic centre, Manger Square, near the Church of the Nativity. The proposal aims to revitalise the city's museum system by providing a new cultural centre dedicated to exploring the territory and history of Bethlehem. To this purpose, a combination of drawing and modelling techniques was used to define a narrative language for the different stages of the design process.

It is worth mentioning that within the framework of the methodological approach combined with the SMART Bethlehem objectives, the presented application fulfils the scopes of the 9th – "Industry, Innovation and Infrastructure", the 11th – "Sustainable Cities and Communities" and the 17th – "Partnership for Goals".

Fig. 04: Overview of the museum layout envisaged for the Peace Centre. The first level is reserved for interactive areas and temporary exhibitions, while on the upper level, there are permanent exhibits on "The Myth of the Holy Land", "The Sites of the Nativity", "The Cultural Heritage of Bethlehem", "The Landscape of the Governorate of Bethlehem" and "Interactive Area for Territorial Awareness".

The HBIM process starts from an Integrated 3D Survey (3DS) database, which combines 38 B/W TLS scans carried out in 2018 with a CAM 2 FARO S150 laser scanner (Parrinello, 2020) and 44 SLAM scan trajectories acquired in 2022 with a Leica Geosystem BLK2GO . The final output was a 53.2 GB total point cloud with an RMS error of 2.1 cm and a mean error of 1.3 cm. In addition to the 3D measurements, an extensive photographic database was also acquired during the 2022 survey campaign using a Canon 77D camera and a Ricoh Theta 360° camera for general documentation purposes (DOC).
Following a thorough visual analysis of the site and its subsequent breakdown into its elementary components, BIM modelling followed a bottom-up approach. The HBIM model was then referenced using the EPSG:28191 – Palestine 1923/Palestine Grid Coordinate System – (GEO) via an overarching environmental model that stores the common coordinates (FSC). In fact, the prospicient buildings modelled for the 3D GIS – one of the outputs of the 3D Bethlehem project (Parrinello, 2022) – were also generated as instances in Revit using a VPL script (Fig. 2). Keeping in mind that the main objective of the project proposal is a sustainable rehabilitation of the Peace Centre, the proposal for the museum layout was also designed in the BIM environment, taking care to parametrically model the furniture elements and add photorealistic finishing materials to them (Fig. 3). These materials, identified from the photographic

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	OID	Discipline	BldgLevel	Category	CreatedPhase	ObjectId	Base_Cut_Style	B...	Bas...	BaseLevel	BaseLevel_Desc	BaseLevel_Elev	FamilyType	Top_Offset	TopLevel	TopLevel_Desc	TopLevel_Elev	TopLevel_IsBuildingStory	TopLeve
44	44	Structural	01.2_Floor -2	Structural Columns	New Construction	327411	Perpendicular	0	0	01.2_Floor -2	01.2_Floor -2	754,7018	PC - 0.50x0.50 m	0	02_Floor -1	02_Floor -1	757,6356	Yes	
45	45	Structural	01.2_Floor -2	Structural Columns	New Construction	327426	Perpendicular	0	0	01.2_Floor -2	01.2_Floor -2	754,7018	PC - 0.55x0.55 m	1,312336	05_Roof	05_Roof	770,6839	Yes	
46	46	Structural	01.2_Floor -2	Structural Columns	New Construction	328551	Perpendicular	0	0	01.2_Floor -2	01.2_Floor -2	754,7018	PC - 0.50x0.80 m	0	05_Roof	05_Roof	770,6839	Yes	
47	47	Structural	01.1_Floor -3	Structural Columns	New Construction	328625	Perpendicular	0	32546	01.1_Floor -3	01.1_Floor -3	751,1203	PC - 0.50x0.50 m	3,772966	05_Roof	05_Roof	770,6839	Yes	
48	48	Structural	01.1_Floor -3	Structural Columns	New Construction	328648	Perpendicular	0	32546	01.1_Floor -3	01.1_Floor -3	751,1203	PC - 0.55x0.55 m	0	01.2_Floor -2	01.2_Floor -2	754,7018	Yes	
49	49	Structural	01.1_Floor -3	Structural Columns	New Construction	328654	Perpendicular	0	32546	01.1_Floor -3	01.1_Floor -3	751,1203	PC - 0.50x0.50 m	0	01.2_Floor -2	01.2_Floor -2	754,7018	Yes	

Fig. 05: GeoBIM model of the Peace Center within the ESRI ArcGIS Pro environment.

sources, were provided by generating PBR-type materials in the Revit browser and later assigning the required maps within each corresponding section (LOIN) (Sanseverino et al., 2022).
The BIM model optimised for visualisation is not only a virtual archiving system. Still, it is also ready to be opened for remote access, thus reaching distant users and fulfilling a broader educational purpose. In particular, the interactive design allowed quick testing of the proposed solutions using Chaos Enscape, a real-time plug-in for Revit. The same application was then used to simulate the proposed museum route through a short video, as a potential user would experience it. The visitor is at the centre, the fulcrum around which the new museum experience revolves. Following the criterion of minimal intervention as a cornerstone, a fil rouge guides the viewer from the general to the particular through a continuous narrative system (Fig. 4).

Conclusion

If, on the one hand, the design proposal aims to inform external visitors, possibly with online applications, on the other hand, it seeks to give the building back to the community in the form of a place of rediscovery, with flexible spaces suitable for educational purposes and daily visits. Certainly, this initial museum design and its implementation do not represent the end of the research activities but rather a starting point for a dialogue with the municipality and the community based on shared values and capacity-building actions.
Operationally, the proposed workflow aims to foster interoperability and accessibility for multiple stakeholders, both in the form of open data formats such as IFC (Industry Foundation Classes) and GeoBIM models managed via monitoring multiscale platforms (Fig. 5).

Note

The project "SMART Bethlehem – Sustainable Management And Renewal of Technology in the city of Bethlehem", was conceived following the positive cooperation and development experience of two previous projects co-financed by AICS (Italian Agency for Development Cooperation) and the municipalities of Pavia and Turin (3D Bethlehem – AID 011321 – and NUR: New Urban Resources – AID 011319).
Co-funded by AICS, SMART Bethlehem is coordinated by the Province of Pavia, with a partnership composed of the Municipality of Bethlehem, the Metropolitan City of Turin, the municipalities of Pavia, Parma and Padula, the municipality of Bruino (as leader of Co.Co. Pa – Coordinamento Comuni per la Pace, Turin), ANCI Lombardia, the Cilento-Vallo di Diano-Alburni National Park, the Joint Services Council for Tourism Development in Bethlehem Governorate, VIS – Servizio International Voluntary Service for NGO Development, the Pavia SISTERR territorial system for international cooperation, the University of Pavia (scientific coordination), the Polytechnic of Turin, Bethlehem University, the LINKS Foundation, Ai Engineering S.r.l. – AI Eng., and Piacenti S.p.A.

The project "SMART BETHLEHEM – Sustainable Management And Renewal of Technology in the city of Bethlehem" is scientifically coordinated by professor Sandro Parrinello. The digital survey activities were conducted by Anna Dell'Amico, Hangjun Fu, and Raffaella De Marco (March 2022). The point cloud data processing and the 3D model of the Peace Center were carried out by Anna Sanseverino. The proposal and design of the museum itinerary, yet in progress, are being developed by Anna Sanseverino and Hangjun Fu under the supervision of professor Sandro Parrinello and professor Francesca Picchio.

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Use and reuse of non-rhetorical architecture. The legacy of former "Case della madre e del bambino" in post-fascist Italy

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Abstract

This paper explores the architectural and socio-political legacy of the Case della madre e del bambino, welfare buildings developed by the Opera Nazionale Maternità e Infanzia (ONMI) during Fascist Italy, with a focus on their design, function, and postwar reuse. Originally conceived to serve women and children through a rationalist and non-rhetorical architectural language, these buildings reflected the regime's eugenic policies while avoiding overt ideological symbolism. Drawing on the thoughts of Giuseppe Pagano, the study highlights how these "ordinary" architectures modest, functional, and unadorned, embodied a unique civic and hygienic modernity, which allowed for their continued use and reinterpretation after the fall of Fascism. Rather than being demolished or ideologically purged, many ONMI buildings were silently re-semantized and adapted for new uses, becoming enduring elements of urban welfare infrastructure throughout postwar Italy.

Through selected case studies from Mortara to Udine and Rome, the article assesses preservation challenges, contemporary values, and the feasibility of sustainable reuse strategies. In doing so, it contributes to the broader debate on the conservation of fascist-era buildings that lack commemorative symbolism but remain embedded in the everyday fabric of cities. The paper argues that these non-monumental structures, long considered "minor architecture," merit recognition as part of Italy's architectural heritage—not despite their origins, but because of the complex historical layers they represent and the continued social function they can fulfill.

Keywords

Fascist Architecture, Legacy, Heritage, ONMI, Welfare buildings.

In January 1935, Giuseppe Pagano wrote in Casabella the article, which later became famous, entitled "Architettura nazionale". In a climate of confusion and, in his view, of "artistic insensitivity" and "impressive mediocrity" concerning the monumental buildings of those years, he clearly explains the importance of non-rhetorical architecture: "The physiognomy of a city, of a country, of a nation is not given by those works of exception but by those many others that historical critics classify as minor architecture", that is, art that is not courtly, less constrained by representative intent, more subject to the economic limitations and modesty of those who neither want nor need to exaggerate in vanity. Of this architecture the city must be made: modest and sodden architecture, which rests without insolence around the few indispensable representative buildings. This current architecture-so it might be called in commercial jargon-represents normal production: modesty of purpose and modesty of results, but in return clarity, honesty, economic rectitude, and comma almost always, urban education" (Pagano 1935: 44). Among the architectures less bound by representational intentions were certainly those dedicated to the care of women and children, created by ONMI (Opera Nazionale per la protezione della Maternità e dell'Infanzia).

ONMI was a parastatal institute, which officially came into existence in December 1925 with the aim of boosting welfare policies aimed at mothers and children (Origine 1936; L'Opera nazionale 1962). Not yet having its own buildings, ONMI used in large and medium-sized cities existing health and welfare facilities or private homes made available by benefactors. One had to wait until the early 1930s to see the first buildings suitable for the purpose.

Until that time, there were no building types that contained offices, outpatient clinics, kindergartens, refectories and other spaces for care. Thus, guidelines were prepared on the design of spaces, to be

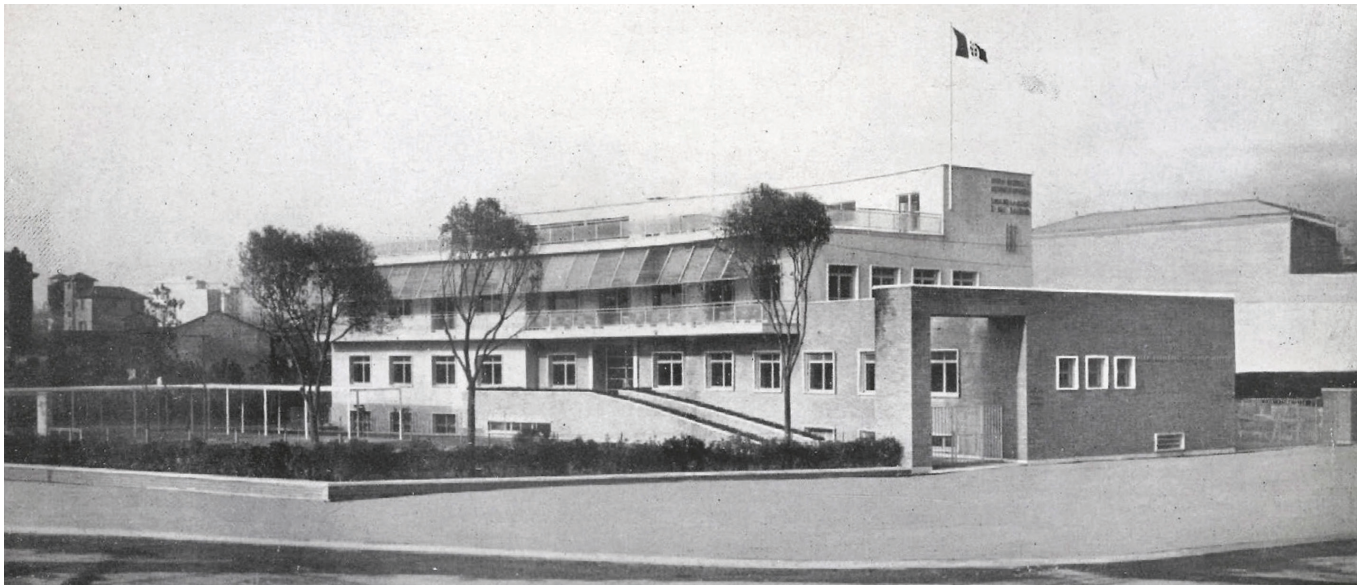

Fig. 01: E. Rossi, "Casa della madre e del bambino", Rome 1935-38 (Casabella, 165)..

adhered to by the professionals who would design future buildings dedicated to mothers and children. Thus, appeared the first designs of buildings, realized by Luciano Baldessari and other rationalist architects (Savorra 2021).
These buildings were called, according to the nomenclature of the fascist regime, "Case della madre e del bambino", and were created in every Italian city to protect, both the woman, assisting her in all

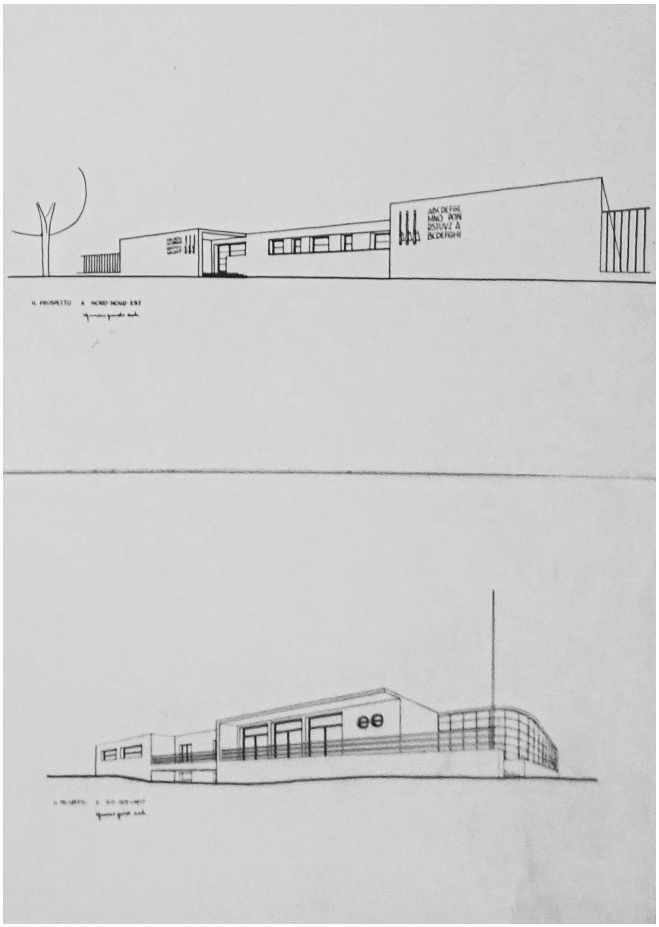

Fig. 02: I. Guidi, Project of "Casa della madre e del bambino", Rome 1934 (Archive Guidi, Rome).

stages of gestation, childbirth and puerperium, and the child, from birth to the age of three. Among the exemplary buildings, along with those of Baldessari (Mortara, Brescia, Rome on Via Cassia Vecchia), were the Roman buildings realized by Ettore Rossi and by Ignazio Guidi, and the Trieste building by Umberto Nordio. These were functional buildings, without rhetorical adjectives, designed in a sober rationalist language. The "Casa della madre e del bambino" built in Rome on Via Volpato by Rossi was characterized by the veranda solution, the rhythm, and the harmonious lines, which would best serve the function for which the building was erected (Fig. 01). The importance of sun and air was decisive in the design choices, in the orientation of the rooms, in the use of materials such as glass, in technological applications, such as the "parcel shutters" useful to protect from the sun while preserving perfect ventilation, impossible with curtains. The building constructed by Guidi at Tiburtino also responded to the welfare needs of the neighborhood population (Fig. 02). The design of outpatient clinics, playrooms, checkrooms, baths for infants and toddlers, kitchens, lactarium, and refectories followed rationalist prescriptions and dictates. Prominent among the buildings only designed and not built were those of Gio Ponti for Bruzzano, of Eliseo Mocchi for Pavia (Fig. 03), and that of Giuseppe Pagano for Split (Fig. 04), which were notable for the special attention that was paid not only to interior spaces but also to exterior ones.
Removal issues did not affect the ONMI buildings, as the institution survived until 1975. It was evident that these places of fascism that did not directly "speak" of fascism in a rhetorical sense precisely because they were created without blatant symbols. The survival of the "Case della madre e del bambino" after the Second World War must be read in the difficult context of Reconstruction. Admist commissarial managements, strenuous revitalization of the bureaucratic machine, failed purges and ordinary administration activities, the life of the ONMI continued, despite its scarce

funding and despite the fact that it had been one of the most active institutions of the regime based on questionable ideologies. This was because, as we have seen, the symbolic meanings that had been decisive at the time of its establishment and during much of its existence had gradually diminished. In fact, the aims of the institution – which by the end of the 1930s had become mostly welfare, prophylactic and sanitary after various managements – were deemed important both by the High Commission for Hygiene and Public Health, immediately after 1945, and later, from 1958 onwards, by the Ministry of Health.

In 1950, a publication by the ONMI, using data and statistics, recounted the assistance provided in its 3700 paediatric advisory centres, 2300 obstetrical advisory centres, more than 100 crèches, 800 maternal refectories and 198 "Case della madre e del bambino", which annually assisted hundreds of thousands of pregnant and nursing mothers and millions of children (Gagliardini 1950). In the aftermath of the conflict, having overcome the issue of the so-called betterment of the bloodline, a legacy of a government to be quickly forgotten, in a situation of general misery, aid to poor women

Fig. 03: E. Mocchi, Project of "Casa della madre e del bambino", Pavie 1938 (Archive of State, Pavia).

and needy children, as well as to the civilian victims of the war, became a priority. If racism, the pillar of the organisation's foundation, was soon and quickly forgotten, the social and humanitarian values of the ONMI buildings remained central to assistance in the area, at a time when financial resources were scarce. The buildings were thus used for intervention in favour of populations suffering from precarious housing, lack of education and food, and, lastly, the absence of adequate basic healthcare.

Law no. 698 of 23 December 1975, which effectively abolished the ONMI and divided its tasks among the regions, provinces and municipalities , thus ended the history of the institution dedicated to mothers and children, but not that of its buildings, which passed into the hands of local authorities, who in some cases made them survive masterfully (see, e.g., the "Casa della madre e del bambino" in Udine, and Mortara), while in others they exposed them to decay or improper maintenance. Regardless of the individual cases, the question of minor, non-rhetorical, "current" architectures in the meaning given to them by Giuseppe Pagano in 1935, to be saved or not, remained open until today, when the appropriateness and feasibility of their preservation is still being debated, given their unquestionable contemporary value and their being "ordinary quality buildings".

In the second half of the twentieth century, the former ONMI buildings – considered minor works, albeit some "auteur" ones – have been, in some cases, exposed to deterioration, neglect or improper maintenance, in others, modified-often by massive works that have distorted the rationalist features of their origins. There has been no shortage of exceptions, as for example in Latina (Littoria), where the ONMI building was restored in the early 1990s to be used as offices for the Operational Center of the Soprintendenza per i Beni ambientali e architettonici of Lazio; or as in Udine, where the "Casa della madre e del bambino" built by Provino Valle, used since 1975 as a kindergarten, has been periodically maintained by the municipality with good results. The episode of the Mortara building is also to be considered a

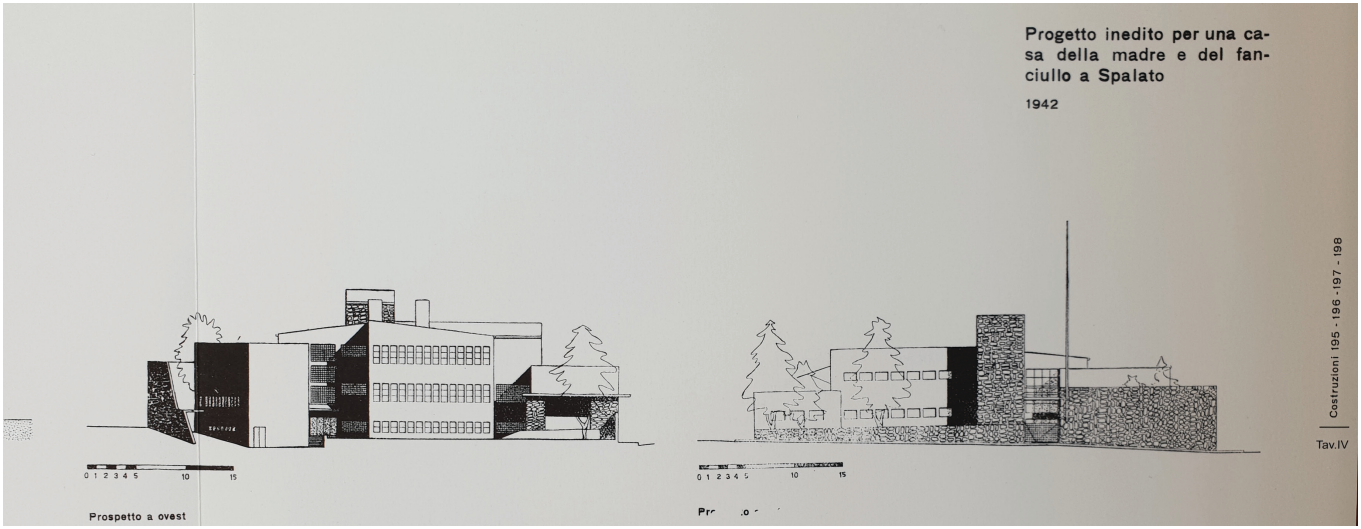

Fig. 04: G. Pagano, Project of "Casa della madre e del bambino", Split 1942 (Casabella, 195/198).

virtuous case, not only of preservation but also of intelligent reuse: after the dissolution of ONMI, the building was used exclusively as a nursery school until 1990, when, following some transformation works, it also became a kindergarten, and then in 2010 it was destined for use as a civic library (Figs. 05-06). This was a brave choice, considering that Baldessari's kindergarten center, although born as a replicable project and, in the designer's intentions, also easily expandable, was indeed a unique work and therefore difficult to modify.

