Climate change related urban transformation and the role of cultural heritage

Matthias Ripp & Christer Gustafsson
(Eds.)

Foreword by Claire Cave

Il Sileno Edizioni

Geographies of the Anthropocene

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Matthias Ripp & Christer Gustafsson
Editors

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Geographies of the Anthropocene

IL Sileno Edizioni

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The book series "Geographies of the Anthropocene" edited by the Scientific International Publisher "Il Sileno" (Il Sileno Edizioni) will discuss the new processes of the Anthropocene epoch through the various worldviews of geoscientists and humanists, intersecting disciplines of Geosciences, Geography, Geoethics, Philosophy, Socio-Anthropology, Sociology of Environment and Territory, Psychology, Economics, Environmental Humanities and cognate disciplines.

Geoethics focuses on how scientists (natural and social), arts and humanities scholars working in tandem can become more aware of their ethical responsibilities to guide society on matters related to public safety in the face of natural hazards, sustainable use of resources, climate change and protection of the environment. Furthermore, the integrated and multiple perspectives of the Environmental Humanities, can help to more fully understand the cultures of, and the cultures which frame the Anthropocene. Indeed, the focus of Geoethics and Environmental Humanities research, that is, the analysis of the way humans think and act for the purpose of advising and suggesting appropriate behaviors where human activities interact with the geosphere, is dialectically linked to the complex concept of Anthropocene.

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Foreword

Claire Cave[1]

The global urban environment is rapidly growing. We could say that cities are the future for humanity, but it is a future that is rapidly changing not least from the impact of climate change. Climate change is forcing transformation at an unprecedented scale across cultural, economic, environmental, political, social and technological spectrums. The challenge for cities is that this rapid transition is managed in such a way as to also provide a liveable, resilient and sustainable place for people to live. Cultural heritage is a resource which can contribute significantly to this outcome, providing quality of life for example by connecting people to place and supporting sense of identity and well-being, but how is this resource impacted within rapidly changing urban environments?

When we think of the impacts of climate change on urban cultural heritage the images that might first come to mind are historic buildings damaged by floods caused by torrential rain or the encroachment of rising sea water. Similarly, we envisage the degradation of the fabric of historic buildings exposed to high levels of humidity or new extremes of heat and cold. However, it is important to widen our focus beyond the direct impacts on tangible historic structures and their consequent preservation to a broader understanding of cultural heritage as a system. Cultural heritage is not just represented by static monuments preserved as remnants of the past but is appreciated as an evolving concept, incorporating both the tangible and intangible i.e. places, practices and objects encompassing multiple values determined by multiple stakeholders and integrated into the life of the wider community. This awareness that cultural heritage is people focussed, i.e. defined and managed by communities, means that we need to shift to a systemic, cross disciplinary approach to better address the complex, interrelationships and dynamics of a cultural heritage system and how it is affected by climate change and urban transformation.

However, the levels of complexity are increasing as the extent of environmental change is felt on the ground and in the disruption of daily lives across societies. Weather events can severely affect socio-economic activities in cities. Energy shortages caused by extreme heat and water scarcity for example

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affect industry and commerce including tourism. On a global scale, together with other stressors, climate change is forcing people to migrate, mostly from rural locations towards cities or from one city to another across countries and continents. This mass migration not only influences rapid urban transformations but disrupts cultural heritage systems as moving people are dislocated from places and practices. As a result, the distinctive character of living historic landscapes is affected by loss of people and their associated cultural knowledge. However, the movement of entire communities, displaced from their traditional homes, also means that it is important that host cities have the capacity to plan and allocate resources needed to support their social integration and sustain their cultural identity.

But cultural heritage should not be regarded solely as a victim of climate change. It has a role to play in mitigating climate change and supporting adaptation strategies and in changing human behaviour and lifestyles. Increasingly, research is revealing how culture has the power to help people imagine and realise climate resilient futures, to protect places and encourage circular and regenerative solutions. Exploring the history and heritage of cities can improve our understanding of current circumstances and our capacity to envisage and influence developments for residents and to accommodate new people and new stories. Traditional infrastructure and land management practices can inform us of sustainable approaches for dealing with storm events and acute weather. Appreciation of the process of cultural adaptation and the needs and values of communities will help identify adaptation strategies that are more likely to be accepted and employed. By promoting adaptive reuse, energy efficiency and renewable energy sources, such as the installation of solar panels, heritage can act as a model for the circular economy and climate change mitigation.

Effective governance and appropriate policies are critical factors in realising this potential. The New Urban Agenda (NUA), for example, adopted by the UN General Assembly in 2016, emphasises the role of national urban policies, legislation and regulations in achieving integrated and sustainable cities for the member states. Culture is recognised as a priority component of the programme. The NUA highlights that together with good governance, which should be inclusive and collaborative at national and local levels, it is the implementation of policies and regulations supportive of cultural diversity, sustainable planning, effective financing and local implementation that is necessary to achieve safe, resilient and liveable cities. Research which focusses on the conditions required for good governance or on the identification of good practices and successful policies are important for expanding knowledge and improving management approaches.