In recent years, the thorny issue of the preservation of buildings constructed in the Ventennio has again been the subject of interest, not only scholarly. In Italy, but specially abroad (Gundle et al. 2013; Hökerberg 2018; Lucaroni 2020), contemporary historians have sought to actualize the issue of "places of memory" (Albanese & Ceci 2022), even in the aftermath of current political events, often disregarding the multi-year debate recorded in the copious bibliography produced by Italian architectural historians. Discussions and controversies have been triggered over inconvenient legacies, once again raising questions that were thought to be outdated (Malone 2017; Bartolini 2020). The democratic "populism" of political correctness – as Irace writes – erases the troubled and complex work of historiographical elaboration

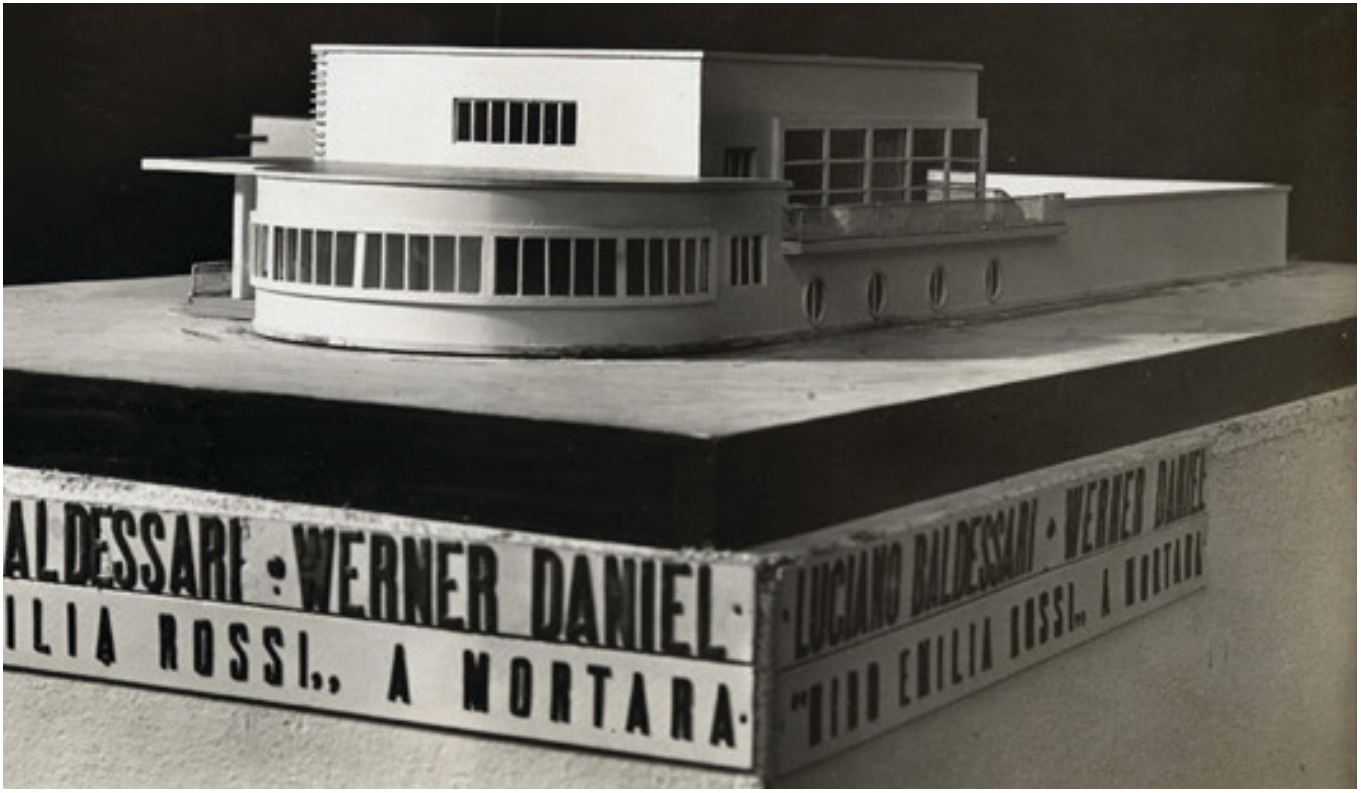

Fig. 05: L. Baldessari with W. Daniel, "Casa della madre e del bambino", Mortara 1932-33 (Archive Fondazione Triennale di Milano).

that for decades "allowed for a less sectarian and crude conception of the twentieth century" (Irace 2017). Controversy aside, it remains incontrovertible that the legacy of architecture produced during the years of fascism consists of public buildings often of the highest quality. It is no coincidence that in the last fifty years the terms rational architecture, monumental architecture, and interwar architecture have been preferred to the appellation "fascist architecture". In Italy those buildings possess a value beyond any personal consideration and allowed rural Italy's entry into modernity (Ciucci & Muratore 2004; Gentile 2007; Gentile 2008). As Irace also write: "This consideration also implies that it would be anti-historical and wrong to think of saving a few 'masterpieces' by demolishing the 'ugliness' of so-called minor buildings. First because history teaches us that what was once considered minor has often been reevaluated and recognized as valuable and fundamental. Then because history cannot claim to rewrite the past at will, it being the shared heritage of a collective memory" (Irace 2017).

The issue of "ordinary" quality architecture built during fascism opens up a number of questions about the desirability and feasibility of their integral preservation. Of course, it is not a question of safeguarding the so-called commemorative value, let alone the original use value.

But precisely the latter value – according to the well-known meanings given of it by Alois Riegl over a century ago – can be considered in relation to the meaning of contemporary value (Riegl 1903). After all, the concept of use value had prevailed during the difficult years of Reconstruction, when it was decided to continue to employ the former buildings with the same functions, despite the racist ideology of the patrons. In fact, the issue of the erasure of political symbols, of "deiconization" (Cresti 2005), did not concern, as was mentioned above, the ONMI buildings, since in these buildings the emblems of fascism were not stamped on the marble as in the ONB buildings or the Case del Fascio. There were no decorations, spaces or rooms with an obvious fascist connotation, such as shrines, classrooms for rallies or propaganda projections.

The "Case della madre e del bambino" were expressions in themselves of fascism's racist policies, but the absence of any rhetorical character, iconographic apparatus or overt exterior form linking them to the past regime, as well as the maintenance of sanitary functions necessary for the new republican Italy, were a saving pass, allowing for a silent re-semantization, as well as the removal of shame for the racist purposes inherent in their birth. However, paradoxically, it was precisely this absence that contributed to the proliferation of improper maintenance or disrespectful transformations, even when, in the last quarter of the twentieth century, the process of re-evaluation of many architectural works built during the Fascist period had begun.

Fig. 06: L. Baldessari, "Casa della madre e del bambino", Mortara 1932-33 (photo by author).

Note

A broader research on the relationship between Euthenics and Architecture in Fascist Italy, particularly on the theme of welfare architecture for women and children, is in progress. Initial results were published in Savorra 2021; ; Savorra 2024a; Savorra 2024b; Savorra 2024c.. Please refer to that book for bibliography and for information on the various archival references.

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The Law no. 698 of 23 December 1975 was published in the Gazzetta ufficiale on 31 December 1975.

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EDUCATIONAL APPROACH AND CASE STUDIES

INTERDISCIPLINARY RESEARCH AND DESIGN ON SUSTAINABLE REUSE

Integrated methodology for the development of sustainable reuse projects

B.SuRe 2022

Marco Morandotti

University of Pavia - Italy

The first edition of the B.SuRe Winter School was organized in response to the growing need to provide students with the opportunity to engage in an interdisciplinary program dedicated to the sustainable reuse of built heritage. Conceived as part of the didactic activities of the European Campus of City-Universities (EC2U) Alliance, the Winter School was designed as a space for exchange and experimentation among students and scholars from different disciplines and universities. Its primary aim was to foster critical dialogue and collaborative practices in the field of building and urban sustainability, with particular reference to interventions on historic cities and architectural heritage within the EC2U Alliance.The School's ambition was to establish the nucleus of a long-term research community composed of young scholars and experts sharing an interest in sustainable heritage reuse, approached through complementary and interdisciplinary perspectives. In this sense, the Winter School acted as a catalyst for diverse interests and ongoing activities among several groups involved in the Alliance.

Due to the restrictions imposed by the COVID-19 pandemic, the first edition was held entirely online. Nevertheless, the program was carefully structured to guarantee a multidisciplinary and multiscalar educational approach, combining plenary lectures, focus groups, and team-based project work.

Four thematic areas were identified as the backbone of the School's activities. Each was introduced by contributions from university researchers and followed by collegial discussions involving faculty members and participants, thus stimulating active participation and critical debate. The thematic clusters included:

- Urban sustainability and sustainable urban development strategies and tools;
- Energy retrofitting of cultural heritage;
- Sustainable reuse and restoration: models and strategies;
- Innovative technologies for heritage representation, digital documentation, and valorization.

These topics were explored not only through theoretical lectures but also through the analysis of case studies

on functional reconversion projects and restoration practices. This approach fostered a trans-European comparison of shared challenges and promoted a broad, comparative perspective on sustainable heritage management. In addition to lectures and discussions, students participated in focus groups designed to encourage personal reflection and the exchange of experiences, expectations, and academic trajectories. The School culminated in a public final conference that extended its impact beyond the academic community by engaging local professional associations, administrators, faculty members, and representatives of civil society. This closing event provided a platform for dialogue between academia and practice, highlighting the School's potential as a bridge between research, education, and local governance.

Since its inception, the B.SuRe Winter School has aimed to consolidate itself as a recurring EC2U initiative. Over its subsequent three editions, it has progressively become an integrated training component within EC2U Work Package 6 (Virtual Institute), strengthening its position as a regular interdisciplinary training and networking moment.

Collaborative Learning and Group Work

A key feature of the School was the emphasis on teamwork as a driver of cooperation among students with diverse academic backgrounds and skillsets. Each group, composed of six students, was structured to foster the development of specific competencies: conducting preliminary analyses; designing strategic actions; establishing effective collaboration; and sharing knowledge toward a common goal.

Groups were intentionally mixed in terms of disciplinary background and methodological approach. This pedagogical choice mirrored real-world professional environments, where diverse expertise must converge to address complex problems. Within each team, roles were distributed to guide project development, including introducing proposed actions, structuring workflows, facilitating discussions, and synthesizing outcomes. This organization fostered responsibility-sharing and trained students in collaborative leadership and negotiation—essential skills for future professional practice. The final project required each team to develop an in-depth analysis of one of the thematic topics discussed during the School. This entailed identifying the most relevant aspects of the chosen theme, defining objectives, classifying issues, and structuring a coherent path for presenting findings. Through this exercise, students learned to translate theoretical insights into actionable strategies for heritage sustainability. In this context, the discussion naturally evolved toward broader reflections on methodologies and tools capable of supporting the sustainable management of the built environment, particularly through the lens of digital innovation.

Digital Asset Management and Sustainable Heritage

Although at first glance Digital Asset Management (DAM) might appear tangential to the School's thematic focus, it is in fact deeply transversal and increasingly central to sustainable built heritage practices. DAM provides an integrated framework that connects disciplines related to heritage conservation and management, and it is expected to play an even more crucial role in the near future as a result of ongoing digital transformations in the built environment sector.

As a discipline, asset management pursues three complementary goals:

- Balancing risks, opportunities, and costs in order to achieve organizational objectives through the integration of diverse digital technologies;
- Producing value through the management of the built environment, particularly by enhancing CH;
- Supporting sustainability strategies by embedding long-term planning in conservation/reuse practices.

The concept of integration is fundamental: not only between technologies, but also between technologies and users, and between users and buildings. Asset management thus becomes a framework for fostering value creation, aligning with the principles of cultural heritage valorization and sustainable reuse.

Applied to built heritage, asset management requires a shift from restoration conceived as a one-time event to preservation understood as a continuous process. This perspective entails more than maintenance and monitoring: it involves a complex strategy combining large-scale risk reduction with the organization of daily conservation practices, all of which can be greatly enhanced by coordinated digital ecosystems.

Asset management proves particularly relevant when linked to adaptive reuse strategies, which recognize that buildings, districts, and sites are dynamic entities whose functions evolve over time. Adaptive reuse introduces new uses into existing heritage while responding to societal needs and respecting the principles of maximum conservation and minimum transformation. Within this framework, integrated digital asset management strategies can leverage predictive evaluation tools and decision-support systems, making full use of interactive models and big data to optimize interventions.

Sustainable Management of Historic University Facilities

A specific focus of the School also concerned the sustainable management of historic university facilities located within consolidated urban fabrics. This topic, which lies at the very heart of the EC2U Alliance given its composition, was addressed not only through dedicated scientific contributions, but also through a special in-depth session on the strategic planning and building interventions currently underway at the University of Pavia. This theme, in itself, represents a potential asset for the development of future research within the Alliance.

Although this is not the place for an exhaustive examination of the multiple forms of interaction between university facilities and urban structures, it is important to note that, particularly in the European context and especially in cities with a strong historical tradition, mixed settlement typologies have developed. These include the simultaneous presence of universities in central historic buildings and in more recently built functional complexes located in peripheral urban areas. This makes it increasingly necessary to develop effective integration policies between universities and cities, enabling university facilities to be perceived as integral parts of the urban structure—also through controlled access by external public users where appropriate—while at the same time allowing the university community, with its distinctive needs, to engage productively with the city as an integrated system of economic, social, cultural, and recreational offerings. In general terms, it is possible to identify and recognize a dual relational dimension of university heritage: an internal and an external one. The internal dimension concerns the interaction with the direct users of university spaces and is connected to the paradigms of quality evaluation—understood as the fulfillment of explicit and implicit user needs. This involves the management and rationalization of spaces, regulatory compliance, safety, and usability.

The external dimension relates to the public role of the university, and can be viewed from two complementary angles. On the one hand, the relationship with other local public administrations (municipal, provincial, and regional), thus tying back to the strategic question of institutional relations and their optimization in support of the university's strategic interests. On the other hand, the broader cultural and touristic dimension, involving policies and strategies for the valorization of university heritage, especially in terms of its most historically and architecturally significant assets. From this perspective, it becomes clear that the built heritage of a university, beyond being a set of functional facilities, plays an essential role in any governance strategy.

Firstly, it represents a symbolic and prestigious asset, embodying the relevance of the institution. Although the era of sterile self-celebratory architecture has passed, the need remains to ensure adequate facilities that are not only functionally efficient but also representative of the tradition and role of the university.

Secondly, universities face the rapid transformation of user needs, both explicit and implicit, which characterizes contemporary society. This requires technical, operational, and financial capacity to

continuously update existing infrastructure in order to maintain adequate performance levels and meet rising expectations. Consider, for instance, the pressing need to address accessibility, safety (fire prevention, seismic vulnerability), and energy efficiency. For historic universities, this inevitably means working with architecturally and monumentally valuable structures that, while embodying prestige and tradition, impose strict constraints on transformation and adaptation.

Thirdly, the expansion of university functions beyond teaching and research must be taken into account. The so-called "third mission" brings new opportunities for opening universities to external economic and social actors, such as business incubators, technology parks, and even cultural facilities like university museums, which can serve as interfaces between the academic community and the wider public.

Especially in the case of historic universities that have developed across centuries, the continuous use of facilities, combined with growing demands for modernization and efficiency, makes it imperative to enhance both the management and valorization of university heritage. This implies the need to rethink the built environment in technological and typological terms alike, in line with the evolving mission of the contemporary university.

Conclusion

B.SuRe has demonstrated its capacity to nurture a new generation of scholars and practitioners equipped to address the complex challenges of sustainable heritage reuse. Beyond its didactic and research value, the School has also played a pioneering role in fostering interinstitutional dialogue within the EC2U Alliance. By connecting universities and municipal administrations around the shared theme of cultural heritage valorization, it has created the first conditions for building a common and transversal platform of collaboration across historic cities with historic universities. In this sense, cultural heritage has emerged not only as a field of study, but as a shared language capable of bridging academic, civic, and administrative perspectives. It has acted as a unifying element, a "common ground" that enables dialogue and cooperation across diverse institutional and territorial contexts. The School thus stands as both an educational initiative and a strategic instrument for consolidating cultural heritage as the connective tissue of the EC2U network, reinforcing its identity as a community of historic cities and universities committed to sustainability, innovation, and the valorization of their common legacy.

PHASES	ACTIONS	GOALS
0: STARTING POINT	Comparison and shared choice of the topics.	Definition of the topic to be explored during the afternoon activities based on the interests of the majority of the group.
1: TOPIC AND SUB-TOPIC	Discussion about the knowledge of each on the subject.	Indicate what the level of general knowledge is based on your experiences.
2: IDENTIFY THE MAIN ASPECTS OF THE PROBLEM	Define the main objectives based on the main aspects of the chosen theme.	To define the main objectives organize the aspects into: 1. Main features 2. Important elements according to the objectives 3. Possibility of action and development
3: ORGANIZE BY AREAS	Group the questions that emerged in Phase 2 by areas of interest.	Classify the questions into categories. Identify a logical path for presenting the topics. Try to answer the questions.
4: SUBDIVISION OF IN-DEPTH TASKS	Search for information on the web and evaluate the validity of the sources to be used.	Research on the web and preparation of material to share with classmates. Each participant prepares a summary to share with the group. Phase of sharing and presentation of what has been summarized and analysed.
5: SYNTHESIZE AS A GROUP ACTION	The students discuss the main aspects of the problem and indicate to the Minute Reporter how to build the final power point, which is created all together as a Group.	While the Minute Reporter prepares the final document, sharing the monitor, the group actively participates, proposes any corrections, and verifies that the points addressed have been correctly summarized. Take a group screenshot and insert it into the ppt. Rename the power point as: DayX_FocusY_GroupZ
6: CONCLUSIONS	Final phase: final round table of all groups together (about 10 minutes per group).	Comparison and discussion with Tutors and Professors of the Winter School. Digital delivery of the final power point.

Right: during the summer school, a day was organised for the EC2U Alliance municipalities where each municipal technician/assessor could show good practices from their city on one of the school's topics. From that initiative an active partnership was then built that led to the winning of the Interreg Europe call for proposals and the creation of the Interreg CHARME project that has the Municipality of Pavia as lead partner and University of Pavia, DICAr, as Advisory Partner.

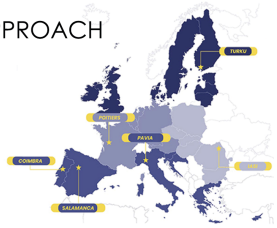
Previous page: the image outlines the structured phases of a student group project conducted during the Summer School program. The chart is divided into six distinct phases, each with clearly defined actions and goals, aiming to promote collaborative learning and critical thinking among participants. This process emphasizes teamwork, digital skills, and peer learning, culminating in a final presentation that reflects the group's collective insights and efforts. The framework encourages responsibility, active participation, and analytical thinking, making it ideal for immersive educational programs.