Exploring the role of cultural heritage in climate change related urban transformation and the associated challenges and complexities this implies, is an important and urgent topic which requires input from multiple disciplines. This book is a welcome addition to the growing literature that considers the world's urban heritage in this time of global climate crisis. The broad scope of the chapters in this volume reflects the wide range of innovative approaches and strategies for integrating cultural heritage resources and policies into our response to climate change and sustainable development. The multidisciplinary nature of the content and the concrete case studies and theoretical approaches provides a substantial contribution to the discourse on the adaptation of cultural heritage systems in city environments. In addressing the complex and wide-ranging issues and challenges posed by climate change and in reappraising and recognising the role of cultural heritage in defining our present and future potential we are in some ways preparing for what is to come.

Introduction

Climate Change related urban transformation and the role of cultural heritage

Matthias Ripp[1], *Christer Gustafsson*[2]

1. Scope

The book focuses on *Climate Change and urban transformation in cultural heritage* and the ambition is to bridge the gap between cultural heritage with its traditional narrative of conservation and preservation on the one side and increasingly rapid urban transformation and urban development based on the climate crisis and related disasters and risks on the other hand. The idea is to embrace a systemic understanding of cultural heritage and analyse urban transformation through a multi-disciplinary and integrated approach.

There is a bundle of diverse challenges, however, also conflicts related to urban transformation and cultural heritage. These challenges and conflicts can be related to the (unequal) distribution of wealth, health, access to common goods and different generations of users (Larondelle et al., 2016). In this book we want to focus on climate change as a meta-challenge and related risks and disasters and how these result in urban transformation processes. Cultural Heritage as an important resource not only for identification, well-being, quality of life and many other benefits (Ripp, 2022) is understood here as a *system* and a *process* that belongs to local communities (Ripp, 2018). But at the same time – because of its highly relevant role for these communities – it's heavily affected by unplanned urban change (urban transformation).

Conservation principles and praxes have also been changed according to these new challenges from a supply-driven conservation praxis, with focus on protection, via conservation and restoration in focus, to a demand-driven conservation praxis, with focus on adaptive re-use and spill-over effects in connection with sustainable development, social inclusion, urban transformation and regional growth (Gustafsson, 2019). This broaden perspective has often implied a change of objectives from protection to pro-action, and that cultural heritage advocators have need to leave their comfort zone and

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enter the trading zone to be part of a bigger context and to be able to find new ways of opportunities to negotiate with policy- and decision-makers as well as other stakeholders (Sörlin, 2001; Muñoz Viñas, 2005; Gustafsson, 2009).

The purpose of this book is not to describe damage or deterioration of the physical heritage. This has been examined already in different projects and publications (Sesana et al., 2021). Instead, we shall focus on how these changes are affecting the cultural heritage-system and what this means for the people – be it local communities, other users like tourists or visitors and also decision makers. Similar issues between the heritage sector and urban transformation and urban development as mentioned above have been described by Gustafsson (2009), who suggests such challenges and conflicts can be overcome if stakeholders and decision-makers first enter a "trading zone" of discussion and negotiation, from which all parties ultimately benefit. Many challenges and conflicts have the potential to contradict the original objective of preservation doctrines like for example the Venice Charter or the World Heritage Convention, even if sometimes in an indirect way.

Urban transformation can be rooted in many different causes, Hölscher and Frantzeskaki (2021) outline three perspectives: *in, of* and *by* cities as a structuring approach for integrated knowledge about the subject. However, the objective of this book is to focus on the climate crisis. Indirect effects are also of interest, for example results of changes in weather patterns, extreme heat, drought, heavy rainfall, flooding, but also limitations of accessibility for example through climate-change-prevention measures like the ban of conventional fueled cars and heating systems, etc. Other topics of interest could be e.g., urban heritage in relation to the UN SDGs, the New Urban Agenda, the Green Deal as well as the New European Bauhaus; adaptive reuse of historic urban landscape; and circular business models for conservation projects. The effects of various processes of urban transformation have been analysed and described, for example, in McCormick's "Advancing Sustainable Urban Transformation", which serves as an analytical lens to describe and understand the continuous, complex and contested processes and dynamics in cities (McCormick et al., 2013).

2. Context

The global society is today facing many pressing issues besides climate change; ageing population, threatened democracy, unsafe use of AI, and wars. Just to mention a few important ones: poverty, food insecurity, refugee rights, pandemics, healthcare, disability rights, LGBTQ+ rights, reproductive justice, children's rights, gender equality, cybersecurity, disinformation, freedom of the press, debt crises, corruption, authoritarianism, and global cooperation. In 2015, the world leaders agreed upon 17 global goals, the United Nations Sustainable Development Goals, Agenda 2030, in order to fight the challenges (United Nations, 2015).

In 2016, the New Urban Agenda was adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador (United Nations, 2017). It was the first internationally agreed document detailing implementation of the urban dimension of the SDGs. The New Urban Agenda highlights linkages between sustainable urbanisation and job creation, livelihood opportunities and improved quality of life, and it insists on incorporation of all these sectors in every urban development or renewal policy and strategy.

To overcome climate change and environmental degradation as an existential threat to Europe and the world, the European Commission has adopted the European Green Deal with the aim to transform the EU into a modern, resource-efficient and competitive economy (European Commission, 2019). The Green Deal ensures no net emissions of greenhouse gases by 2050, economic growth decoupled from resource use and no place left behind. The ambition is that this will create new opportunities for innovation and investment and jobs, as well as reduce emissions, create jobs and growth, address energy poverty, reduce external energy dependency as well as improve health and wellbeing.

In order to connect the European Green Deal to living spaces and experiences, the European Commission has launched the New European Bauhaus. It is a creative and interdisciplinary initiative that calls to image and build a sustainable and inclusive future that is beautiful for people's eyes, minds, and souls. Beautiful are the places, practices, and experiences that are enriching, sustainable and inclusive. According to Europa Nostra, for the work with cultural heritage this could be an opportunity to take into consideration the current shape and historic character of built environments as well as inspiring framework for social cohesion which contributes to the wellbeing of citizens and their communities. Furthermore, cultural heritage is a dynamic concept which defines to a large extent the future of living, cultural, social, and economic environments as well as each cultural heritage project entails a strong partnership between a wide range of actors and disciplines.

In recent times, the term circular economy has been used more and more frequently. It could be described as a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. Hereby, the life cycle of products is extended and furthermore, circular economy implies reducing waste to a minimum.

Many cities are shifting to a "circular paradigm" of production-consumption. The circular economy vision makes strong cases for business models centred on re-use, rather than consumption of ecological resources, and regenerative practices that have, on top of economic advantages, beneficial impacts for society as a whole (Ellen Macarthur foundation, 2015; Ellen MacArthur Foundation et al., 2015). The transition to a circular economy facilitates ecosystem conservation, regeneration, restoration and resilience in the face of new and emerging challenges (United Nations, 2015).

3. Our Understanding of "Urban" and why Urban becomes more important

The scope of this book is URBAN transformation related to cultural heritage. and we define Urban Heritage here as follows:

Urban Heritage

The term Urban Heritage is understood in different meanings, and often this understanding is still dominated by monuments and buildings, or what we may call tangible heritage. An easy definition of Urban Heritage would be cultural heritage in an urban setting. But as already shown, the understanding of cultural heritage is shifting currently and there is no general understanding of what "urban" is. Throughout this dissertation I will use the term "Urban Heritage" in the following way:

Urban Heritage is a system of tangible and intangible heritage, including dimensions of use and functions as well as communities and users. The ultimate purpose of Urban Heritage is to increase the quality of life of these communities and users.

*As urban I refer to the methodology that was used by the European Commission in their report on the state of European cities, where three categories (urban centre, urban cluster and rural) were introduced, based on urban density and measured by satellite data rather than numbers of inhabitants, which are difficult to count in countries with low levels of governmental structures. Following this more flexible and on the world-level easier to apply concept, heritage in dense urban centres and in (the surrounding) urban clusters is the topic of this book (*European Commission & UN Habitat, 2016, as cited in Ripp, 2022).

The still ongoing global trend to further urbanisation (Seto et al., 2013) results in the fact that more and more people are living in what can be conceived as an urban environment that is connected mostly to higher digress in density related, not only to infrastructure, population, and services, but also cultural heritage. The trend to the cities is - maybe after a small home-office-related dent in industrialised countries (Pileva and Markov, 2021) stronger than ever. Cities are struggling to provide basic needs, affordable housing and on the level of social sustainability with topics of integration, providing equal opportunities and of course desired "urban development" on different levels to name only a few. While focusing here on urban transformation we acknowledge of course that also in less dense environments climate-change related transformation is also happening and of course also affecting cultural heritage. In the scope of this book, we want to focus on urban settings for better comparability of the presented cases.

Figure 1: Additional Water Space integrated in the historic urban Landscape in Bordeaux, France (Matthias Ripp 2021)

4. Urban Transformation

Urban transformation can be understood as a set of planning methods and prerequisites which considerably change the features of the built environment by altering the urban arrangement of public spaces, purpose and shape of construction works, shape and size of building areas. Research in urban transformation has increased during the last decades, especially in relation to the three pillars of sustainable development focusing on partnership in cities with objectives to support more resilient and future-ready local economies. This can be noted in, for instance, the interest of World Economic Forum in supporting net zero and nature-positive cities, improving quality of life and growing local economies. The Davos *Baukultur* Alliance follows this and connects public and private sector stakeholders in a conscious, quality-oriented approach to planning, construction and management of buildings, infrastructure, public spaces and landscapes (Davos Declaration, 2018). For the relation between cultural heritage and urban transformation is the Davos Declaration of importance. It emphasises the value of culture in the built environments and expresses its idea for a high-quality *Baukultur*, underlining its benefits for society and the conditions to reach it.

The sustainable city of the future is usually visualised as smart, creative and disruptive, assuming that urban and local sustainability succeeds through new technology and innovation (Lillevold & Haarstad, 2019). On the other hand, if we agree upon that the built urban environments are vastly durable, we need to emphasise on how assets brought from the past – histories, artefacts and places – can be used in adaptive manners for promoting urban sustainability.

UNESCO presented in Historic Urban Landscape an approach to manage urban transformation in a holistic way by integrating the ambitions of urban heritage conservation with those of social and economic development (UNESCO, 2011). Hereby, urban heritage can be understood as a social, cultural and economic asset for the development of cities. That opened up for heritage advocators to not just focus on preservation and conservation of built heritage but to focus on the complete human environment with all of its tangible and intangible qualities. This was an important step to increase the sustainability of planning and design interventions by taking into account the existing built environment, intangible heritage, cultural diversity, socio-economic and environmental factors along with local community values.