B.SuRe **B**UILDING **SU**STAINABLE **RE**USE

A MULTIDISCIPLINARY AND MULTISCALE EDUCATIONAL APPROACH FOR SUSTAINABLE CITIES AND COMMUNITIES

EC2U ALLIANCE ONLINE WINTER SCHOOL

24/25 FEBRUARY - 02/03/04 MARCH 2022
UNIVERSITY OF PAVIA



11 SUSTAINABLE CITIES AND COMMUNITIES — UNSDG GOAL 11: MAKE CITIES INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE

EC²U

THURSDAY 3RD MARCH 2022 — DAY 4

Morning session	**BEST PRACTICE & CASE STUDIES: UNIVERSITY OF PAVIA AND MUNICIPALITIES**		
09.00 - 09.30	Sustainability at UNIPV: the role of OSA-Office for sustainable actions	Andrea Zatti *Office for sustainable actions (OSA) - Pavia*	Oral presentation
09.30 - 10.00	Between valorization and innovation, between reuse and new buildings: the strategies of the University of Pavia for the building heritage	Alessandro Greco *Building delegate - University of Pavia*	Oral presentation
10.00 - 10.30	Historic Buildings sustainable reuse: establishing passive barriers in office buildings - a case study	Luisa Pereira *University of Coimbra*	Oral presentation
10.30 - 10.45	DISCUSSION		
Morning session	**CULTCITIES PROJECT**		
11.00 - 13.00	Opening of the meeting	Marco Morandotti *University of Pavia*	
	EC2U and CultCities project	Maria Spitti *Pavia Europe Office Coordinator*	
	Municipality of Pavia	Mara Latini *Head of the Public Works, Maintenance, Expropriation and Mobility Department*	
	Municipality of Hildesheim	Fritz Ahrberg *Tourism Manager of Hildesheim Marketing*	
	Municipality of Turku	Joanna Kurth *Municipality of Turku - Project manager*	
	Municipality of Coimbra	Joana Gouveia Loureiro *Municipality of Coimbra - Cultural Officier*	
	Grand Poitiers Urban Community	Florence Cazals *Chargée de mission ingénierie de projets européens et internationaux*	
	Municipality of Iasi	Elena Farca *Head of International Affairs Office*	
	Municipality of Salamanca	Rubén Tostado González *Coordinador general Fundación Salamanca Ciudad de Cultura y Saberes*	
	Municipality of Besançon	Marieke Steenbergen *Head of international relations*	
Afternoon session	**STUDENTS FOCUS GROUP** ABOUT TOPIC 4		
14.00 - 17.00	Working group	Students focus group	Student activities
17.00 - 18.00	DAY'S WORK PRESENTATION Students roundtable		

UNIVERSITÀ DI PAVIA · DIPARTIMENTO INGEGNERIA CIVILE ARCHITETTURA DICAr · UNIVERSIDADE D COIMBRA · UNIVERSITATEA „ALEXANDRU IOAN CUZA" din IAȘI · FRIEDRICH-SCHILLER-UNIVERSITÄT JENA · Université de Poitiers · VNIVERSIDAD D SALAMANCA · TURUN YLIOPISTO


Iași - former capital of Moldova
TRANSYLVANIA
WALLACHIA

A collaborative method for planning a sustainable cultural café in a historic building

B.SuRe 2023

Mihai Bulai

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Abstract

The third-wave paradigm in coffee culture and cafés has shaped, since the 2000s, a new social and cultural urban stage. University students are key customers and participants in these new sociable, creative, and sustainability-oriented places. This study proposed a collaborative methodology for planning a sustainable cultural café in a historical building, based on five pillars: business approach, café characteristics, social and cultural aspects, characteristics of historic buildings, and environment-oriented sustainable or circular economy consumer behaviours. This was applied to 24 students from 7 different European university cities within a workshop whose results proposed three different concepts: the "Coffee Garden" experience within a Botanical Garden, "La Galleria", a museum or art gallery-style creative space, and "Meet Cups", a place of storytelling and cultural diversity celebration. All proposals emphasized the social, cultural, and educational role of new cafés seen as stages to promote diversity. Moreover, the guest is perceived as the potential co-creator of the place, experiences, relationships, and products. Future approaches may include professionals and researchers in the student teams to create dialogue and feasibility to such proposals.

Keywords

sustainable café, circular economy, cultural places, entrepreneurship, historic building

Coffee is part of the contemporary culture in most parts of the world, often symbolizing or being part of hospitality, socialization, and tradition. (Maspul, 2023). Coffee is pleasure, enjoyment, self-reward, an excuse for communication, and for being accepted in a group.

Coffee is consumed in larger quantities, especially in the North, and is mainly produced in the South. (Samper & Quiñones-Ruiz, 2017). Europe and North America hold the records for coffee consumption, over 4.5 kg/year/capita, as opposed to Africa or Asia with only 0.6 kg/year/capita (International Coffee Organization – Coffee Report and Outlook 2023). Coffee shops, coffeehouses, or cafés represent a global hospitality sub-sector that plays an increasingly important role in national economies and societal well-being. (Filimonau et al., 2019)

From the traditional coffee culture in the 19th and most of the 20th Century, where coffee was seen as a commodity, a basic item easy to find in every household, the 1970s brought the Starbucks model of cafés, with better quality coffee, social experience, new architecture, and interior design. The dawn of the 21st Century has seen a new change in the environmental impact of coffee, such as the essential role of geographical origin, direct trade, and shorter supply chain of coffee beans from farm to cup, and developing partnerships with coffee-growing communities (Samper & Quiñones-Ruiz, 2017), along with new quality standards (the „specialty coffee" trend) which made professionals call it the "Third Wave" at the beginning of the 2000s. The third-wave coffee phenomenon also focuses on artisanship and expertise, sensual experience, face-to-face communication, community, and technology (Manzo, 2015). New design standards have arisen, with Scandinavian-inspired minimalist furnishing, and a focus on materials' sustainability. This design enhances the communication of products or communication between customers and employees (Brose, 2018). Knowledgeable coffee baristas and entrepreneurs often become sustainability pedagogues, inviting guests to join in a convivial, creative, and sustainable engagement with the place, thus placing cafés within the area of `urban ecotourism` (Higgins-Desbiolles et al., 2014).

University students are key customers of third-wave cafés (or simply "specialty cafés") which become new gathering places in large cities, and also vectors of sustainability ideas and change. Such cafés are, in their majority, independent, not part of franchises or chains, as the entrepreneurs are young graduates who recently dived into the world of coffee. Entrepreneurship has tended, in the past years, to be more and more integrated in the Universities that often access project grants to support such innovation.

The winter school "B.Sure" – Building Sustainable Reuse – a Multidisciplinary and Multiscale Educational Approach for Sustainable Cities and Communities, organized in Febr-March 2023 by the University of Pavia, Italy within the frame of the European University Alliance EC2U aimed at „triggering processes of exchange and of experimentation between students of different disciplines, focused on the field of building and urban sustainability, regarding the intervention on historic cities and building heritage", from 7 different European Universities: Coimbra (PT), Jena (DE), Turku (FI), Iași (RO), Poitiers (FR), Salamanca (ES) and Pavia (IT). Thus, keywords such as exchange, urban sustainability, and heritage has led to our workshop proposal: how can students from different backgrounds and countries bring their ideas together to plan a sustainable café business in a historic building, with social and cultural features making it open to the community or even a community-builder? The workshop methodology included the following steps:

- Understanding the keywords within the proposes topic, the utility of the topic within a cross-disciplinary discussion, including a warm-up session about the participants' own active sustainable practices

- Constructing the workshop steps in accordance with the research methodology, and building the workshop frame for teams
- Defining oral presentation methods
- integration of own results into the final document.

Participants have immediately connected with the topic as they already had a positive perception over some of the sustainability features proposed by the specialty cafés, as well as of the social and cultural side of such places they have already frequented. The utility of the topic was discussed through each one's experiences with heritage conservation and promotion, gastronomy as the new culture, entrepreneurship as increasing career opportunity for students and graduates, places of gathering and places of culture, as well as the importance of sustainability in our daily lives.

Methodology

In order to better reiterate the concept of sustainability and its three pillars, environment, economy, society, students have given examples of own sustainable practices they have adopted so far. Most examples have targeted environment-oriented practices such as waste-sorting, reducing unsustainable foods, avoiding single-use plastic, use of bicycle, buying basic products from the proximity to diminish pollution generated by transports etc. Few examples have targeted economy-oriented measures, such as supporting local entrepreneurs, buying from family-owned or independent businesses, avoiding best-located restaurants or cafés in order to tackle touristification or gentrification of central spaces. The social aspects have been neglected, the few participants mentioning their choice for community-like gathering places, with cultural activities.

The research methodology offers an easy-to-use tool to tackle such a topic: premises (thesis) – keywords – problematics – relationship between object and subject – results – conclusions. The premise (thesis) was thus defined: sustainable cultural cafés fit well into the historic urban tissue. A unique, well-defined concept is needed to succeed in such implementation and to differentiate from similar proposals. The following keywords were retained: sustainability and circular economy, social aspects and culture, entrepreneurship (objects), café business, physical café within a historic building (subjects).

From these keywords, a series of research questions arose: Which are the main successful business characteristics? What makes a great café or coffee shop in order to succeed as an entrepreneur? What makes a space or a business premise "social" or "cultural"? What are the main characteristics (pros and cons) of a historic building? Which environment-oriented sustainable behaviours are necessary or easy to implement in such a business activity? Answering each of these questions provided a structured work frame:

- General business characteristics: motivation, initial investment (how much?), sales plan, capital recovery plan, target audience (consumers), location & geography (where?), position to competitors (collaboration or detachment?), marketing plan, pricing plan, employees, current resources & skills, time investment, USP (unique selling proposition), ownership (single or multiple).
- Characteristics of third-wave cafés or coffeehouses: quality grade of coffee beans, equipment and technology, traffic of customers, profile of baristas (employees), strong identity, contemporary or thematic design, type of furniture, atmosphere, customer service, accessibility & convenience etc.
- Social and cultural aspects. Culture contains but often transcends social characteristics, thus, in order to understand what makes a place social or cultural, a dichotomy is needed: people gathering place vs. arts presentation place, social interaction vs. participation and co-creation,

sense of community vs. sense of creativity and innovation, feeling of safety vs. feeling of ephemeral, comfort vs emotions, informative experiences vs. educational experiences, classical seating places vs. unconventional seating or standing, extrospective vs. introspective etc.

- Characteristics of historic buildings: great façades, stories to tell, architectural character, sense of place, sense of culture and pride, environmental value (preserving and restoring historic buildings is like recycling materials), learning tools for locals, value for businesses, especially for tourism sector, community involvement etc. There are a series of weaknesses to be considered, as historic buildings are expensive to restore or rehabilitate, there are restricted interventions on registered historic monuments etc.
- Environment-oriented sustainable or circular economy consumer behaviours: the 10Rs of circular economy (refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, recover), resource-efficient (water, food, energy, trees), carbon-neutral, and ethical practices ecological products (less harm on the environment), organic or biological resources (less direct harm on human health), local products (production place close to consumption place), green commuting, environmental education of consumers and employees etc.

The workshop consisted of working in three teams, each planning a concept of sustainable cultural café in a historic building by identifying 3-4 characteristics of each of the five pillars (business characteristics – café entrepreneurship – social and cultural places – historic building – circular behaviours) which they must argue, elaborate and use effectively to create a personalized overall concept. At the end, each team had to choose a business name and a verbal identity (such as a brand promise, motto or phrase) who build the proposal, but also clearly differentiate it from others, as well as to present the concept in front of the audience.

Results

The results were the following:

1. COFFEE GARDEN – The Coffee Experience in the Botanical Garden: "Unique, because you made it". This proposal will emphasize on employees as part of the development process of establishing a café within a greenhouse inside a Botanical Garden. The uniqueness will consist in the fact that customers will be able to plant, grow and crop their own coffee plant by creating a partnership with a local farmer. The benefits of such a place include interaction and connection with nature, healthy and cosy atmosphere within a family-owned business. Other organic ingredients grown within the greenhouses will also be integrated the café food menu, and most products and ingredients will be eco-friendly. Employees will educate people about the coffee journey from plant to cup. Customers may decide to learn how to use brewing tools. The nature-like atmosphere will complete the positive impact on mood that coffee offers.

2. LA GALLERIA – Il Museo del Café: "Let our art inspire your Creativity". This proposal offers a partnership between art and coffee. The premises will be set to accommodate arts and artworks, where young people and new artists are able to display or perform their art, and sell their products. The café will hire disabled or discriminated employees in order to increase their social integration. The location will be on a well-connected accessible place, near public transport to support public mobility, with ramps for wheelchair accessibility. Advertisement will be done only through social media in order to avoid waste. Coffee will be bought with no intermediates from certified producers and baristas will be educated about coffee road from farm to cup. This café will enhance social interactions by shared tables, boardgames and group activities, cosiness and safety feeling through noise-cancellation materials (glass windows,

small trees etc.). Moreover, it will provide a cultural stage for master classes, exhibitions on city history, monthly thematic events. The plates and cutlery will be edible, local ethical-certified producers will be favoured, and organic waste will be used to produce plant fertilizers. The historic features of the building will be preserved, whereas windows will be used as a creative billboard and event calendar.

3. MEET CUPS – "A Cup of Stories". This proposal places students and their stories at the heart of the business. The target geographical location will be near the University campus, and main employees will be students, mostly part-time, in order to enhance their entrepreneurial skills. The premises will be designed with attention to people with disabilities, and with emphasis on communication between guests, on customizable seating, on collaborative ideas (such as a wooden board to stick ideas for future events), and on enjoyability (comfort zones, study and lecture areas, friend-zones, privacy areas). Sustainable furniture such as vintage recycles, ecological materials etc. will be favoured. The space will have a stage for daytime workshops, and for evening events crafted by students (open microphone nights, karaoke, stand-ups etc.) Thematic events will be based on cultural diversity of students in order to promote each one's values and increase the cultural sensitivity. Local products will be favoured within the food and drinks menu, and customers bringing their own coffee cups will receive incentives. Guests will be encouraged to tag the café in their social media "stories", but also to tell and offer their own stories to the barista, such as amazing, curious or fun life events, anecdotes, utopian stories, poems etc. thus contributing to the storytelling virtual library of the community. In order to promote these stories, coffee cups will display unique QR codes for customers to read the building or the city stories, as well as the community stories. The café walls will regularly display pictures of contributing customers (environmentally or culturally), in order to promote them as drivers of change or as community builders.

This collaborative approach has led to some surprising consistencies among the three teams that worked separately. All the proposals emphasized the guest or customer as the potential co-creator of place, experiences, relationships, even products. Then, the teams insisted on social and cultural aspects, with various concrete implementation measures, from physical design to specific activities. Thus, although sustainability is perceived in theory as mainly environmental and then economical, rarely social, when put into practice, the social and cultural aspects reveal as central to the approach. Another important aspect all teams have emphasized was that education is a basis of sustainability implementation, and of creating bonds and durable networks. The proposed concepts were designed as cultural stages for guests and visitors to say their word, to be able to act and influence others, to promote each one's diversity. On the other hand, the proposals offered simple and heterogenous circularity examples, which was due to the limited amount of time. Also, the characteristics and assets of the historic building were neglected due to the lack of a concrete case-study or imposed geographical setting.

The results have shown a surprising amount of fresh collaborative feasible ideas in a very short amount of time. This workshop can be seen as a case study of highly productive model of working together with people having very different background and nationality. In the future, these conceptual proposals may be assessed on specific markets to understand their feasibility and coherence. Further participative University workshops may include, in each team, professionals and researchers from each of the five fields (business administration, coffee entrepreneurship, culture and sociology, architecture and historical preservation, environmental sciences), in order to increase the feasibility of the approach.


Palazzo Vistarino

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Figures: Educational activities and workshops conducted during the B.SuRe winter school in its second edition, from 27 February to 3 March 2023, at Palazzo Bellisomi Vistarino in Pavia.

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23-27/09/2024

PAVIA

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BUILDING SUSTAINABLE REUSE

3RD EDITION

A MULTIDISCIPLINARY AND MULTISCALE EDUCATIONAL APPROACH FOR SUSTAINABLE CITIES AND COMMUNITIES

APPLICATION FROM 12/06/2024 TO 05/07/2024

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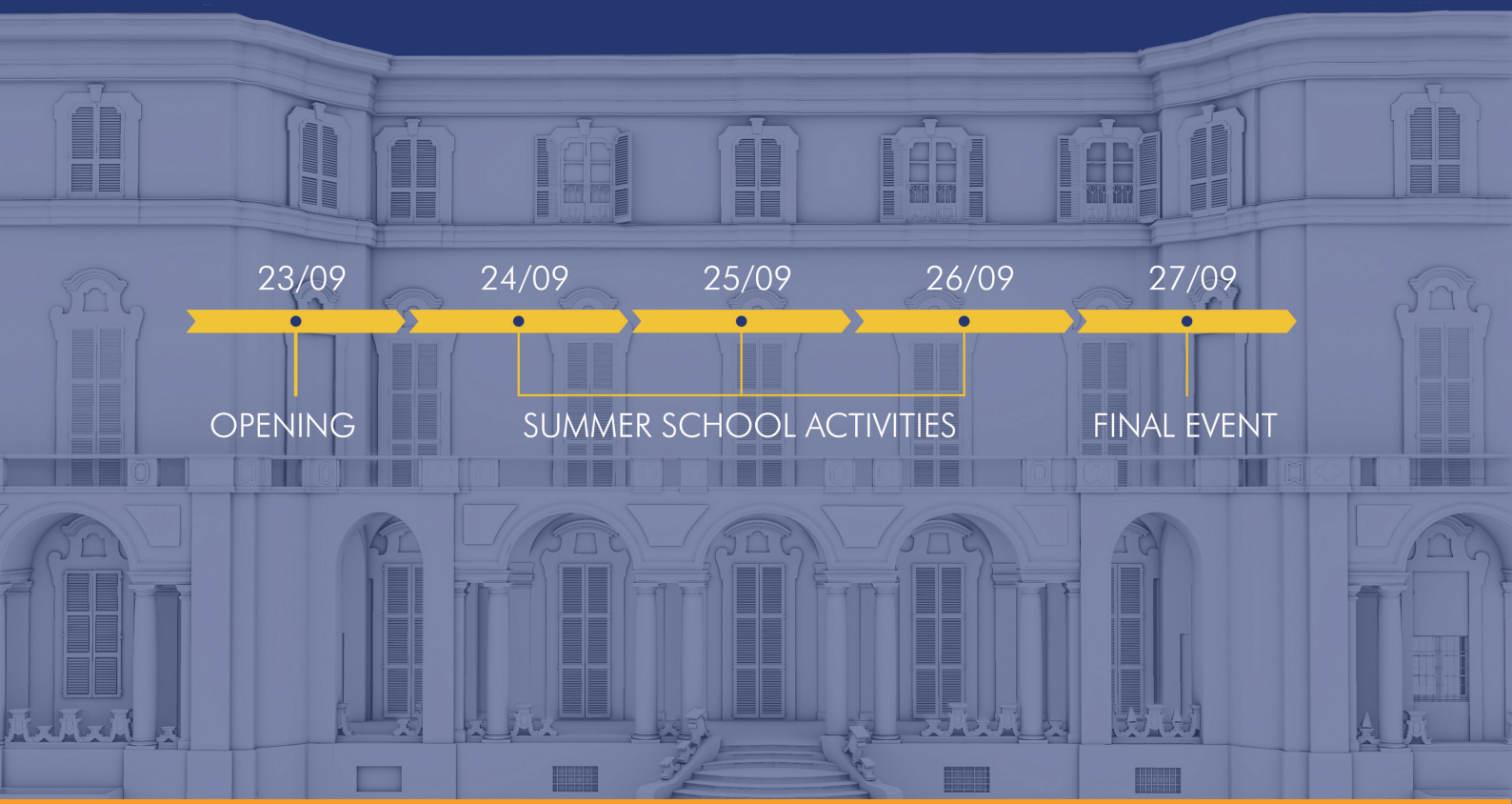

UNIVERSITÀ DI PAVIA

DICAr DIPARTIMENTO INGEGNERIA CIVILE ARCHITETTURA

STEP

PLAY Photography and 3D Laser for virtual Architecture LaboratorY

11 SUSTAINABLE CITIES AND COMMUNITIES

Co-funded by the European Union

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TURUN YLIOPISTO

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Multidiplinary approach for the re-functionalisation of abandoned buildings

B.SuRe 2024

Elisabetta Doria

University of Pavia - Italy

The implementation of sustainable reuse strategies constitutes one of the most effective approaches for mitigating resource consumption and safeguarding the existing built heritage. In addition to addressing pressing environmental concerns, reuse offers a critical design opportunity to reinterpret the value of existing buildings, enabling new modes of occupancy and preserving the continuity of constructed environments. Within the European Union, architectural heritage is not only extensively distributed across member states, but the existing building stock is also characterized by a high average age and increasing demands for maintenance and regulatory compliance. Currently, approximately 35% of buildings in the EU are over 50 years old, and nearly 75% of the real estate portfolio is classified as energy inefficient. The imperative to reduce the environmental footprint of the construction industry has led the scientific and professional communities to investigate reuse as a viable alternative to demolition and new construction. The adaptive recovery and functional reconfiguration of existing structures enable significant reductions in the consumption of raw materials, lower CO_2 emissions, and the retention of historical, cultural, and social value embedded in the built environment. Beyond environmental performance, reuse plays a pivotal role in reinforcing community identity and local cohesion—particularly in cases involving buildings of symbolic relevance or those that contribute significantly to the urban and landscape image. The reactivation of underutilized or abandoned spaces is thus not solely a technical intervention but also a socially embedded process, capable of reintroducing civic functions and fostering inclusive and innovative urban dynamics. In response to the economic crisis triggered in 2020, the European Union launched the Next Generation EU (NGEU) recovery instrument, a €750 billion initiative aimed at promoting sustainable management of human settlements at both architectural and urban scales. This comprehensive framework encompasses interventions targeting

not only the ordinary building stock but also protected cultural assets. The overarching framework guiding these actions is the United Nations 2030 Agenda for Sustainable Development. Sustainable reuse relies on the recognition that buildings, sites, and urban systems are dynamic entities, subject to evolving functions and socio-spatial roles throughout their lifecycle. Accordingly, they should not be conceived or managed as mono-functional structures. Sustainable reuse entails the integration of new uses and functions into pre-existing built fabric, with a critical emphasis on societal needs, and following the principle of maximum conservation with minimal transformation. This design paradigm, which balances conservation imperatives with spatial and functional adaptability, provides a robust foundation for enhancing the resilience and long-term sustainability of the built environment.