Urban transformation is highlighted in the United Nations Sustainable Development Goals, Agenda 2030, in goal 11 Sustainable cities and communities. In target 11.4 cultural heritage is mentioned for the very first time in such international high-level policy documents. Jyoti Hosagrahar, Jeffrey Soule, Luigi Fusco Girard, and Andrew Potts (2016) discuss in a paper certain integration of culture and cultural heritage into urban development plans and policies as a way to enrich sustainability of urban areas through cultural heritage. According to them, culture and cultural heritage play a critical role in the achievement of this new paradigm of a sustainable city. They recognize several contemporary issues in urban heritage conservation: unprecedented and incessant urbanisation, globalisation and loss of identity, excessive and insensitive tourism, climate change related disasters, significant demographic changes with migrant and refugee population, inadequate urban planning, ecological perspectives on urban settlements, and human rights-based approaches to cultural and natural heritage processes and outcomes. Urban transformation that integrates cultural heritage is more sustainable, more diverse, and more inclusive. The authors stress cultural heritage and creativity as a driver for inclusive economic development, as an enabler for social cohesion, inclusion and equity as well as that cultural heritage and historic quarters of cities can improve liveability and sustainability of urban areas.

It is positive that cultural heritage is mentioned in connection to urban transformation in Agenda 2030 target 11.4. However, the original indicator for measuring the progress and to determine whether it had been achieved or can be regarded as too vague. "UN-designated Indicator 11.4.1 (Tier III): Total expenditure (type of heritage (cultural, natural, mixed, World Heritage Centre designation), level of government (national, regional, and local/municipal), type of expenditure (operating expenditure/investment) and type of private funding (donations in kind, private non-profit sector, sponsorship and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage". This can be considered as a double fault: it is impossible to draw conclusions about how much the cultural heritage turns over if you only consider public sector budgets - the majority of, for example, building maintenance is carried out by private construction companies for private property owners. Furthermore, cultural heritage should not be seen as a cost to society - instead it is a significant investment.

UNESCO's thematic indicators for culture in the 2030 Agenda are responding to the "5 Ps": People, Planet, Prosperity, Peace, and Partnerships with the objective to make culture's contribution to sustainable development more visible. The 22 new indicators are grouped into 4 thematic dimensions (Environment & Resilience, Prosperity & Livelihoods, Knowledge & Skills, and Inclusion & Participation) that correspond to the 3 pillars of sustainable development plus a fourth dimension related to education, knowledge and skills. (UNESCO, 2019).

5. Cultural heritage as a system

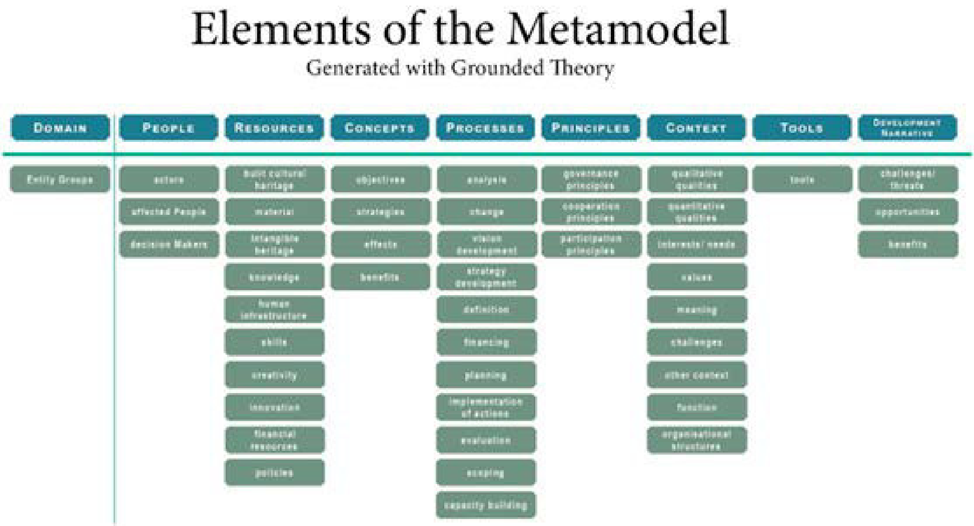
As cultural values and perspectives evolve, so does the concept of cultural heritage. Today, cultural heritage is viewed more broadly than in previous generations, and there is increased urgency to protect and safeguard it for future generations. In urban planning, the traditional approach to preserving historic areas focused solely on physical structures, treating them as relics with value separate from their context and everyday use. (Siravo, 2014: 161) This approach stemmed from a materialistic view of heritage as a discipline solely concerned with the physical appearance and conditions of monuments, solely overseen by conservators. This viewpoint has been given the name "authorised heritage discourse" by Laurajane Smith (2006).