The third edition of the EC2U Summer School "B.SuRe: Building Sustainable Reuse," held in September 2024, was hosted at Palazzo Bellisomi Vistarino, a 18th-century palace located in the historic center of Pavia and an emblematic example of Lombard Barocchetto architecture, completed in 1753 by the renowned architect Francesco Croce. Organized by the Department of Civil Engineering and Architecture (DICAr) of the University of Pavia, the summer school engaged 33 master's and PhD students from eight European universities within the EC2U Alliance. The initiative was further supported by the Erasmus+ BIP framework and included international participants, among them students from Lviv, in Ukraine. The 2024 edition focused on the integration of new functions within underused and historically valuable spaces, specifically, the ground floor rooms and internal garden of Palazzo Bellisomi Vistarino, currently not in active use.

Participants from diverse disciplinary backgrounds were guided through a comprehensive, multidisciplinary methodology aligned with UN United Nations Sustainable Development Goal 11 ("Sustainable Cities and Communities"). The course combined theoretical instruction with hands-on workshops covering conservation techniques, heritage documentation, and site analysis. Field surveys and diagnostic investigations were conducted on-site, generating a digital twin of the selected areas. This virtual representation included geometric modeling, material mapping, and structural vulnerability assessments, following protocols developed by the coordinating team in recent research on sustainable restoration planning. Design proposals focused on adaptive reuse scenarios that introduced new spatial programs into the historical fabric. Each project was accompanied by feasibility assessments, including cost-benefit analyses and future-use simulations.

Final outputs were presented as immersive Virtual Toursinteractive digital models that showcased the restored spaces with newly assigned functions. A key innovation in this edition was the integration of Artificial Intelligence systems in the design process, explored through lectures by international experts (see Mishra, 2021). AI applications were examined in relation to predictive maintenance, monitoring, and risk prevention for historical assets, offering a forward-looking perspective on heritage management. With 72 applications received and 14 disciplinary profiles represented, the third edition marked the most interdisciplinary and productive iteration of the Summer School to date. It highlighted the critical role of transdisciplinary collaboration in developing resilient, digitally informed strategies for the sustainable reuse of built heritage.

The program was embedded in a broader research and training framework supported by the DORIAN excellence project and the experimental laboratories STEP and PLAY, aiming to advance dynamic conservation approaches and promote the integration of digital tools in architectural heritage practices and activities.

Workshop results

The third edition of the B.SuRe Summer School culminated in the development of interdisciplinary and forward-looking design research proposals for the adaptive reuse of Palazzo Bellisomi Vistarino. These projects, elaborated by international student teams from multiple EC2U universities, exemplify a shared vision of cultural heritage as a catalyst for sustainable development, combining architectural restoration, digital innovation, and community-centered business strategies.

The first project, "A New Vision: The Palace as an Art Center for the City", reimagines the disused spaces and garden of Palazzo Vistarino as a multifunctional cultural hub, incorporating exhibition rooms, an info point, a themed café-bar, and a museum-inspired retail area. The team emphasizes the restoration of the historical garden based on 19th-century design principles and introduces eco-friendly systems such as rainwater harvesting and composting. By integrating immersive storytelling and digital projections into the visitor experience, the project fosters accessibility, community engagement, and economic sustainability through culture-led revitalization.

The second proposal, "Preserving Cultural Heritage with a Sustainable Business Model", adopts a business-oriented approach to heritage reuse, applying the Business Model Canvas framework to envision the transformation of the palace into a dynamic coworking environment coupled with a community café and event space. This strategy supports the functional reintegration of the building into the urban and social fabric, providing flexible workspaces for local entrepreneurs, spaces for cultural and sports events in the garden, and a financial plan that ensures long-term viability. The project presents a detailed stakeholder map, SWOT and risk analysis, and a ten-year economic forecast that anticipates return on investment within five years, combining private and public funding sources, including EU programs and local foundations.

The third contribution, "Innovating User Experiences in Cultural Heritage: VR/AR Solutions for Palazzo Vistarino's Valorization", focuses on the use of immersive technologies such as virtual and augmented reality, coupled with AI-driven damage detection tools, to enhance both heritage preservation and audience interaction. The team developed a functional virtual tour prototype using 3D Vista, allowing users to explore interiors through 360-degree imagery, while proposing a range of AR applications tailored to different user groups, from families and tourists to professionals in architecture and conservation. Notably, AI models trained to detect various types of architectural decay (e.g., cracks, spalling, paint loss) were integrated into the AR platform, enabling real-time assessment and targeted maintenance planning. This approach merges education, entertainment, and conservation in a single strategy, offering sustainable revenue generation and deepening the public's connection to cultural heritage.

These projects not only demonstrate the educational impact of the B.SuRe Summer School but also offer replicable models for sustainable heritage reuse. Each of the three projects developed by international student teams exemplifies the convergence of architectural design, engineering, economics, digital technology, and cultural studies. This integrated approach proved essential in generating proposals that are not only technically and economically viable but also socially and culturally meaningful. The inclusion of tools such as business model frameworks, immersive digital media (VR/AR), and AI-powered diagnostics introduced innovative layers of analysis and engagement, while still respecting the historical integrity of Palazzo Vistarino. These tools were not mere technological add-ons, but means to enrich interpretation, expand accessibility, and ensure the long-term sustainability of the proposed interventions. The strength lies not only in the innovative content but in the collaborative method through which they were developed.

Photos by the 360° camera for the structuring of an interactive virtual tour and as a fast documentation activity of the rooms of the palace and garden under investigation for the Summer School. On this page: photos of the activities conducted at Palazzo Vistarino and at the Faculty of Engineering of the University of Pavia.

THE CASE STUDY OF VISTARINO PALACE IN PAVIA

ART CENTER

Palazzo Vistarino

The poin of PROJECT

Reuse hypothesis e new function of the palace

Historical garden reuse hypothesis

Include the city in the palace

A new vision: the Palace as an art center for the city

Rosy De Luca[1], Noemi Fregonara[1], Diana Strilchuk[1], Mohammad Fatemi[2]

[1]University of Pavia, [2]University of Turku

Abstract

This project reimagines the use of Palazzo Vistarino's underutilized spaces and garden through sustainable and culturally enriching functions. By integrating exhibition areas, an information point, a themed retail shop, and a relaxation bar, the proposal enhances visitor experience while respecting the site's historical identity. The restored garden adopts 19th-century design principles, incorporating art installations and eco-friendly technologies. Emphasis is placed on social inclusion, local collaboration, and the fusion of historical narrative with modern multimedia tools. The intervention aims to revitalize the palace as a vibrant cultural and social hub within the city of Pavia.

Summer School group:

University of Pavia: De Luca Rosy, Fregonara Noemi, Strilchuk Diana
University of Lviv: Fesiak Nadiia, Herhel Kateryna, Varenytsia Mariana
University of Turku: Mohammad Fatemi

The art Center disegn

Palazzo Bellisomi-Vistarino is a noble residence of eighteenth-century origin, overlooking the Ticino; defined as a "villa of delights", with frescoed rooms, spaces for music, reading and conservation, with a park, belvedere, chapel and stables.
The construction of the palace was commissioned by Gaetano Annibale Bellisomi who, around 1700, entrusted the work to the architect Francesco Croce. The project for the residence also included a library, an antiques and science museum and a wunderkammer (chamber of wonders) with naturalistic collections. The palace occupies a surface area of 5600 square meters. It is also one of the most important examples of the Lombard Baroque, thanks to the view from the belvedere and the park, creating a dialogue between the interior and exterior and between the city and the river. In 1800 the building was acquired by the Vistarino family, thanks to the marriage between their daughter and Annibale, who renovated it by creating an overlapping of styles, the eighteenth and nineteenth century. In the last period of 1900, in the 60s and 70s, it was used in the summer as a

Figures are part of the Summer School B.SuRe 2024 final presentation of students held in Pavia during the closing events.

ballroom Corsino Park, Source Archivio Chiolini.
Subsequently it was abandoned and left to decay until the purchase by the Alma Mater Ticinensis University Foundation, which occurred in 2007 and subsequently the public body restored it until 2013, making it fit for advanced training courses, conferences, seminars and concerts.
Then, after having made a historical and territorial analysis of the object, we moved on to the "meta-design", a preliminary approach in which we first define the users with their needs. For example, as tourists, students, families and workers. We decided to reuse the spaces inside the building to enhance the building and the garden. The spaces are dedicated to culture as art exhibition halls to support artists and events and provide information services, food and relaxation spaces. Subsequently, we moved on to the project which was divided into its parts:

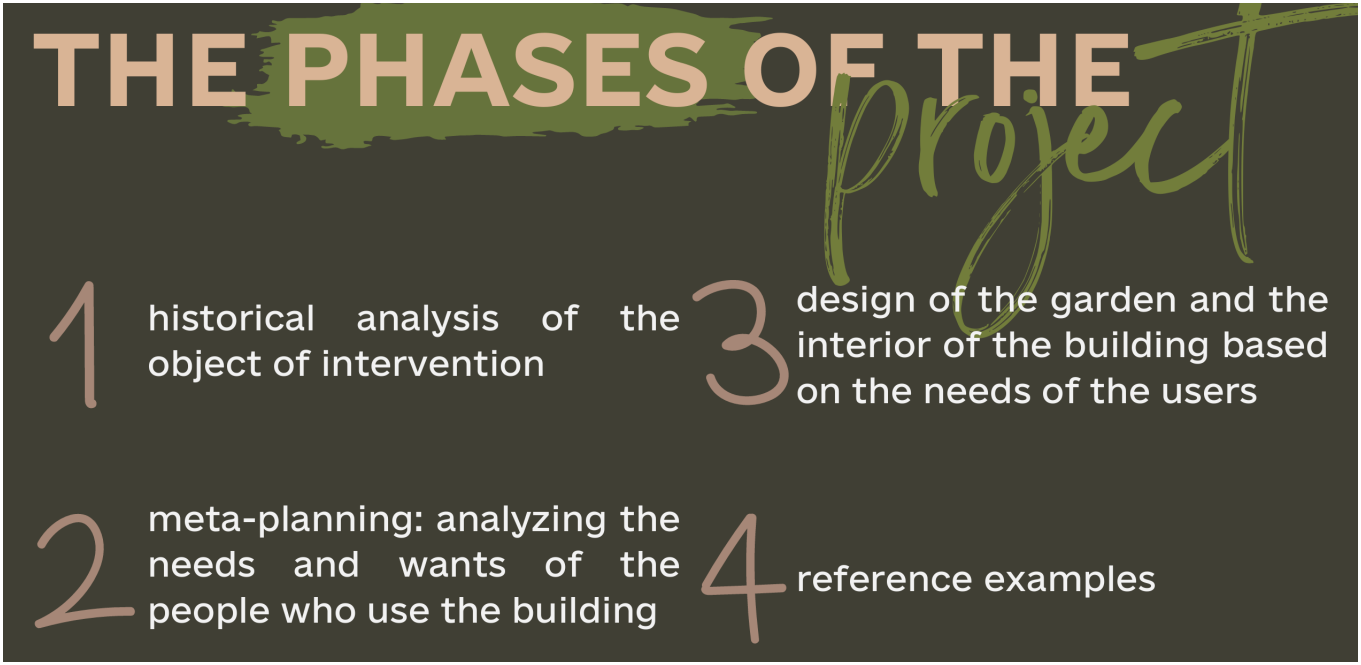
- the restoration and reuse of the garden;
- the reuse of the rooms not currently used.

The restoration of the garden is defined by taking up the regularity of nineteenth-century gardens, for example the garden of "Collegio Borromeo, Pavia".
In fact, the concept of the design is based on a module that takes up the regularity of the facade designed by Francesco Croce, so as to form a grid. As you can see, the design is made up of rigid and fluid elements:

1. The rigid element is the central path that leads from the entrance to the city to the palace and the belvedere;
2. The fluid elements are the old dance floor and the artificial hills.

All designs are valued by the placement of artwork according to the grid.
The main points of the historic garden project are:

1. Respect for history;
2. Bringing the city inside the palace;
3. Enhance the garden with art and events;
4. Use of sustainable technologies to respect the environment and biodiversity.



Moving inside, we have divided the spaces into 3 zones. The first zone is the InfoPoint where users can ask for information and a room dedicated to the guesthouse.
In the second zone there are two rooms for exhibitions of paintings or photos. Always going out, there is the loggia where sculptures can be installed.
In the third zone there is the bar where you can sit and have a snack.
We wanted to achieve three main goals, to enhance the different spaces.
The first goal is Museum Theme Product Integration, which includes a retail space dedicated to museum-themed products such as bags, gifts and souvenirs. This initiative does more than generate revenue; it reinforces the cultural identity of the Palazzo. By offering items inspired by its architecture, history and exhibitions, visitors can take home a memento of their experience. This retail will also foster a connection between visitors and the history of the Palazzo, making it a bridge between history and modern engagement.
Implementation Approach:

- Collaborating with local artists and craftsmen to create unique, site-specific merchandise.
- Design the store to integrate seamlessly with the exhibitions, offering thematic items in line with the current exhibitions.

As a second goal we wanted to enrich the visitor experience, video projectors will be incorporated into each exhibition area and bar. These will serve as tools for dynamic storytelling, allowing for immersive visual presentations that bring historical narratives to life or showcase modern art in innovative ways.
Implementation approach:
Strategically placed projectors will ensure optimal visibility while preserving the integrity of the historic interiors. Rotating projections tailored to the themes of exhibitions, allowing for renewal of the visitor experience. Leveraging modern projection technology to minimize energy consumption, aligning with sustainability goals.
The last one is the dedicated bar space which will be established as a central hub for visitors to relax and socialize. This space will cater to a diverse audience, offering refreshments and a welcoming environment to unwind after exploring the exhibitions. The bar will also serve as a place for informal discussions, promoting a sense of community within the Palace.
Implementation Approach:

- Designing the bar area to reflect the architectural and aesthetic sensibilities of the Palazzo.
- Using sustainable materials and practices in its construction and operation, such as locally sourced ingredients and minimal-waste practices.
- Offering a selection of themed beverages inspired by the history and culture of the region.

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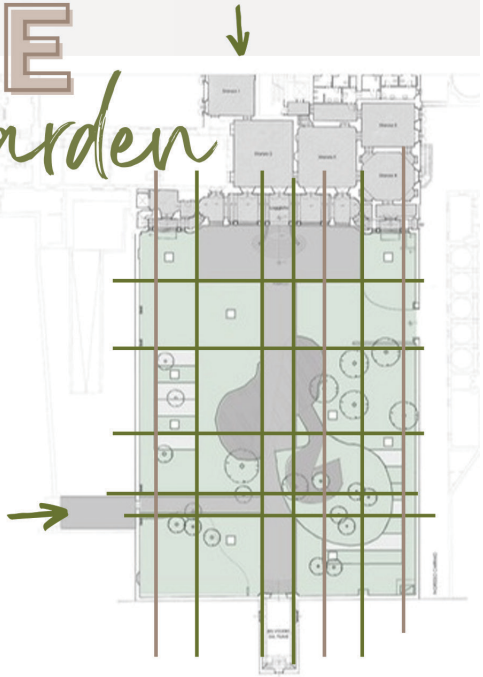
REUSE OF THE concept of historic garden

- the garden design was planned following the Croce façade module
- it is characterized by rigid and fluid elements
- Rigid elements is the central path connects the palace with the belvedere and the city
- fluid element is that we wanted the central square and artificial hill



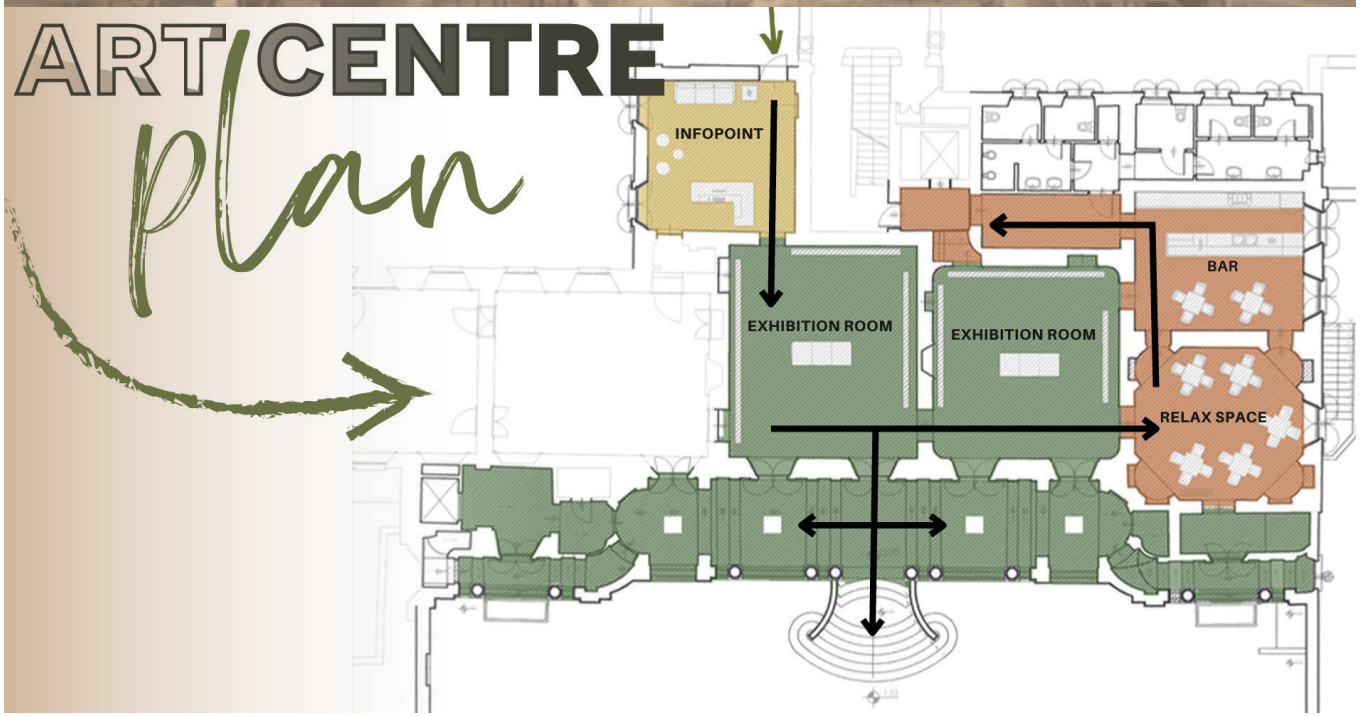
The garden will be open to citizens and tourists to visit. A path was designed to respect the history of the garden and its old functions; Integrating sustainable practices into the garden, such as using eco-frendly irrigation systems, rainwater harvesting, or composting, could make it a model for green heritage management. In addition to preserving traditional elements, the garden could include modern sculptures or contemporary design elements to symbolize of past and present. Community engagement for interconnection between different society and biodiversity conservation are fundamentals in the design phase.


reference
EXAMPLE OF THE
REUSE GARDEN

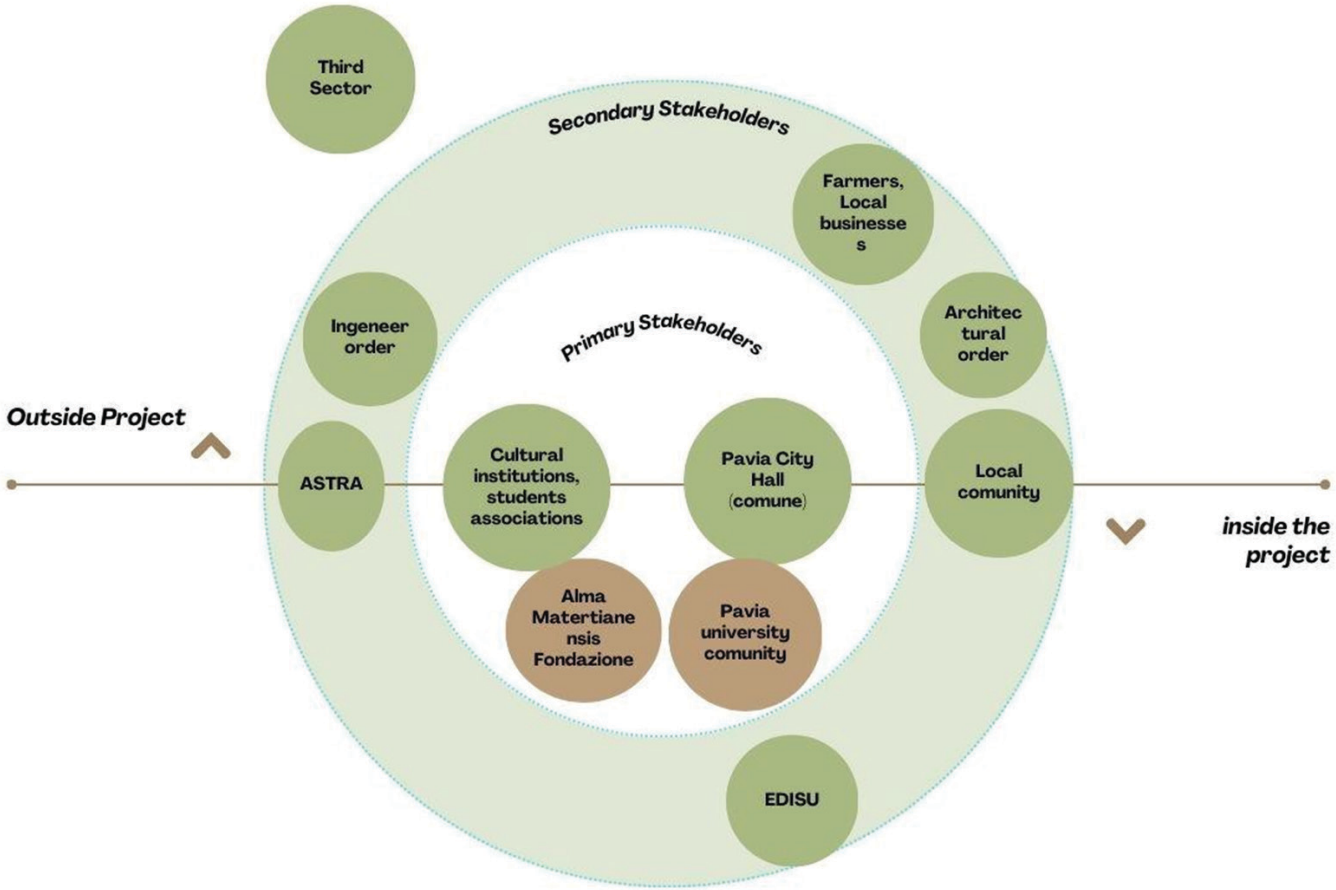
New elements WE ARE ADDING TO GARDEN

- Statues and sculpture
- Lights
- The roads
- Plants
- Stage
- Dancing area

ART CENTRE plan




reference
OF THE EXHIBITION ROOM
reference


Third Sector
Secondary Stakeholders
Farmers, Local businesses
Ingeneer order
Primary Stakeholders
Architectural order
Outside Project
ASTRA
Cultural institutions, students associations
Pavia City Hall (comune)
Local comunity
inside the project
Alma Matertianensis Fondazione
Pavia university comunity
EDISU

Preserving cultural heritage with a Sustainable business model

Elisabeth König[1], Jakob Haas[1], Laura Pérez[2], Inès Touré[3], Denner Déda[4] Sergiu Ursan[5]

[1]University of Linz, [2]University of Salamanca, [3]University of Poitiers, [4]University of Coimbra, [5]Alexandru Ioan Cuza University, Iasi.

Abstract

This project, part of the B.SuRe EC2U Summer School program, aims to contribute to the preservation of the cultural heritage of the palace and its garden by integrating modern innovation, community involvement and environmental sustainability, through a business model based on coworking spaces and use of spaces that foster collaboration and trust between the different stakeholders, using the Business Model Canvas that assesses the key players, resources, opportunities and challenges of the project for its viability.

Keywords:

Cultural Heritage, Co-working space, Sustainable restoration, Business Model Canva, Democratisation of Space

School group:

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University of Pavia: Miriana Forti
University of Coimbra: Denner Déda

Figures are part of the Summer School B.SuRe 2024 final presentation of students held in Pavia during the closing events.
Opposite page: Illustration 3, Stakeholder Map

Introduction

The project restores Palazzo Vistarino, aligning with SDG 11, to preserve heritage, foster identity, and promote social cohesion, innovation, and sustainability (Veldpaus & Roders, 2013).

The Importance of Cultural Heritage Preservation in Buildings

Nowadays there is a lot of interest in restoring historical buildings. The studies published in 2018 by Berg and Fuglseth and also the study by Loli & Bertolin highlight the environmental advantages of restoring historic structures while preserving their originality and point out shortcomings in the integration of conservation with environmental objectives. Furthermore, other studies show how the value of both tangible and intangible historical heritage generates meeting spaces for the community involving different actors during the process and also offers a narrative legacy that allows the appropriation of the community of its local cultural history through the use of space (Murzyn-Kupisz & Dziazek, 2013). The report proposes a business model for space rehabilitation, preserving heritage, and involving local actors in a sustainable business model (Waters Lynch & Potts, 2017; Osterwalder & Pigneur, 2010; Ferreira et al., 2022; Schaltegger et al., 2012).

Methodology

The Business Model Canvas by Osterwalder and Pigneur (2010) serves as a strategic management tool for the holistic creation of business ideas and it has been generally accepted among entrepreneurs. This model has been created as a tool to depict how an organization creates, delivers and captures

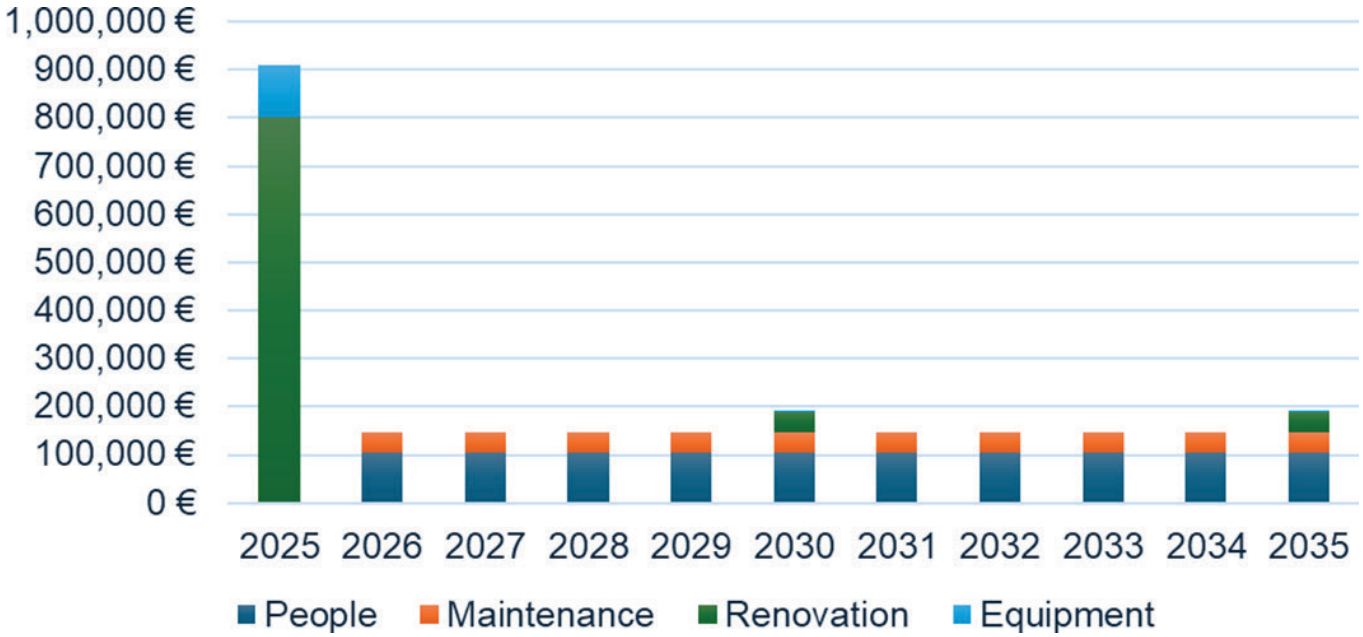

Illustration 1: Cost Dimensions and its Different Sectors From 2025 Until 2035

value. It defines 9 comprehensive building blocks as imperative entrepreneurial actions that should primarily generate revenue streams. They can be separated into 4 major clusters: Infrastructure defines how key partners, key activities and key resources support value creation. Customers discuss who the value will be provided to and comprises customer relationships, channels and customer segments. The financial viability cluster identifies the cost structure and revenue streams. Lastly the value proposition depicts which offer will be delivered to the customer (Osterwalder & Pigneur, 2010). The goal of the triple-layered Business Model Canvas is to guide companies in shifting their focus to create sustainably innovative value, integrating economic, environmental, and social considerations.

For the project a limited social and environmental analysis was added by trying to focus on major possible positive benefits and negative impacts in the respective areas. It was also completed by an analysis of the stakeholders community in order to complement the involvement of local actors and its role in the process.

Results

The restoration of the palace offers a unique opportunity to combine the historical and architectural legacy of the city of Pavia with the social and economic needs. Along these lines, it has been worked on the transformation of the palace into a flexible coworking environment, featuring the creation of a community-driven café while allowing the functionality of the garden as a space open to the local community.

Financial model

The financial model for the project includes a combination of upfront investment, medium-term cost management and long-term revenue generation. It emphasizes sustainability, community engagement and a combination of public and private financing. The renovation phase starts in 2025, focusing on building upgrades and operational planning, with full functionality in 2026. The plan will extend through 2035. The renovations will preserve the historic value of the building while upgrading it to modern standards (Team Kaarwan, 2024). The total estimated costs are shown in Illustration 1.

The project achieves ROI within 5 years, with a projected surplus of € 1,920,000 by year 10 as shown in the following Illustration 2. After the establishment phase, operational costs stabilize, supported by diversified revenue streams that mitigate financial risk. Revenue generation is projected at € 446,240 annually. Due to its economic viability, this project could benefit from European Funds and Programs. The project vision focuses on a circular economy, allowing the recovery of the space in harmony with social environment. That is why some opportunities could be found in SFE+ and Interreg Programme. Therefore, private funds and foundations such as Fondazione Cariplo (2024) and Fondazione della Comunità (2024) are possible.

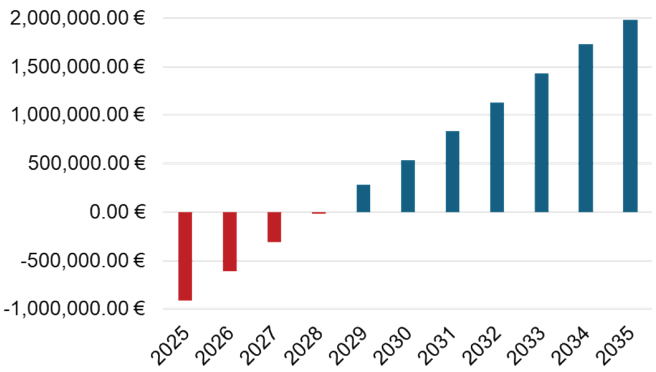

Illustration 2: Gross Income Generated by Palazzo Vistarino

Stakeholders Map

Given that the project wants to contribute to transform historic buildings for their functionality and social impact by relying on the actors present in the local community, a stakeholder map structure is needed to identify those actors involved in the different phases of the process. The level of the actor is linked to their role in the project as it is here:

Primary stakeholders are directly involved in the project, representing the student body and university resources. Secondary stakeholders provide valuable support or resources to the project, such as funding, local expertise or logistical support. Tertiary stakeholders can play a supporting role, such as providing additional expertise, advocacy or volunteering.

Discussion

The restoration goal is to maintain the building's heritage while ensuring its functionality focusing on key areas such as historic interiors, with special attention to original decorative elements, like

frescoes, which will be painstakingly restored where possible. It will also pursue to restore the splendor of the historical garden, keeping the natural elements and giving another functionality for the place through these dimensions:

- Coworking Hub:

In keeping the growing demand for flexible and creative workspaces, the interior of the palace will be transformed into a coworking center. The space will take advantage of the existing room division to create private meeting spaces and collaboration areas, fostering a dynamic environment for young entrepreneurs, freelancers and students. This creates a space to meet the needs of the student community while connecting young people to entrepreneurship and local businesses.

- Cultural & Sport Events:

The historical garden of the palace will be used for a wide range of cultural and sport events that will bring the community together. This space will allow for profits to be reinvested in the improvement and efficiency of the project. Farmers' markets will be organized periodically, where local producers will be able to showcase artisanal products and open-air movie nights which offer a relaxed cultural experience will be held. In addition, the space will host a variety of sport activities, from yoga and fitness classes to informal community sport events, encouraging a healthy lifestyle.

- Café & Social Impact:

In connection with the coworking space, a community cafeteria will be created. This space will offer locally sourced organic products. The café will also serve as a venue for meetings, workshops and cultural exchanges, fostering dialogue and collaboration between visitors and residents.

Social and environmental impacts

According to the research by Water-Lynch and Potts (2017), 70 % of coworking space users typically members of the local community. In this way, the project contributes to revitalizing social participation among actors as a central piece of the community.

The involvement of the university in the project provides a unique opportunity for students in the city of Pavia to engage more actively and benefit from the initiative. According to the European Commission (2018) 'approximately 2/3 of young people see entrepreneurship skills as a barrier of business creation'. In this context, Italian universities and the Youth Guarantee Fund have introduced support measures to invest in these young people and foster their entrepreneurial initiative like this project does.

Sustainability elements of the project include bringing the renovation up to energy efficiency and environmentally friendly standards (Chen, 2024). Accessibility for local start-ups and SMEs through affordable workspace rentals and free sustainability training sessions for the public to encourage environmentally friendly behavior (Goldschein, 2024). Furthermore, by repurposing the existing structure, the project reduces the environmental impact of new construction even though the use of the palace could lead to environmental challenges like waste production, higher carbon emissions, and wear on the site, highlighting the need for a balanced approach to mitigate these impacts while promoting both cultural heritage and sustainable tourism. Another potential negative impact is over-commercialization, where economic profit could overshadow genuine cultural engagement. This might lead to the palace becoming a space for mass consumption.

Future Direction

The Business Model Canvas of Osterwalder and Pigneur (2010) is used to design the value proposition of the 'ReUse Palazzo Vistarino ReUse Project', adding a limited social and environmental analysis, focusing on the highest possible benefits and negative impact on the corresponding areas. However, it is recommended that, in future phases, a more comprehensive analysis be incorporated,

such as the three-layered approach proposed by Joyce and Paquin (2016). Regarding the financial implications, Geissdoerfer et al. (2018) argue that the adoption of a sustainable business model not only favors social and environmental development, but also improves the financial performance of the organization, becoming a competitive advantage in a market where consumers increasingly value ethical decisions when making their purchases. In this context, the project should broaden the analysis by delving into strategies that integrate architectural conservation and sustainability techniques.

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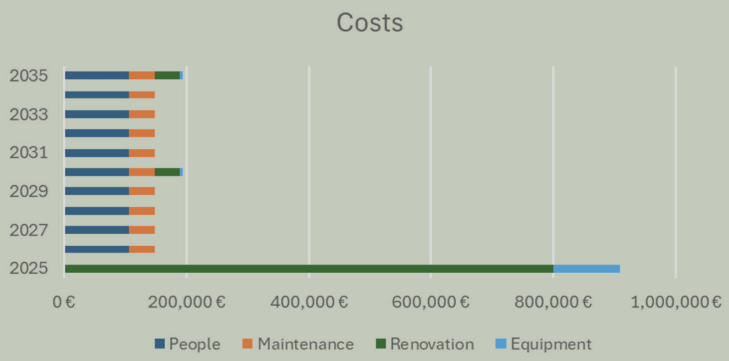
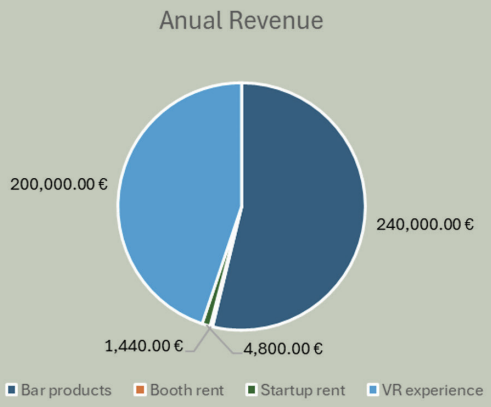
Financials

Costs
First year: 917,000 euros
Mid term (5 years): 193,580 euros
Long term (10 years) :193,580 euros



5 person (cafeteria/bar, incubator and volunteering)
Maintenance (electricity, heating, watering, cleaning, others)
Equipment (furniture, information and communication, others)
Renovation based in the previous costs for the process in the other floor of the same building

Revenues
From the second and beyond: 446,240 euros



Bar produtcs (average ticket 20 euros and 10% of total tourisim)
Booth rent (spring and summer events, 6 months per year)
Startup rent (10 startups using the space monthly: 40 euro)
VR experience (calculated by the tech group: 5 eur average, 10% of tourists presence)

The Business Model Canvas

Designed for: ReUse Palazzo Vistarino | Designed by: Group 3 | Date: 26.09.2024 | Version:

Key Partnerships
- Renovation Companies
- Comune di Pavia, local governments
- University of Pavia & Research Institutes
- Event Organizers
- Sports Associations
- Local Farmers & Food Producers
- Nonprofit Organizations

Key Activities
- Renovation & Restoration
- Event Hosting
- Coworking Management
- Community Building
- Cultural Programming:
- Sustainability Initiatives
- Café Operations

Key Resources
- Palazzo Vistarino
- Restoration Experts
- Dedicated Space Management
- Technology Infrastructure
- Local Food & Café Supplies
- Brand & Reputation

Value Propositions
- Historical & Cultural Significance
- Collaborative Environment
- Diverse Offerings
- Sustainability Focus
- Café with a Cause

Customer Relationships
- Membership Programs for Entrepreneurs
- Sustainable, Cultural and Educational Events
- Café Community

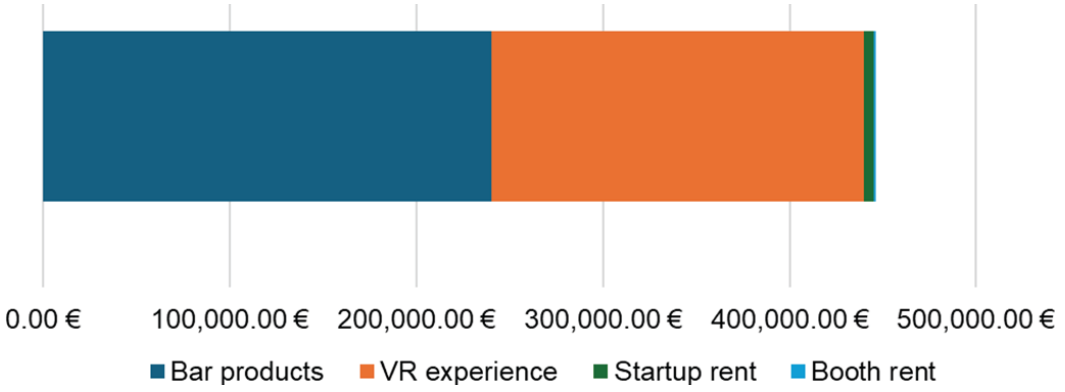
Channels
- Website & Social Media
- Partnerships with Local Institutions
- Event Platforms
Café Promotions

Customer Segments
-Young Entrepreneurs
- Students & Researchers
- Local producers and service providers
- Event Organizers
- Local Ethically-Minded Café Customers

Cost Structure
- Renovation Costs
- Maintenance Costs
- Event Costs
- Staffing
- Technology & Infrastructure
- Café Supplies
- Marketing Costs
- Donations to Positive Impact Causes

Revenue Streams
Coworking Memberships
Café Sales
Event Space Rentals
Cultural & Sports Events
Partnerships & Sponsorships

Above: Business Model Canvas for Palazzo Vistarino; Below: Annual Revenue of Palazzo Vistarino From the Second Year of Usage and Beyond



	Positive	Negative
INTERNAL ORIGIN	Strengths	Weaknesses
	Team members, representing the university of Pavia, come from diverse and complementary backgrounds, enhancing the project's skills and perspectives. The presence of students from the university of Pavia, who live in the city and are familiar with its local economic dynamism, provides valuable insight into the regional context.	Most of the project promoters are international. Team members come from diverse backgrounds, often unrelated to heritage renovation or project management. There is limited knowledge of needs specific to Pavia's residents.
EXTERNAL ORIGIN	Opportunities	Treats
	The city encourages the market of tourism with events (sacred music, theater, food, and wine) The city promote the architecture of the place for a better place The city is a research-intensive student town, welcoming many students each year who could represent a source of additional manpower and potential clientele.	The concept of sustainability is trendy, many places use it for marketing themselves making differentiation efforts harder Decrease of social services (quantity and quality) and sport activities in Pavia these days could make the city less competitive in attracting international students.