The perception of cultural heritage as primarily physical and material remains prevalent worldwide, with a particularly strong foothold in Europe. This view is reflected in the traditional approach to identifying and designating cultural and natural heritage as properties, as enshrined in the 1972 UNESCO Convention on the Protection of Cultural and Natural Heritage (the World Heritage Convention). Article 1 of the Convention defines "cultural heritage" as consisting of monuments, groups of buildings, and sites. However, the 1964 Venice Charter, which served as a founding document for the International Council on Monuments and Sites (ICOMOS) and was adopted in 1965, made references to the "setting" and "socially useful purpose" (ICOMOS, 1964) of the cultural heritage, hinting at the rejection of a broader definition. The 1972 Convention built on this idea, with Article 5(a) expressing a desire to "integrate the protection of [cultural and natural heritage] into comprehensive planning programs" and give it a function in the community's life. It has been only recently that a fuller understanding of the dependent relationship between cultural heritage (tangible and intangible) and communities has emerged.

The 2005 adoption of the Framework Convention on the Value of Cultural Heritage for Society (the Faro Convention - Council of Europe, 2005) marked a significant shift in this direction. Article 1c of the Convention explicitly states that "the conservation of cultural heritage and its sustainable use have human development and quality of life as their goal". The Faro Convention emphasises the need to place people and human values at the core of a broader and cross-disciplinary concept of cultural heritage and involve everyone in defining and managing it, in recognition of a constantly evolving society. The 2005 Convention (UNESCO, 2005) framed by UNESCO further recognized "the fundamental role of civil society" and this issue was later incorporated into the Operational Guidelines for the Implementation of the World Heritage Convention, although only as a retrospective measure.

Modern understanding of cultural heritage is more dynamic and flexible, encompassing a holistic perspective that views heritage as "a social and political construct encompassing all those places, artefacts and cultural expressions inherited from the past which, because they are seen to reflect and validate our identity as nations, communities, families and even individuals, are worthy of some form of respect and protection" (Labadi and Logan, 2015: xiii). This view recognizes the diversity of entities encompassed by the term "heritage," with a growing emphasis on the role of communities and their use of heritage over time (Kalman, 2014).

The evolution in the perception of cultural heritage has significant implications for the COMUS Project (Ripp and Stein, 2018), particularly in terms of the role and integration of communities and stakeholders in heritage-based urban development. The project places a strong emphasis on adopting new and innovative approaches and techniques for the coordination and integration of stakeholders, leveraging the benefits of community participation in developing a sustainable future for local communities. These strategies are at the core of the COMUS methodology and are aimed at generating long-term benefits for local communities, improving quality of life and economic development. Several other urban heritage networks, including e.g. the Organisation of World Heritage Cities, also recognize the importance of stakeholder integration and community participation in heritage-based urban development (Göttler and Ripp, 2017, Ripp and Rodwell, 2018). The development of the COMUS methodology is founded on the principle of incorporating complex, systemic processes in contemporary management and communication, enabling exploration of different approaches and techniques to address the challenges in preserving our cultural heritage while ensuring sustainable development in urban areas.



6. Impacts of climate change and urban transformation in and on the system

If we understand cultural heritage as a system, the impacts of the meta-challenge climate change and related urban transformation are related to different entities of the system:

6.1 People

People are affected on different levels by climate change and related urban transformation. Most obvious for this are impacts on *health,* for instance by the rising number of extremely hot days, floods, heavy rain, drought (Trenberth, 2005) or other direct impacts. Also, the wealth of people can be affected by damage or shrinking or rising property value related to the habitability of certain areas (Brevik, 2013). Migration, gentrification and segregation are other processes that can be triggered by climate change and will accelerate urban transformation, as can poverty, hunger, water scarcity, etc. (Keenanet et al., 2018).

Besides "affected People" also the local, regional and national decision makers need to prepare and respond to these impacts. The emergency mode and the preparation for crises are gaining larger parts in urban acting in many regions of the world.

6.2 Resources (Built heritage, material, Intangible, knowledge, human infrastructure, skills, creativity, innovation, financial resources, policies)

Resources, which are part of the heritage system, are at the same time affected but also have seen changes in their role. For example, buildings as part of built heritage are affected by extreme heat, severe weather, heavy rain, flooding, etc, but at the same time see increased pressure to be part of renewable energy production for Example through the installation of solar panels (Lucchi, 2023). Traditional materials are becoming sometimes low-tech start-ups in adaptation (Idam and Kain, 2021-today), but at the same time are not always meeting the demands of modern norms (Eicke-Hennig, 2017). Connected with traditional materials but also traditional building techniques that can happen for example to cool hot temperatures are closely connected to knowledge that is unfortunately declining in many parts of the world. To put knowledge into practice human infrastructure and skills are necessary as well as creativity and innovation. The conflicts around the distribution of public finances related to cultural heritage are also increasing especially in times of (economic) crisis and policies for urban planning, cultural heritage and climate change adaptation are reworked in most cities, and the balance between adaptation and safeguarding cultural heritage is rebalanced or questioned (Schmitt, 2013).

6.3 Concepts (Objectives, strategies, effects, benefits)

While for Example in Europe for the last 80 years the objectives in cultural heritage have been mainly dominated by the preservation and safeguarding narrative, today the pressing effects of climate change are increasingly demanding adaptation and change also in urban heritage settings. This pressure is shaped by new forms of mobility, renewable energy systems, the need to reduce energy consumption of heritage buildings, etc. In the public discussion this has left an impact on our vision of heritage that is more often perceived as an obstacle for adaptation. To rediscover the resilience qualities of cultural heritage can open new possibilities for adaptation (Ripp and Lukat, 2017). The effects and benefits of urban heritage related to climate change adaptation and urban transformation in general are not always obvious and need to be highlighted more often.