Table 1. The SWOT matrix (Strengths, Weaknesses, Opportunities, Threats) is a strategic planning tool that helps highlight the key characteristics of a project within its environment. It allows us to identify all the factors influencing the project, enabling a quick analysis of the opportunities and challenges it may face.

	Intervention logic	Indicators (IOV)	Sources of verification	Assumptions
Global objective	All achievable project objectives are met each year: the residents of Pavia have access to a coworking space, as well as a space for exchanges around cultural and social topics; Palazzo Vistarino is restored and preserves its cultural heritage.	Number of cultural events organized ;	Yearly financial report of the project ; yearly activity summary/report ;	
Specific objective	The coworking and exchange space is efficient and sustainable, enabling the generation of working capital to diversify activities	Annual variation in the number of stakeholders involved ; Evolution of the amount of funds raised	Yearly financial report of the project ; yearly activity summary/report	Students and residents of Pavia are interested in participating in and organizing activities.
Results	The number of partners is increasing	Annual variation in the number of partners	yearly activity summary/report	New students and inhabitants motivated by the project ensure the continuity of the active team each year ; The stakeholders agree to participate in regular meetings to stay informed and updated.
	The sustainability of the project is ensured	Annual stakeholders meeting attendance (number of people present)	Stakeholder meeting minutes	
Activities	1.Ensure communication around the project 1.a. Sending emails to all students to introduce the project and invite them to participate 1.b. Distribution of flyers across various universities and campuses and also at the town halls. 1.c.Organization of informational meetings within Palazzo Vistarino 2. Facilitate the integration of new students and partners; 2.a. Include newcomers in meetings; 2.b. involve newcomers in publicity campaigns.	**Means** : All the active partners (students and local residents) **Materials** : Communication posters, Project brochures, Computers, Access to equipment and spaces of the Palazzo.	**Costs:** Fuel expenses, Transport tickets, Printing costs, Office supplies (tape, scissors, glue, etc.)	New students and residents are willing to take over the project. New stakeholders are eager to participate in the activities. Maintaining good relations with the town hall, local merchants, and the Palazzo managers.
				Involvement of project stakeholders (students from the University of Pavia, local partners, Palazzo staff).

Table 2. Logical Framework

To ensure the successful implementation of the project, it is essential to establish a strategic management plan to guide the project's operations as well as the local community of Pavie (Riva & Pilotti, 2017).

We will establish clear objectives for the BSURE Coworking Space project and link them to activities and outcomes. The logical framework aims to support reflection and provide a way to check the coherence of the project proposal. We will also include the relevant indicators and sources needed to monitor and evaluate the project both before and during its implementation.

Risk ID	Potential Risk	Date the Risk Was Identified	Probability of Occurrence (1-4)	Severity (1-3)	Mitigation strategies
1	Not enough funds to implement the project	During the conception	3	3	Apply for grants, seek sponsorships, and explore crowdfunding options.
2	The marketplace/or cinema/other activities in the garden are too noisy and disturb other activities (coworking, studying)	During the conception	2	2	Designate specific areas for different activities and enforce noise control measures.
3	Not enough volunteers or people interested in our activities to help with the maintenance of the project	During the conception	3	1	Promote volunteer opportunities through social media, local events, and partnerships with community organizations.
4	New competitors arrive with the same or a similar concept	During the conception	1	1	Differentiate the project by offering unique services or focusing on niche markets.
5	Communication materials are not attractive enough	During the conception	1	2	Invest in professional graphic design and marketing services to improve branding and communication materials.
6	The town of Pavia feels that the project is not sufficiently in keeping with its historic setting	During the conception	1	3	Engage with local authorities and historians to ensure the project aligns with the town's heritage.
7	The costs for the maintenance are too expensive	During the conception	2	3	Optimize operational costs, consider partnerships, and explore sustainable revenue streams such as events or rentals.

Table 3. Risks analysis matrix

No project is immune to potential problems, so we have identified the various risks that could slow down or even stop our project. Risk analysis involves identifying all events that could affect the direct or indirect objectives of the project. We therefore created a risk matrix to assess the severity and likelihood of occurrence associated with these risks.

Positive

Collaboration & Innovation through networking connections

Local Economic Support to local business but also to young people

Cultural Preservation through a functional uses of the space

Involve the local community being part of the solution

Environment creating well-being and preserving the health of locals

Negative

Exclusivity: while the space may promote collaboration, the historic site limits access for certain underrepresented groups (walking disability)

Cultural over-commercialization: cultural programming may prioritize profit over genuine engagement, risking the project's authentic value.

Social Impacts

Environmental Impact of the Project

Positive Benefits

- **Historic Preservation:** By restoring and reusing the existing structure, the project avoids the environmental costs of new construction, such as material waste and habitat disruption.
- **Sustainable Renovation:** The use of eco-friendly materials and energy-efficient systems in the restoration process reduces the building's carbon footprint and resource consumption.
- **Local Sourcing:** The café's focus on locally sourced products minimizes transportation emissions and supports environmentally friendly farming practices.

Possible Negative Impact

- **Resource Intensive Restoration:** Even with sustainable materials, the renovation of a historic building can still consume significant resources (energy, water, materials) during construction.
- **Tourism Footprint:** Increased traffic and events at Palazzo Vistarino could lead to waste production, transportation-related carbon emissions, and deterioration of the garden, negatively impacting the local environment.

TEAM ANALYSIS

S
Strengths

- Team members, representing the University of Pavia, come from diverse and complementary backgrounds, enhancing the project's skills and perspectives.
- The presence of students from the University of Pavia, who live in the city and are familiar with its local economic dynamism, provides valuable insight into the regional context.

W
Weaknesses

- Most of the project promoters are international.
- Team members come from diverse backgrounds, often unrelated to heritage renovation or project management.
- There is limited knowledge of needs specific to Pavia' residents.

O
Opportunities

- The city encourages the market of tourism with events (sacred music, theater, food, and wine)
- The city promote the architecture of the place for a better place
- The city is a research-intensive student town, welcoming many students each year who could represent a source of additional manpower and potential clientele.

T
Threats

- The concept of sustainability is trendy, many places use it for markting themselves making differentiation efforts harder
- Decrease of social services (quantity and quality) and sport activities in Pavia these days which could make the city less competitive in attracting international students.

Conclusion: It's all about providing value

Historical & Cultural Significance: An inspiring space that blends history with modernity, connecting the past and the present.	**Collaborative Environment:** A space for professionals, students and researcher to work together.	**Diverse Offerings:** A combination of coworking, culture, sports, and a café in one location.
Sustainability: A focus on eco-friendly practices in renovation, operation, and local sourcing.	**Café with a Cause:** A space to enjoy local products while supporting positive impact causes through donations.	**Community Focus:** Bringing people together in a shared space for learning, collaboration, recreation, and social good.

- Sustainable reuse integrates **modern functionality** with heritage conservation.
- Reducing the environmental impact of demolition and new construction while **breathing new life into old structures.**

VR/AR Experiences

Valorization & / Exploitation

Innovating user experiences in Cultural Heritage: VR/AR solutions for Palazzo Vistarino's valorization

Fernando J. R. Mascarenhas[1], Maya Moussallieh[2], Seyedkourosh Sajjadi[3]

[1]University of Coimbra, [2]University of Turku, [3]University of Pavia.

Abstract

This study proposes immersive VR/AR experiences for preserving Palazzo Vistarino while fostering engagement and funding restoration. Combining AI-assisted damage detection with tailored AR applications, the project showcases concepts like escape games and interactive tours, blending historical authenticity with modern needs. Visual prototypes and strategies align with sustainable cultural heritage valorization, promoting education, entertainment, and appreciation.

Keywords:
Cultural Heritage; Augmented Reality; Valorization; Damage Detection; Sustainable Reuse

School group:

Fernando Mascarenhas, Gabriel Seebach, Josefa Manni, Maria Țibulcă, Matias Fahllund, Maya Moussallieh, Nohelia Gutiérrez, Seyedkourosh Sajjadi

Figures are part of the Summer School B.SuRe 2024 final presentation of students held in Pavia during the closing events.
Opposite page: Illustration 3, Stakeholder Map

Introduction

Cultural heritage plays a vital role in revitalizing urban areas and improving environmental quality, in line with international and national policies. Its preservation is critical as an irreplaceable resource (Anelli & Tajani, 2022). In Europe, initiatives like Horizon 2020 and the European Year of Cultural Heritage focus on enhancing public buildings and fostering cultural tourism (European Union, 2020). Italy, home to the highest number of UNESCO World Heritage Sites, exemplifies the link between cultural heritage and national identity (Government of Italy, 2024). Pavia, home to the University of Pavia, also houses Palazzo Vistarino, an 18th-century building blending historical styles. While partially restored, its first floor remains in need of renovation (Fondazione Alma Mater Ticinensis, 2024).

Restoration of cultural heritage sites often faces financial challenges, as preservation is costly and does not offer immediate financial returns (Macek et al., 2019; Tahoon et al., 2024). Thus, sustainable projects that respect architectural, historical, and social aspects of these sites are essential, while generating resources for restoration. Advances in information and communication technologies (ICTs), especially augmented reality (AR), enhance cultural heritage sites by providing immersive, informative experiences (Graziano & Privitera, 2020; Dieck et al., 2016). On the other hand, AI-powered tools such as deep learning models, trained on built environment decay datasets enable precise damage classification. When integrated with AR, these tools offer architects and engineers immersive platforms to visualize damage, understand its causes, and plan targeted maintenance.

This study was conducted during the B.SuRe 2024 Summer School at the University of Pavia, under

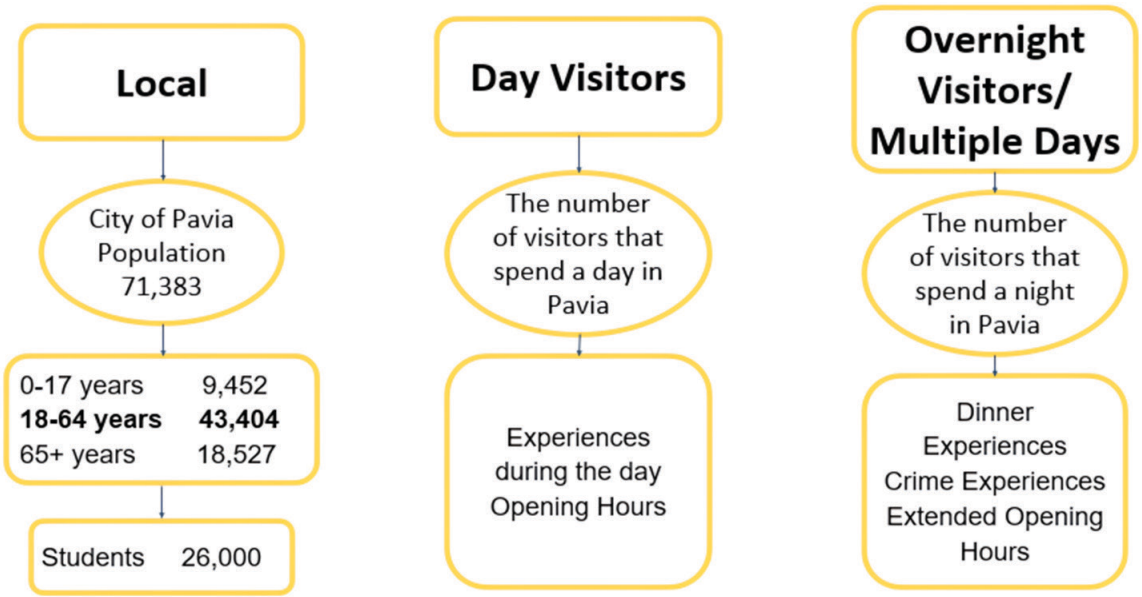


Fig. 01: Target users

the European Campus of City-Universities (EC2U) initiative. It explores sustainable reuse strategies for Palazzo Vistarino, including the development of an AR experience aimed at supporting restoration and promoting cultural heritage appreciation. The project aims to make the site accessible to future generations, engage diverse audiences, and inspire greater appreciation for heritage conservation. The prototype provides basic information on the building's condition and a vision for its future development using AI-generated visuals.

Methodology

Tools and techniques

Resources and tools provided during the B.SuRe 2024 Summer School, along with previously collected data, were used for the project development. Digital documentation of key rooms in the palace, including high-resolution photos, 3D models, and point cloud models for spatial representation, were presented. Additionally, 360-degree imagery was produced for the creation of the virtual tour using the test version of 3D Vista software.

Plus, data on Pavia's population demographics, including age groups, student populations, and tourism statistics, were collected and analyzed to tailor the AR experiences to potential visitors' needs and interests. Figure 1 summarizes the analyzed data on target users.

Analysis of Costs, Revenue Streams, and Profitability

An initial cost analysis and estimated revenue streams were conducted to evaluate the financial feasibility of the proposed experiences. Case studies from similar heritage sites, such as the Baths of Caracalla and the Colosseum, utilizing VR/AR technologies, were reviewed to project visitor numbers and potential revenue. Figure 2 presents the valorization strategy

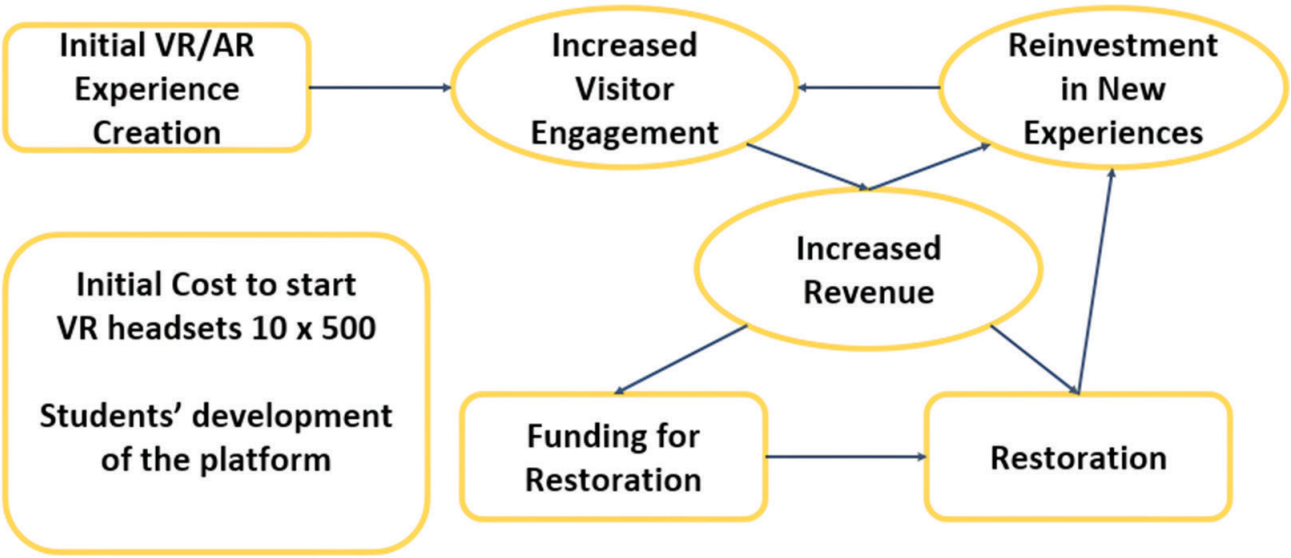


Fig. 02: Valorization strategy

adopted in this project.

AR Experiences and Revenue Opportunities

By combining AR with AI techniques, various AR experiences were designed for different target audiences. This paper focuses on the AR experience developed for engineers and architects, though the project was designed to accommodate experiences for other groups, including the general public, art and history enthusiasts, and social researchers. Additionally, potential uses were explored to generate the financial resources needed for the building's renovation and maintenance.

AI-Assisted Deterioration Detection and AR Integration for Palazzo Vistarino

AI-assisted visual inspections improve damage detection accuracy in cultural heritage sites, particularly when combined with real-time data collection (Mishra & Lourenço, 2024). Deep learning models, trained on datasets of decay types such as cracks, spalling, brick exposure, and blistering, automate and enhance assessments. High-quality datasets are created by gathering images using drones, cameras, and remote sensing technologies, followed by precise annotation. YOLO (You Only Look Once) is highlighted as an effective technique for detecting architectural defects (Mishra & Lourenço, 2024). AR technology is used to visualize defects and improve on-site inspections (Hsu et al., 2023). Using photos of Palazzo Vistarino, a deep learning model can classify decay types, and when integrated with the AR experience, it provides architects and engineers with tools to identify damage, understand its nature, and plan targeted maintenance. This integrated approach offers immersive insights into the building's structural health, aiding decision-making and supporting efficient restoration.

Results and discussions

Future Uses for Palazzo Vistarino

According to the research by Water-Lynch and Potts AI tools were utilized to generate visuals representing the proposed AR and VR experiences. Figure 3 illustrates these concepts, showcasing how Palazzo Vistarino could engage diverse user groups and emphasizing the importance of innovative marketing strategies. The figure highlights the potential uses, such as cafes and restaurants within the palace's interior and exterior

Fig. 03: Showcases of future uses of the palace

areas, as well as immersive experiences for crime and drama enthusiasts, including escape games and VR/AR scenarios showcasing the site's historical usage.
This strategy not only preserves the palace's legacy but reimagines its role as a center for education, entertainment, and cultural appreciation, fostering deeper connections between heritage and modern audiences. Moreover, this approach provides revenue-generating opportunities.

VT Prototype
The virtual tour prototype, created using 3D Vista software, demonstrated the potential of VR technologies to engage audiences with Palazzo Vistarino's historical and architectural significance. The prototype featured a 360-degree imagery with immersive views, documentation of decay, basic navigation and interaction, enabling users to explore interiors with accessible historical and structural information. This initial prototype served as a proof of concept, illustrating VR's potential to connect visitors with the palace's current state and laying the foundation for advanced AR/VR integration.

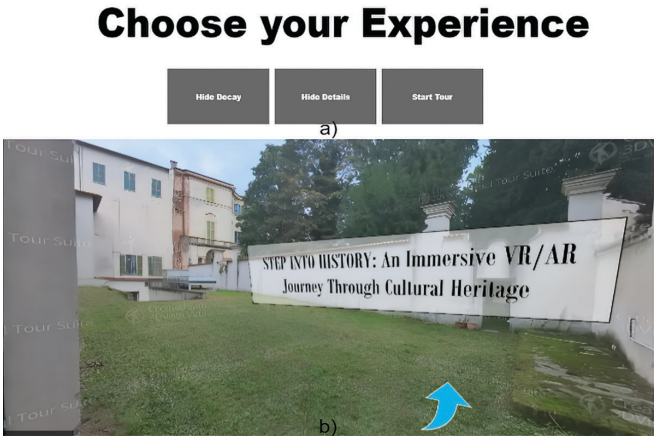


Fig. 04: Views showing (a) the selection part for the virtual tour type and (b) the tour's beginning.

Personalized AI Experience
A key aspect of the project was the development of AR experiences tailored for diverse user groups. For general visitors, AR features enhanced traditional tours with interactive overlays showcasing historical and architectural details. For families and children, educational games and interactive storytelling made the site more engaging.
Specialized AR content for professionals, including architects, engineers, and researchers, enabled analysis of structural details and restoration techniques. Figure 4a illustrates the AR interface for engineers and architects, allowing users to choose different ways to begin the virtual tour. Upon selecting an option, such as "Start Tour," Figure 4b displays the beginning of the VR experience, also featuring a floor map in the right corner of the screen, if enabled. The AR experience provides architects and engineers with a tool to identify deterioration areas and describe damage types, enhancing real-time decision-making and supporting targeted maintenance planning. AI-generated visuals demonstrate the potential of AR experiences to drive repeat visits and generate revenue for restoration (Dieck et al., 2016).
As instance, Figure 5 presents selected views from the VR experience for Palazzo Vistarino, aiding architects and engineers. The VR system highlights each identified deterioration in the architecture. Figure 5a shows a brick exposure marked by a rectangle. Detailed explanations and fuzzy scores for each deterioration are provided. Figure 5b identifies a painting gap with expert insights on causes and mitigation (classification accuracy: 75%). Figure 5c displays painting loss with technical details, while Figure 5d features a red information point that opens a detailed info window about a specific point, such as a painting. Involving students in developing these experiences offers a cost-effective approach while engaging local academic talent.

Conclusions and Future Work

The project demonstrated how immersive technologies can bridge historical authenticity with modern needs, offering tailored experiences for tourists, students, and residents. It also highlights how pre-restoration visualization can engage diverse audiences. Proposed AR experiences, including escape games and treasure hunts, provide innovative ways to attract repeat visitors and generate revenue for restoration.

It aligns with regional goals to enhance cultural infrastructure and engage local communities while introducing replicable AI models for AR-based decay classification in cultural heritage sites.Future steps include testing specific AR experiences, conducting surveys to refine user engagement, expanding the virtual tour with advanced features and restoration simulations, and applying a business model for further development.

Fig. 05: Views from the VR experience for Palazzo Vistarino, identifying (a) brick exposure, (b) a painting gap, (c) color loss on the wall, and (d) an information point. On the opposite page: Proposal for the use.

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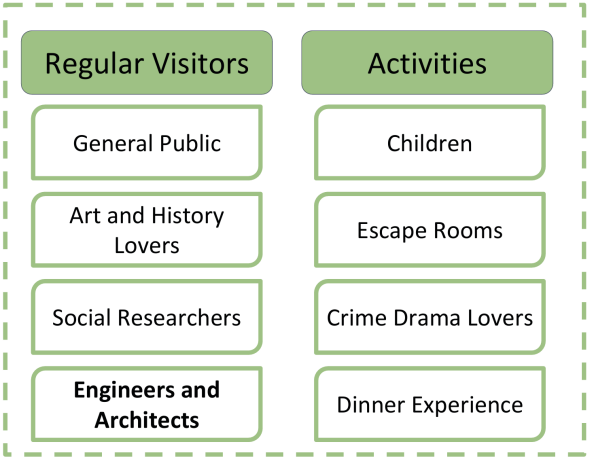


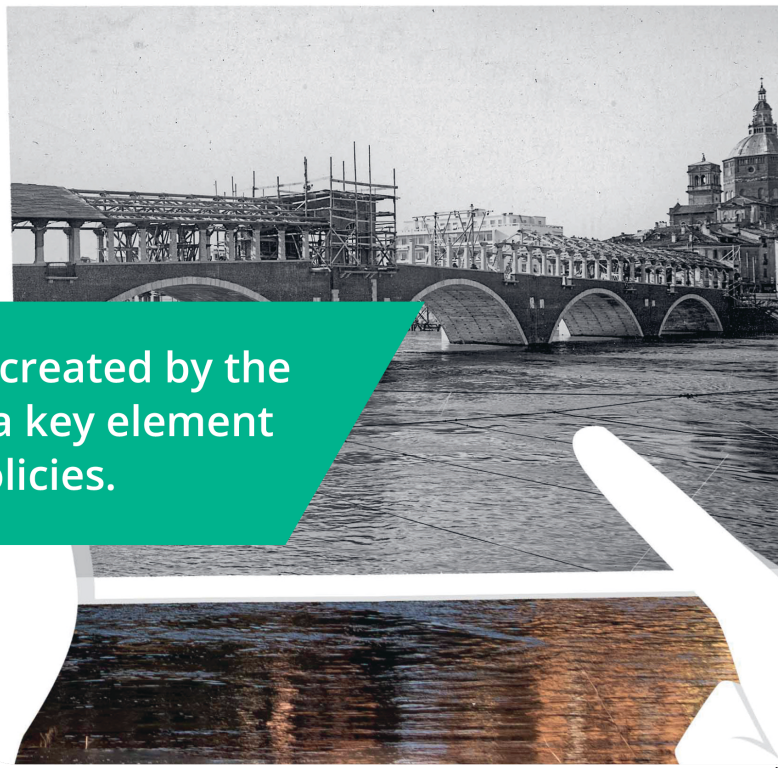
THE CITY AS A SPACE FOR EXPLORING & EDUCATION

GOOD PRACTICES OF DIGITISATION EXPLORED DURING THE CHARME PROJECT

Interreg Europe

Co-funded by the European Union

CHARME



CHARME explores the possibilities created by the digitisation of cultural heritage as a key element of cultural strategies in regional policies.

SMART

https://www.interregeurope.eu/charme

An interregional cooperation project for improving **Digitisation** policies

Cooperation between EC2U associated partner Municipalities: cultural heritage as a context for urban sustainability actions

Maria Spitti

Municipality of Pavia, Head of "International Relations and Coordination with Supra-municipal Planning Fundraising" Service

The EC2U Alliance aims to create an innovative environment that facilitates seamless mobility among its nine universities and their associated cities: Poitiers (France), Coimbra (Portugal), Iași (Romania), Jena (Germany), Pavia (Italy), Salamanca (Spain), Turku (Finland), alongside the recently added Linz (Austria) and Umeå (Sweden).

Since the first in-person forum held in Salamanca in October 2021, collaboration among the EC2U associated municipalities has progressively developed, with a shared commitment to addressing the challenges of the Alliance initiative under the concept of city-universities. Given that all partner cities are medium-sized and possess significant historical and artistic heritage, cultural heritage naturally emerged as a common and strategic focus. Intermediate cities represent the contexts in which resources, capital, skills and talents are concentrated and, at the same time, the places where many environmental, economic, political and cultural challenges are experienced. They provide an ideal setting to pioneer the transition from a linear to a circular economy, fostering synergistic, fair and inclusive processes capable of driving new forms of urban productivity as well as social and economic innovation. In particular, cultural heritage stands out as a key driver of local development.

Adaptive reuse strategies for cultural assets not only extend their lifecycle but also serve as innovative urban policies that generate diverse values - economic, cultural, educational, and political - thus supporting dynamic pathways of sustainable development.

The collaborative path among the EC2U network Municipalities has developed and continues to evolve through joint projects integrating urban sustainability with the conservation and enhancement of cultural heritage. The first collaborative project, Cultural Cities Twinning (CultCities - www.comune.pv.it/cultcities), was funded in 2022 by the European Commission under the CERV Programme. It brought together six EC2U municipalities – Municipality of Pavia (IT, coordinator), Câmara Municipal de Coimbra (PT), Grand Poitiers Communauté Urbaine (FR), Primăria Municipiului Iași (RO), Ayuntamiento de Salamanca (ES), Turun Kaupunki (FI) – along with two of Pavia's twin towns – Ville de Besançon (FR) and Hildesheim (DE). The University of Pavia's Department of Civil Engineering and Architecture (DICAr) also joined as a technical partner, offering experts support for dialogue and the opportunity to engage academics and the young student population.

The project's main objectives were to facilitate the sharing and discussion of good practices, projects, and examples related to the conservation of tangible cultural heritage among citizens and relevant stakeholders, with a long-term perspective. Additionally, it aimed to establish a sustainable

cooperation framework among cities to enable the continuous exchange of good practices, foster the development of joint projects, identify innovative solutions, and promote shared experiences.

The CultCities kick-off meeting was held on March 3, 2022, during the first edition of the EC2U B.SuRe Winter School. This session was the first opportunity for each participating Municipality to present and exchange good practices and case studies focused on buildings or historic complexes, emphasizing their historical, cultural, and sustainable reuse values.

The exchange continued in Pavia from April 4 to 7, 2022. This four-day event allowed delegations – comprising municipal representatives, cultural experts, university professors, and students – to explore Pavia's rich cultural heritage, deepen mutual understanding, exchange good practices related to cultural heritage enhancement, and engage in open discussions. This event culminated on April 7, 2022, with the signing of a Friendship Agreement that established the Culture and Heritage Living Lab as a permanent, voluntary working group. The agreement underscored the partners' shared commitment to continue collaborating on the themes explored in the CultCities project.

Since April 2022, the Culture and Heritage Living Lab has convened through virtual meetings to foster ongoing collaboration among partner Municipalities on the conservation and enhancement of cultural heritage, framed within the European goals of circular economy and urban sustainability. In this context, the CHARME project "digital Cultural Heritage Activities acRoss Multiple European regions" was developed and is currently underway, co-financed by the European Union under the Interreg Europe Programme 2021-2027.

The project involves the Municipality of Pavia (IT, lead partner), Coimbra (PT), Iași (RO), Turku (FI), the Grand Poitiers Urban Community (FR), and the city of Lviv through the Lviv Bureau of European Integration (UA) as a discovery partner, together with the University of Pavia, DICAr, as an advisory partner.

Launched in April 2024, CHARME will run for four years (three years core phase and one year follow up), advancing joint efforts on the conservation and valorization of built cultural heritage with a focus on digital technologies. Digitisation of cultural heritage opens new possibilities for adaptive reuse, enabling the creation of innovative services and creative products across various fields, including restoration, preservation, planned conservation, climate resilience, civic engagement – particularly among youth – and cultural inclusion, especially for people with disabilities. Its activities are grounded in a shared learning approach that actively involves all partners alongside a network of local stakeholders. Through study visits to good practice projects, thematic seminars and workshops, critical reviews of regional policies and legislation, and the development of shared guidelines, the project aims to integrate cultural heritage digitisation into regional development strategies by improving five policy instruments identified by the partners.

The sustainable reuse of urban buildings and spaces presents complex and multifaceted challenges that benefit from interdisciplinary approaches, cross-sector cooperation, and close collaboration among local authorities, academia, and stakeholders, as well as active citizen engagement.

The EC2U Municipalities network tackles these challenges from a European perspective, leveraging cultural heritage to strengthen a shared European identity and to promote innovation, creativity, social inclusion, and sustainable economic growth. Through these synergies, the network aims to create resilient urban environments that reflect both local uniqueness and common European values.

The new phase of the EC2U Alliance project, which includes the addition of two new universities and their respective cities, is enabling the network of associated partner municipalities to implement new common activities, continue the dialogue, and share experiences, thereby strengthening and deepening the European ties that enrich their communities.

Institutional greetings

Rodolfo Faldini
Municipality of Pavia, Councillor for Local Police, Commerce, Civil and Cemetery Services, and Toponymy

The Municipality of Pavia has been actively collaborating for several years with the University of Pavia within the framework of the European Campus of City-Universities (EC2U) project, sharing a commitment to concretely address the challenge set by the Alliance: strengthening the ties between the university and the local community. This collaboration is part of a broader strategic vision aimed at positioning the city within a network of structured international relations, a goal strongly supported by the current Municipal Administration, as demonstrated by the recent establishment of a dedicated department focused on urban innovation, international relations, and coordination with supra-municipal planning initiatives. Among the shared core themes, the concept of a sustainable city holds particular importance, with a specific focus on enhancing the built cultural heritage. Along this line, a strong synergy has been established with the Department of Civil Engineering and Architecture (DICAr), which has led to significant joint initiatives and projects.

In this context, the first two editions of the B.Su.Re. - Building Sustainable Reuse - Winter School have served as key milestones, fostering dialogue among European Municipalities on good practices in urban sustainability and the protection and enhancement of cultural heritage, thus contributing to the strengthening of ties between the Municipality, the University Department, and other European cities. These exchanges laid the foundation for future developments, the most significant of which is the ongoing Interreg Europe project CHARME "digital Cultural Heritage Activities acRoss Multiple European regions", coordinated by the Municipality of Pavia with the involvement of DICAr as an advisory partner.

Recalling Goal 11 of the UN 2030 Agenda – Sustainable Cities and Communities – which inspires the Winter School, the 2023 edition provided the Municipality with the opportunity to present, as an example of sustainable urban space utilization, the ongoing valorization process of the Monumental Cemetery of Pavia. For several years, the cemetery has been at the core of a historical and cultural enhancement initiative, further stimulated by its membership in the Association of Significant Cemeteries in Europe (ASCE). The most recent activities are part of the cultural program "Monumental Cemetery. Sacred Place of Remembrance", which includes guided tours, lectures, concerts, and ceremonies held at the Famedio, aiming to promote the awareness and appreciation of this heritage of great significance to the community, while fully respecting the sacred nature of the site. The Monumental Cemetery is home to valuable works of art, a witness to local history, and an integral part of the city's memory and identity.

It is my pleasure to introduce the section dedicated to municipal case studies in this volume, which compiles the contributions from the 2023 edition of the EC2U B.SuRe. I trust that it will provide readers with valuable insights into the sustainable reuse of urban heritage, thanks to its interdisciplinary approaches and the sharing of local and European experiences.


FAMIGLIA DOTT. POZZ
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The monumental cemetery of Pavia. Paths of art: valorization, involvement, and accessibility.

Marzia Lorini
Municipality of Pavia, Cemetry service office

The Monumental Cemetery of Pavia is one of the most important heritages of the city, thanks to a set of artworks, both painting and sculptures, object of an intense valorisation activity by the Municipality.
The first city cemetery was built at the end of the 19th century in a big area in the east part of the city, out of the historical wall, due to its natural characteristics consisting of a sandy soil and a high position, not subjected to river flooding. Altough the area was large, the first cemetery consisted of a little field with a wooden fence, so that after only 10 years from its construction, the space was already full of graves. In response to this situation, the Municipality approved a new project for the new Monumental cemetery. The Monumental Cemetery is composed of three parts: the historical courtyard, the first extension and the latest extension.
The historical courtyard was realized between the end of the 19th century and the beginning of the 20th century. It has a cruciform plan with an entrance called Famedio, a space which collects the cenotaphs of the most famous people of local history, and a little church opposite to the entrance. There is a big perimeter wall with arcades facing inside and each arcade is dedicated to a family with a representitive sculpture or painting; on the basement, below the family monument, there is the family grave.
The first extension was realized between 1945 and 1955, due to an increase of population. The perimeter wall has a C shape plan in order to connect the cemetery with future extensions, already predictable at the time of the construction. The architectural language is similar to that of the historical courtyard but only at first sight. Under the arcades are placed nomore family monuments but simple loculus and ossuaries. The second extension was realized between 1965 and 1988. It is composed by three floors (ground, first and basement) with arcades at the ground/first floor that face inside and outside the cemetery. The structure is built in reinforced concrete, with a contemporary architectural language, based on simplicity and functionality.

The cemetery has always had a laical connotation, in order to house the graves of people with different religious beliefs. Beyond two buildings dedicated to cremated people, whose graves were hosted in the cemetery since the foundation itself, there is a space called "Farewell Room", a rounded space inside of a glass cube, devoid of religious symbols. People of other religions, such as Muslims, have two fields already available for their burials, while an Islamic association is currently building its own ossuary.

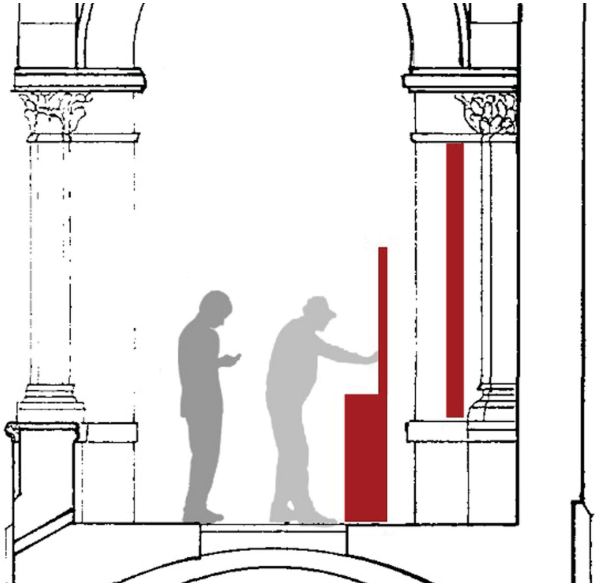
There are different types of artworks inside the cemetery. The oldest artworks are a series of maiolica tiles, placed on the entrance wall, coming from the former cemeteries of the churches of Pavia (17th and 18th century). Beside these, there are also many paintings and sculptures that reflect the sensitivity of the local families and at the same time the ability of the artists of that time.

Family chapels are not the only element of interest in the monumental cemetery. Like in many monumental cemeteries, some important people are buried here such as: Camillo Golgi, a medician who won the Nobel prize for medicine, and the first Italian man winning this award; Angelo Lanzoni, an engineer and the inventor of the reinforced concrete; Lazzaro Spallanzani, a biologist now considered the father of the artificial insemination. The current Municipality is spending a lot of energies to promote the heritage of its cemetery with the aim of making it enjoyable not only as a place of private memory but also as a cultural heritage part of the community.

The most important initiative is the cultural project born in 2020 to promote the artistic heritage of the Monumental Cemetery. Planned as an experiment in 2018-2019, between 2020-2022 it received a positive feedback and a great participation of people; the current initiative has a varied programme that includes guided tours, jazz, classical and gospels concerts and lessons about famous people currently buried at the Cemetery. Initially launched under the name of "open-air museum", the 2025 project is now called "sacred place of remembrance".

In 2024 the Monumental Cemetery of Pavia was admitted in the ASCE Association (Association of Significant Cemeteries in Europe), born in Bologna in November 2001, which currently connects more than 180 important cemeteries in twenty-two European countries and manages the 'European Cemeteries Route Network'.

ASCE is a no-profit organisation and connects the European public and private organisations that deal with Cemeteries; its goals are: enhancing the historical and artistic cemetery heritage; cooperating in the promotion, protection, restoration and maintenance of Cemeteries; sharing and disseminating the best-practices; promoting the adoption of new digital technologies for valorization and maintenance.



The Almedina Tower – using technologies for the enhancement of Coimbra's singular historical heritage

Municipality of Coimbra

This article aims to provide a glimpse into the history of the Walls of Coimbra and specifically the Almedina Tower, one of the main strategic defensive structures of the city of Coimbra during the Middle Ages, showing how the digital interpretation of this monument enhances the fruition and experience to the visitors. Coimbra, called Aeminium by the Romans, was chosen by the Bishop of Conimbriga (nowadays Condeixa-a-Velha) to install the Cathedral in the Visigothic period, in the 6th or 7th century, precisely because it had excellent defense conditions, a fundamental characteristic in times of instability and constant invasions.

Thus its name was changed to Conimbriga, then Qulumbryia at the time of the Islamic occupation in the 8th century, and finally the name evolved into Coimbra from the 12th century onwards.

The city became governed by Muslims in 714 and was retaken by the Christians led by king Ferdinand Magno, in 1064, who handed the city to D. Sesnando, a wise Mozarabic governor that transformed Coimbra into a much vigorous and relevant site in the portugese territorial context.

In 1131, D. Afonso Henriques - the future first King of Portugal - settled his court in the city of Coimbra from where he led his military expeditions to the areas governed by the Muslims.

The 12th century was considered as a golden era and, by the end of this century, the Wall of Coimbra had a two-kilometer perimeter, containing residences and the main military and religious architecture inside (namely the Royal Palace, as residence for the first kings of Portugal, that nowadays hosts the famous University of Coimbra). Until the second half of the 13th century the city was the seat of the Court, and the territory of Coimbra was fundamental to the construction of the identity of the kingdom of Portugal.

The Wall of Coimbra was located around the hill and disposed several towers and gates along its outline.

The Almedina Gate (Porta de Almedina) was one of them, being known as the Gate of the City. The Almedina Tower would have been raised in the 11th

century after the reconquest of the city of Coimbra for Christianity by Fernando Magno's forces.
After consolidating the defence of the territory, at the end of the 14th century and during the following centuries, the Town Hall and the Court were positioned inside the Almedina Tower, leading to the construction of another floor.
This building has always been attached to the Municipality of Coimbra, as a place for Council meetings between the sixteenth and nineteenth centuries.
After the extinction of the Religious Orders in 1834, and the construction of the current City Hall, at the Santa Cruz Monastry, the two rooms in the Almedina Tower were assigned for several pedagogical and cultural purposes, such as the Free School of the Arts and Design established by Master António Augusto Gonçalves in 1878, providing drawing, sculpture and carving workshops.
From May 1954 to 1977 it housed an Ethnographic Museum under municipal supervision, which was replaced by the Municipal Historical Archive in 1978.
In 2003 the Almedina Tower was adjusted and housed the Walled City Centre, one of the nucleus of the Municipal Museum of Coimbra.
The objectives of the Walled City Centre are to reconstitute and disseminate the course of the Wall of Coimbra and to preserve its remains, allowing also to understand the location in the current city of valuable buildings that existed in the Middle Ages (Alcáçova, Bridge, Monastery of Santa Cruz and Churches). The mission of this nucleus is to recover the collective memory of the existence of the Wall of Coimbra, demonstrating its decisive influence on the urban organization of the city of Coimbra.

An interactive set of technologies - which allows the interpretation of a maquette of the defensive structure of the medieval city – is installed in the Almedina Tower. The contents are available to the public using new technologies with a multimedia programme, including a large screen and a projection system which allows:
- the interaction between the maquette and the digital application, through video mapping projection articulated with video projection.
- the interaction with the visually impaired public who can touch and handle the 3d printing models;
- the presentation of interpretative videos of the defensive structure of the city, with narration in several languages (Portuguese, English, Spanish, French, Italian).
Despite the Wall's disappearance, the vestiges that still exist can be observed, not only through technological interpretation, but also "in situ" on a pedestrian route through the upper part of the city (formerly the Medina or Almedina) guided by a map made available on site, complemented by sidewalk signs.
The Almedina Tower is classified as a national monument and plays a key role for understanding the history of Coimbra, the first capital city of Portugal.
The new technological equipment and digital services are an added value to the interpretation of the contents of Almedina Tower, showing the influence of the Wall of Coimbra in the historical context and in the structure of the city today.
The use of new technologies contributes to the attractiveness of the Almedina Tower which becomes more intuitive for the public, namely students and tourists, fostering a rediscovery of the municipal heritage among citizens.