6.4 Processes (Analysis; change, vision development; strategy development, definition, financing, planning, implementation of actions, evaluation, scoping, capacity building)

Heritage as a system and process is made of a variety of different processes. All of them are relevant in connection to urban transformation and climate change: An ongoing analysis and evaluation of the - often rapidly changing - situation regarding not only external factors like climate and disasters but also urban transformation process is necessary to be able to respond adequately. This includes the development of strategies and vision, that today need to be rapid-response and long-term at the same time. Finances, planning tools and strategies need to be adapted accordingly and capacity building activities need to train the officers in charge to be able to respond and also see the impacts of climate change and urban transformation in the whole system (and not only specific silos). (Grafakos et al., 2019)

6.5 Principles (Governance principles, coperation principles, participation principles

Traditional principles on the urban level are often following long planning cycles. The increased speed of urban transformation calls for more flexible approaches in connection with long-term visions. Governance, Cooperation and participation principles need to be adapted accordingly. (Ripp and Daniel, 2023)

6.6 Context

Urban Heritage is at the same time context for other elements of its system and at the time part of a larger complex context (regional, national, financial markets, travel and tourisms, etc.) (Bandarin and Van Oers, 2012).

6.7 Tools

Tools for Example for urban interventions and public management are increasingly affected by digitalisation and the availability of more diversified and detailed data. This can help on one hand to get a more detailed picture of urban transformation and on the other hand to design new interventions like for example under the title SMART CITIES - is currently developed in many cities (Aelenei et al., 2016).

6.8 Development Narrative (Challenges/threats; opportunities, benefits)

The still prevalent development narrative (even in the UN SDGs) is more often questioned and viewed critically. In connection with more rapid climate-change related urban transformation more and more cities are changing their development paradigm for example through a quality of life or livability approach. (Gustafsson and Ripp, 2022)

7. Outlook

Adrianna Brechelke's chapter deals with the historical spatial-functional network system and Smart City strategy as an opportunity for the sustainable development of the Polish town Kolobrzeg. After World War II, Kolobrzeg was destroyed by approximately 90%. The following development led to an urban-functional monoculture subordinated to tourism with ongoing reconstruction and regeneration efforts. The chapter discusses correlations between the historical urban network character and the spatial-functional balance as well as contemporary adaptation necessities, which will provide an opportunity not only for the development, but also for the preservation and adaptation of urban heritage objects in the face of the city's green transformation.

With the experience from the EU Horizon 2020 SHELTER project, and with aims to present these four governance typologies, *Louis J. Durrant, Jacques Teller, Atish N. Vadher,* and *Aitziber Egusquiza Ortega* discuss in their chapter challenges raised by the simultaneous urban adaptation to climate change and conservation of cultural heritage. In focus is how these challenges can be understood by various stakeholders and decision-makers entering a "trading zone". The authors present a refined version of the trading zone which allows stakeholders to identify more adaptive governance processes. In turn, this will provide a theoretical platform to facilitate the integration of cultural heritage sites into wider decision-making processes, enhancing the synergies between heritage and disaster-risk management experts.

Marika Fior and *Rosa Romano* ask the question: how does cultural heritage foster climate action? With urban design approaches and case studies from different climatic zones around the world, representing varied geographical contexts, their chapter investigates the rediscovery and re-evaluation of 'histo-cultural forms' of climate change adaptation. The authors outline techniques and solutions - from traditional and Indigenous knowledge to tangible historical features - that are being used to cope with heat islands, storms, floods, etc. and are genetically congenial to heritage sites.

The chapter of *Friedrich Idam* and *Günther Kain* deals with the enormous sustainability potential of built heritage. It describes how historical solution strategies for building conditioning can be recorded, evaluated and refined using the methods of applied building research. The authors present an alternative to the currently favored high-tech innovation of "smart buildings" and their technological consequences in the form of re-implementation of historically proven technologies which are more sustainable in the long term.

Xinghan Lou investigates the opportunities to use urban acupuncture as an intervention, to show cultural heritage confronting sustainability challenges as urban development. In her chapter, she examines the possibility and pathways in which cultural heritage serves as an acupuncture spot to provide turning points in the trajectory of sustainable urban development. The author presents a new model of heritage practice via which a multidimensional perspective is arising to tackle urban development issues that cannot be addressed with established technical frameworks and mechanisms.

The adaptive reuse of industrial heritage is becoming increasingly important in the era of radical climate change-related urban transitions. *Asma Mehan* and *Jessica Stuckemeyer* studies impacts of climate change when preserving cultural heritage sites and buildings becomes a crucial aspect of sustainable and resilient urban development. Case studies from different parts of the world demonstrate the potential of adaptive reuse in preserving cultural heritage, promoting sustainability, and revitalising urban areas. This approach provides a model for sustainable urban development that balances the preservation of cultural heritage with the needs of communities and the environment.

Diana Farisah Rahman's chapter deals with the conflict between farmers and local communities in safeguarding their livelihood and ensuring the productivity of rice fields and the increasing tourism industry. The changes in livelihood and agricultural practices have transformed Balinese villages and communities, driven primarily by the climate crisis rather than tourism. The chapter explores the role of Balinese culture in climate change adaptation as well as examine the impact of the climate crisis on Balinese cultural heritage, including traditional knowledge, livelihoods, and urban landscape, as well as seeks to explore the potential of local and indigenous knowledge as a bridge for integrating climate actions and heritage preservation.

Bhagyasshree Ramakrishna and *Shruthi Ramesh* chapter opens up for a discussion about negotiations of cultural markers along Mumbai's expanding Metropolitan coast. Mumbai's geographical terrain has been historically reshaped and defined by its several rulers and colonising forces, shaping new cultural morphologies with the island's spatial territoriality. The colonial practice of land-reclamations has continued into independent India to reinstate new coastal-edge meanings. The chapter argues that Mumbai's kinetic urban development juxtaposed over its rich, historic, socio-cultural landmarks poses contentions of climate change and there is a need of forging a more symbiotic relationship.

Carlo Francini and *Gaia Vannucci* present a study on the impact of the photovoltaic system on roofs in the Historic Centre of Florence World Heritage site and the collaboration and balance between innovation, authenticity and integrity. The Florence experience serves as example of how studies and researches on the territory, additional levels of safeguard and international recommendations/conventions can be transposed in local legislation but also come into conflict with it. According to the authors, climate change turns out to be an ambivalent threat: for itself and for those measures that risk contradicting the objective of maintaining the integrity and authenticity of the site.

Yijin Zhang studies heritage conservation when facing new challenges of urban development triggered by air governance in "West Lake Cultural Landscape" and the City of Hangzhou. As air governance has achieved positive results, atmospheric visibility has increased and the range of sight has expanded. The chapter establishes the "Visibility Changes-Urban Development-Heritage Protection" linkage system, and discusses how the positive effects of air governance affect or even break the original balance between the city and the heritage, reflecting the limitations of the current heritage management system. Based on this, the research proposes strategies to make the overall management model more systematic, forward-thinking, precise, and intelligent, as well as to optimise the multi-party dialogue platform for stakeholders — Heritage Impact Assessment.

Based on a six-year case study of the City of Edgerton, Wisconsin, USA, *Sarah E. Braun* has studied climate change related to urban transformation and the role of cultural heritage with a particular focus on the power of local government policy for building resilient cities and communities. The study demonstrates successes and challenges that are all relevant to urban transformation and for local communities.

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Connections, Policies and Governance

1. The Power of Local Government Policy for Building Resilient Cities and Communities: The City of Edgerton, Wisconsin as a case study

Sarah E. Braun[1]

Abstract

Understanding how to build resilient communities around traditional heritage systems is reliant on policy development both in sizeable cities, as well as smaller local governments and the policies they implement. The research performed over six years in the City of Edgerton, WI (United States) covers valuable insights into rural, Midwest community development, where sustainability policies are often put aside, especially when heritage initiatives are involved. Serving for four years in the local community as Alder and six years on the Heritage Preservation Commission, the research demonstrates the importance of grass-roots implementation of UN sustainable development goals for economic growth, climate change infrastructure policy, and heritage tourism development. The findings illustrate victories and challenges relevant to the future of urban transformation, and future pathways for communities of all shapes and sizes. Creating multi-level stakeholder buy-in, education on principles and best practice, or access to resources are all pieces of this complicated puzzle we aim to solve as heritage professionals in an increasingly uncertain global climate. How to mitigate risk and manage factors we may not be able to foresee or predict in a post-Covid-19 world are all part of the equation. Our government policies and the officials that create these guidelines must be knowledgeable and open to collective, innovative ways to grow and change the cities and communities they represent.

Keywords

Urban Transformation, Urban Governance, Sustainable Development, Heritage Tourism, Climate Change

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1. Introduction

Urban transformation and its role in climate change is more commonly associated with larger metropolitan areas and the impact their development has on the unique fabric of cultural heritage and communities. It is no secret that diverse, cultural programs and activities offered by a city or organization are closely tied to successful, socioeconomic development (Hölscher, Frantzeskaki 2021). However, understanding how best to build resilient communities through cultural sustainability is not only reliant on policy development in sizeable urban cities, but also those of medium and smaller, rural environments. It is a process owned by local governments (Ripp 2018) and the programs they write, pass, and implement.

Research serving as a government official with the city of Edgerton from February 2017 to April 2023 investigates and aims to begin to capture the power of comprehensive urban transformation by documenting successful projects and initiatives, as well as demonstrates the importance of grass-roots implementation of UN Sustainable Development Goals (SDGs) for advancing sustainability and cultural policies in urban transformation. Over half of the population in the United States officially lives in communities smaller than 36,000 inhabitants (Kachook, 2020). The power of systemic change at the local level in the US has the potential to bring about radical urban transformation across the diverse systems of the urban landscape – such as governance, risk management, climate change mitigation, cultural heritage preservation etc. Yet, often these types of policies in the United States are met with pushback as politically charged agenda items if not approached from within the proper audience lens, and even notable events, like extreme weather phenomena, do little to sway the general public on investing resources into areas like climate change resilience (Karmarck, 2019).