Renovation and New Destination for Braunstein Palace from Iasi

Municipality of Iasi

The Braunstein Palace is an architectural monument built at the beginning of the 20th century, in Iasi. It is made in an eclectic architectural style, with art nouveau elements. Impressive in its sumptuousness, the palace was built on the site of older buildings owned by Adolf Braunstein, a Jewish entrepreneur who owned several shops in the city center. The dome of the palace was inaugurated in 1915. Over time, the building had various functions, including hotel, bank, political parties' headquarters. During the communist period, the building was nationalized, and the Victoria Store operated here for a while, the apartments on the first floor being used as social housing. After the fall of communism in 1989, the building become the property of the Municipality.

In 2016, Iasi Municipality started a rehabilitation project, won in 2018 by a consortium of Italian companies. The works started in March 2018 and the final reception was carried out in March 2022.

The total value of the project was approximately 4,624,000 Euros without VAT, with non-refundable financial assistance of 3,779,800 Euros, a project co-financed from European funds accessed through Priority Axis 5, Priority 5.1 - Conservation, protection, promotion and development of natural and cultural heritage from the Regional Operational Program (POR) 2014 – 2020.

The Braunstein Palace has been transformed into a multicultural center that includes exhibition spaces, conference rooms, a film projection room, on the ground floor and the 4th floor. The French Institute operates on the 1st floor, the municipal offices and the "Queen Maria" Museum on the 2nd floor, on the 3rd floor is the German Cultural Center. Since the official inauguration in the presence of the Ambassadors of France and Germany in Romania, the Braunstein Palace has hosted over 100 art and photography exhibitions, conferences on various topics, art film screenings, interactive events within the International Creative Week, courses with pupils and students, becoming a major landmark in the cultural life of the city.


J ROGER
OPTIQUE

Le palais: a place open to its neighbourhood

Grand Poitiers Urban Community, International and european relationship office

The « Palais » is one of the most remarkable buildings of medieval civil architecture in France. Its history is closely linked to the figure of Eleanor, Duchess of Aquitaine and then Queen of France and England. A place of power, then a court house, it has been a witness to the great events of French history over the centuries. Over the years, the Palais has been transformed from the Gallo-Roman period to the 19th century. During the Revolution, the former ducal palace became a court house. Extensive work was undertaken to open up the building and adapt it to its new functions. In 1862, the building was listed as a Historic Monument.
The building has now entered a new era, following the relocation of the courthouse in 2019 in another area. Owned by the City of Poitiers since 2020, requiring major research, development and restructuring work, the Palais is above all a heritage that must be offered to future generations, but it must be adapted.
The building has now entered a new era, following the relocation of the courthouse in 2019 in another area. Owned by the City of Poitiers since 2020, requiring major research, development and restructuring work, the Palais is above all a heritage that must be offered to future generations, but it must be adapted.
In the coming decades, the Palais will need to demonstrate its resilience, its ability to respond to new needs and conform to new uses, as it has always done since its construction in the 12th century. Since 2016, the city and its partners have been engaged in a broad reflection. The revelation of the heritage and architecture of this exceptional monument, but also its reinvention, aim to make it the symbolic gateway to the territory.

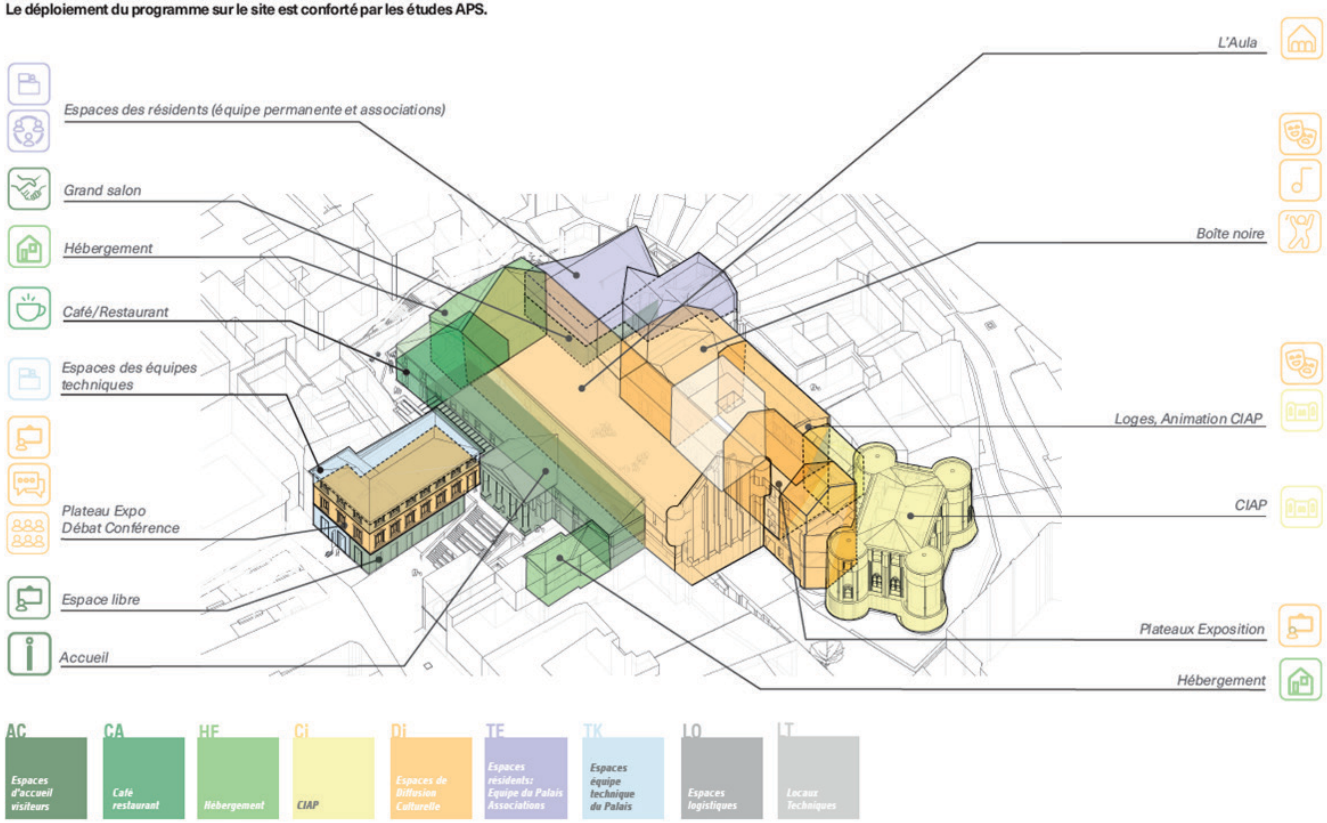
Salle des pas perdus
The "Salle des Pas Perdus" with its dizzying dimensions (50 m long, 17 m wide, i.e. 850 m2) is a place of passage, of meeting, of retreat in case of rain or hot weather. Former reception hall, it is now a place to rest and read, but also a place for cultural events, exchanges and debates.

A project in co-construction
Since 2016 and the announcement of the relocation of the Justice Department, a vast reflection has been undertaken on the future of the Palais and the development of the district. The Palais is seen as an essential heritage building, both locally and nationally, and a real opening on the territory, allowing different uses to be combined.
A consultation phase with actors involved in the fields of culture, urban planning, higher education, tourism and economic development, as well as with citizens, has led to the confirmation of the initial hypotheses and above all the interest expressed by the public in (re)appropriating the building and seeing cultural projects developed there.

The urban project: a palace open to its neighbourhood
The "Palace Neighborhood Project" will reveal and reinvent the Palace, linking the building to the contemporary life of the city, with the aim of changing the way it is viewed and used. It is therefore a project on the scale of a district, from the Palace to the Cathedral-Museum district. This district is an urban ensemble to be (re)discovered, which brings together in a few streets' historic buildings and the city's major cultural and tourist attractions.
The development of the Palais district presents a triple opportunity:
- to open up the public space and enhance the heritage, with the creation of an attractive and popular district, combining conviviality and culture around the cathedral/museum axis.
- Reviewing traffic patterns and encouraging soft mobility to enter and leave the city center.
- To provide a response to global warming on a city-wide scale, by encouraging open spaces for freshness and greenery.
An Architecture and Heritage Interpretation Centre (CIAP) will be located in the building, as well as mediation spaces and a room equipped for various artistic and cultural uses. The Palais will also have reception areas, a café/restaurant, accommodation and offices that will be dedicated to associations. The Salle des Pas Perdus will remain an open space, the central point of the Palais, with the idea of a covered public square allowing both daily use and prestigious events.

Déploiement du programme sur le site

Le déploiement du programme sur le site est conforté par les études APS.



Developing Turku Old Town

Municipality of Turku

Turku is Finland's oldest city. Our city has never been officially founded, but we consider that it was founded in 1229. In a few years' time, we will be celebrating the 800th anniversary of our city.

The area which we now call the Old Town was the administrative and academic centre of Finland from the 14th to the 19th century. It has also been the ecclesiastical centre of Finland from the Middle Ages to the present day. There are several historically valuable buildings in the area, the most visible and significant of which is Turku Cathedral.

In 1827, the City of Turku was almost completely destroyed in the Great Fire. The current buildings in the area are built on top of the ruins, and there is a wealth of rich cultural heritage hidden beneath our feet. Today, in addition to Turku Cathedral, the area has two university campuses, office spaces, creative in-dustry operators, museums, and galleries. There are also many homes in the area.

Development is underway

Although there are many operators in the Old Town area, it needs some liveliness. The City of Turku started developing the area a few years ago together with the area's property owners, other operators and city residents. The development plan for the area was completed in 2021, and it provides guidelines for the area's development. The development plan examined both the possibilities for developing the built envi-ronment and the functional development of the area.

The aim of the development is the year-round liveliness of the area. Especially during the winter, we need activities, more services and recreation possibilities that would interest city residents of all ages.

The aim is also to highlight the region's rich cultural heritage far better than currently. The 3D model was completed a few years ago, modelling the city centre area before the Great Fire of 1827. It makes it possible

to experience the centre of Turku as it was before the destroing fire.
Today, the doors of many buildings in the area are closed, their operations are one-sided, and they are aimed only at a small clientele or occasional passers-by. At night it is very quiet in the area. The aim is that the buildings will be opened in the future, that interesting services will be found in them, and that city resi-dents will be able to make use of them in a wide range of ways. One of the objectives is also to increase cooperation not only between the operators in the area, but also between them and city residents. There are several parks in the Old Town area that could be used more actively by city residents. For a few years, part of the square surrounding Turku Cathedral and the park adjacent to it have been a summer terrace offering a variety of activities in addition to food and drink. The Kirkkopuisto terrace has become a meeting place that city residents and tourists have embraced.

The Old Great Square and the Art House Turku
One of the key areas of the Old Town is the Old Great Square. It was an important trading place in the Middle Ages. Numerous events are held here, especially in the summer. The largest event in the area is the Medieval market, where visitors get a feel for medieval trading and life. Christmas is another important season, and in addition to the Christmas market, the Old Great Square hosts other seasonal events. Christmas peace has been proclaimed from the Old Great Square almost without interruption since the Middle Ages, and it is an important Christmas tradition for Finns. The event is also televised and broad-casted around the world.
For much of the year, however, the market is empty, despite the fact that there are various small cultural operators in the area. There is a need for more services that would attract city residents and tourists alike. The surrounding buildings are owned by the city. In this respect, consideration will be given to the potential of culturally and historically valuable buildings for different purposes.
A major change took place in the Old Great Square quarter in 2022, when the Art House Turku was founded. It is located in a former tobacco factory. The Rettig tobacco factory operated in the Old Great Square quarter from 1848 to 1961. For decades, it remained one of Turku's biggest businesses.
The factory buildings offer the Art House an interesting and inspiring environment in the middle of the city. The Art House is becoming a completely new kind of operator in the cultural field of Turku. Firstly, it aims to promote and support cultural activities in the city. Secondly, it provides space for cultural and creative operators. On the two floors of the main building there are already artists' workspaces. Thirdly, the aim of the Art House is to promote the employment and vitality of art and culture professionals. Another important goal is to increase the range of services in the area, such as cafés, restaurants, boutiques and events, for which the courtyard offers a great location. Several events were already held there last and this summer, and they attracted a large number of visitors. Another aim is to create a community that cooperates not only with each other but also with other operators in the Old Town.

The concept work of the Art House Turku is currently underway. Its operations have already intensified cooperation and joint development across the area. It enlivens the entire Old Town area, enables diverse cooperation and brings a vibrant concentration of culture and art to the heart of the Old Town.


LVIV
POCKET
CITY AR
@pocketcityar
SET #1
3. St. Olga and Elizabeth Church
Церква Ольги та Єлизавети
3D
7. Monument to Taras Sh
Пам'ятник Тарасові Шевчен
SET #1
SET #1

Pocket City AR: Lviv

Municipality of Lviv

In the heart of Western Ukraine, the city of Lviv stands as a living museum of architectural styles, baroque, renaissance, art nouveau, and gothic, all layered into a vibrant urban fabric. Yet, like many heritage-rich cities, Lviv faces the persistent challenge of preserving its historical legacy while making it ac-cessible and meaningful for new generations. To respond to this, SKEIRON, a Lviv-based company specializing in digital preservation of cultural heritage, in close cooperation with Gwara Media, developed Pocket City AR: Lviv, an augmented reality (AR) mobile application that represents a groundbreaking step in how cultural assets are interpreted and experienced.

Launched in 2019, Pocket City AR: Lviv is more than a mobile app, it is a multi-layered digital experience that bridges historical depth with technological innovation. Its core purpose is to digitally preserve and promote the architectural heritage of Lviv using interactive tools like 3D scanning and AR visualization. Through this digital lens, users are able to interact with historically significant buildings not just as passive viewers but as active participants in a virtual storytelling experience that overlays time and space.

What makes Pocket City AR particularly effective is its user-oriented, accessible interface. The app is freely available on mobile platforms. Once installed, users can navigate a digital map or scan physical markers (placed near specific landmarks) to unlock augmented reality visualizations. These visualizations take the form of high-fidelity 3D models rendered directly over the real-world view as seen through the phone camera. In doing so, users can observe reconstructions of damaged or lost architectural elements, explore the site's layout as it may have appeared in the past, and engage with curated historical content, including background stories, architectural analysis, and relevant cultural insights.

This format allows Pocket City AR to function simultaneously as an educational tool, a virtual tour guide, and a conservation advocacy platform. It is not limited to tourists alone—residents, students, educators, and even urban planners can use the app to deepen their understanding of the city and its evolution through time.

Among the key sites featured in the app are some of the city's most prominent and historically loaded structures, including:

- The Lviv National Academic Opera and Ballet Theatre;
- The Dominican Church;
- The Church of Sts. Olga and Elizabeth;
- The Boim Chapel;
- The Potocki Palace;
- The Latin Cathedral, and many others.

Each of these was chosen not only for their aesthetic or architectural value, but also for their ability to tell unique stories about the religious, political, and social transformations that shaped Lviv over centuries. Through AR, Pocket City empowers users to see these sites not as frozen relics, but as dynamic cultural entities shaped by positivie and negative events such as changes, destruction, and restoration.

The implementation of the project is notable for its efficient use of resources. With a budget of approxi-mately $3,000 USD, the project was financed entirely by SKEIRON and executed by a team of just six to seven multidisciplinary experts, including specialists in AR development, 3D modeling, drone and terrestri-al scanning, historical research, and digital storytelling. Gwara Media played an essential role in support-ing the research, editorial, and communication efforts, helping to ensure the cultural accuracy and public relevance of the digital content.

What started as a local initiative quickly gained traction. Over the last five years, Pocket City AR: Lviv has been downloaded and used by thousands of users, including tourists, schools, universities, and cultural institutions. Its success has led to the creation of more than ten derivative projects, including AR post-cards and applications developed for other cities and institutions throughout Ukraine. These spin-off initia-tives confirm the transferability and scalability of the model. It is not tied exclusively to Lviv's context but can be adapted to other urban or rural settings, museum collections, or even archaeological sites. The success of the Lviv edition has sparked the development of similar AR-based postcard sets for over ten other cities and institutions across Ukraine.

The long-term implications of Pocket City AR go beyond tourism or digital novelty.

It redefines how we relate to heritage in an increasingly hybrid world, where physical and virtual experiences merge seamless-ly. The app transforms public space into an open-air classroom, a digital museum, and a site for participa-tory learning. It inspires a sense of ownership among citizens, encouraging them to engage not just with monuments, but with the narratives, identities, and values these monuments represent for the citizens.

In conclusion, Pocket City AR: Lviv exemplifies how digital tools can serve the deeper mission of cultural continuity. It offers a cost-effective, scalable, and engaging solution that balances innovation with historical fidelity. By using AR and mobile platforms to elevate the cultural heritage experience, the project trans-forms everyday cityscapes into portals of the past, making heritage not only visible, but truly alive. This initiative is a model of good practice in the field of digital heritage and should be seen as a benchmark for cities and institutions across Europe and beyond seeking to foster sustainable and inclusive cultural futures.

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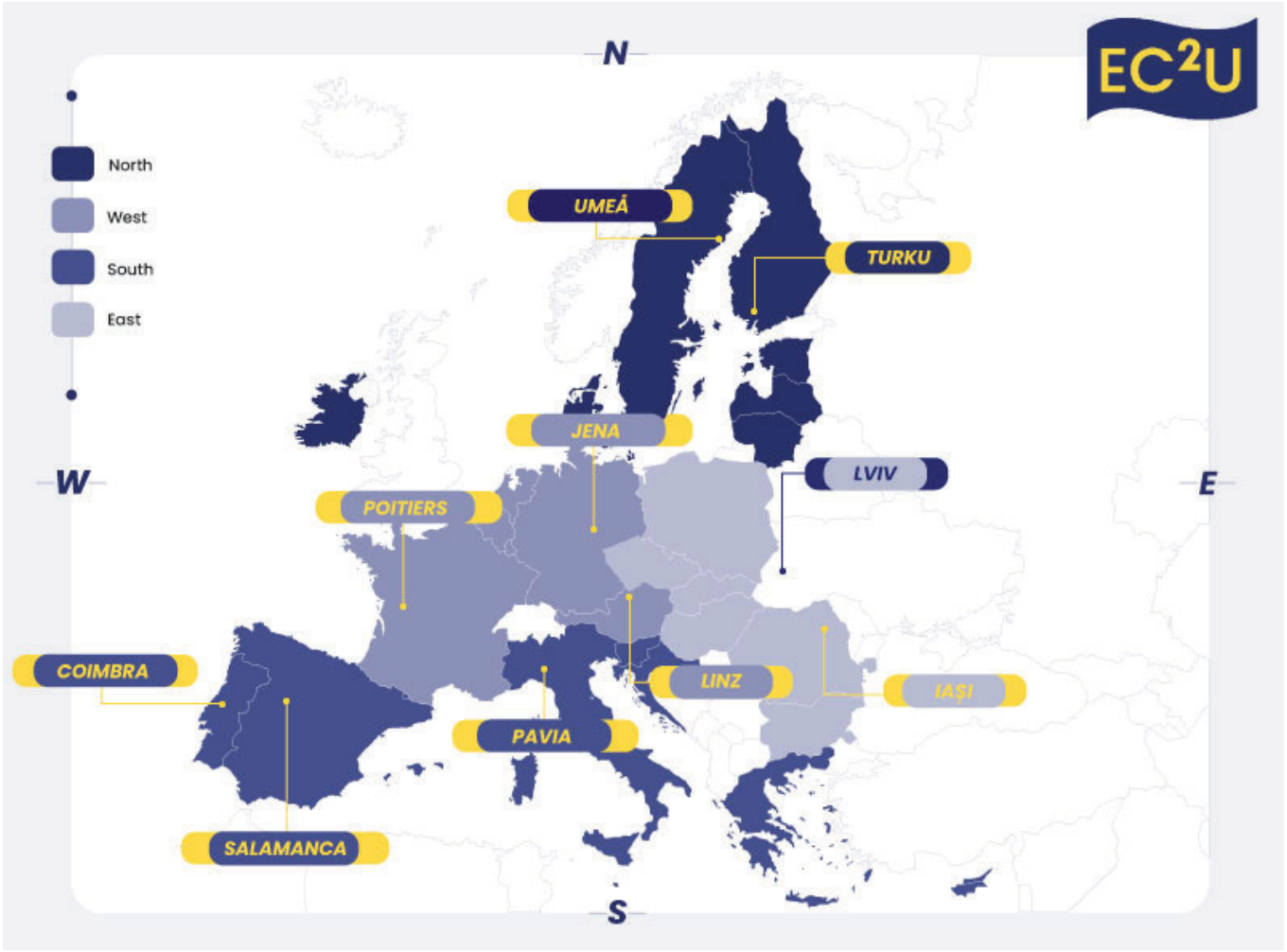

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