However, not all policy change needs to be put within the framework of global objectives to begin the conversation. In fact, methods of downscaling at grassroots level have resulted in successful implementation of innovative projects and polices in the city of Edgerton, specifically on water infrastructure upgrades (White House 2023), renewable energy studies and fund allocation (Slip Stream 2023), public-private partnerships (PPPs) to provide affordable housing for homeless veterans while simultaneously restoring and renovating two historic downtown buildings (Aarsvold 2022), establishing new cultural heritage policy in sustainability (Historic 2023), as well as the formation of new governing bodies for sustainable tourism and economic development (Tourism, 2020).

While the last six years laid the groundwork for the successes that were achieved in these multi-level stakeholder initiatives, they also highlighted the complexities of operating in the urban-transformation landscape at a local level and the limitations many medium, small, and rural communities face. It should also be noted that implementation of resilient and robust development policy and governance coincided with the unique resources provided as a result of grant monies available through the Public Service Commission (PSC) of Wisconsin, Covid-19 relief through American Rescue Plan Act (ARPA) funds (City of Edgerton, 2022) and the new Inflation Reduction Act (IRA) at the Federal level. The funding sources, while incredible opportunities to facilitate the creation of more resilient urban systems, also illustrate the complexities and limitations city officials and staff face on how best to utilize unique resources with strict project criteria, without full access to technical expertise, and how to best leverage funding within the critical timeframe (US Treasury, 2022).

2. Baseline Situation

Edgerton, Wisconsin is a city located in the South-Central part of the state along the Interstate 90 corridor connecting Madison, Wisconsin and Chicago, Illinois. It has a population of 5,945 (Census Bureau, 2020) and was founded in 1853, a hub for tobacco cultivation in North America at the end of the 19th century (Scarborough, 2014). This agricultural hub for tobacco resulted in a great influx of wealth to the area and the subsequent growth and development of the community that residents still feel connected to today with the annual Tobacco Heritage Days Festival (Visit Edgerton, 2023). While the roots of tobacco built the community, Edgerton boasts other notable cultural history intrinsically tied to the identities of the residents – nationally acclaimed Pauline Pottery (Fig. 1), buildings designed by notable Beloit, Wisconsin architect, Frank H. Kemp (Fig. 2), internationally known author, Sterling North, and his boyhood home (Fig. 3), the childhood home of decorated PGA golfer, Steve Stricker (Fig. 4), and the fundraiser music festival Chilimania, billing top US musicians and attracting thousands to the city each year, all while raising money for academic scholarships for local high school students (Fig. 5).

Fig 1
Pauline Pottery
Image: Scarborough, 2014

Fig 2
House designed by
Frank H. Kemp for H.E. Peter.
Image: Scarborough, 2014

Fig 3
Sterling North Home
Image: Scarborough, 2014

Fig 4
Steve Stricker (Center) in 2010 donating $100,000 to Edgerton Hospital and Health Services.
Image: Scarborough, 2014

Fig 5
Thousands celebrate the Chilimania music festival and fundraiser
Image: Chilimania, Inc., 2022

As agriculture has declined in the area over the years, especially the cultivation of tobacco, the focus has now turned toward heritage tourism for economic growth and development (Scarborough, 2014). Due to its unique location and proximity to major metropolitan areas, like the state capital city of Madison, Edgerton has seen steady growth over the past two decades, and the expectation of that continued trend (Table 1) for the next twelve (City of Edgerton, 2015).

	2015	2020	2025	2030	2035
Linear growth based on number of residents added over past 30 years (38 residents/year)	5,649	5,836	6,024	6,212	6,399
Long-term compounded growth based on rate of growth over past 30 years (0.77%)	5,681	5,912	6,153	6,403	6,663
Recent compounded growth based on rate of growth over past 10 years (1.02%)	5,740	6,032	6,340	6,663	7,003
Wisconsin Department of Administration forecast	5,620	5,930	6,210	6,465	6,655

Source: Vandewalle & Associates, Wisconsin Department of Administration Population and Housing Projections

Table 1

In fact, according to the latest Economic Impact Report of Rock County, where a majority of the city is situated, the "total visitor spending (includes indirect and induced) totaled $439 million - an increase of 12% in respect to the previous year (Rebout, 2023). However, developing infrastructure for economic growth, development, and heritage advocacy through tourism has been intermittent and inconsistent in the past, due to lack of continuity in local champions over time, collective vision within the local government, and a connected network of community volunteers and businesses.

With the update of the city's comprehensive plan in 2015, the city and community sought to address areas of disconnect in collaboration and set collective goals for the next twenty years, highlighting objectives for sustainable development. The city's comprehensive plan was developed in accordance with nine elements contained within the State of Wisconsin "Smart Growth" legislation passed in 1999 (State of Wisconsin, 1999), and sets out to "guide short-range and long-range growth, development, and preservation" (City of Edgerton 2015). Coming into the community in August of 2016 as a resident and serving on the Historic Preservation Commission beginning in February of 2017, I received a first glimpse into both the enthusiasm of the community and their commitment to valuing and preserving its heritage, as well as the desire for both tourism growth and preservation. I was also confronted with the struggle many small communities face with lack of manpower and funding for cultural resources. Sustainability and the UN SDGs were also not a well-known topic when I arrived back to the Midwest in 2016. Over the past six years, this has changed a great deal, but the delay in widespread knowledge and awareness of the UN Agenda 2030 has put the heartland of the United States at a disadvantage. The center of the United States lags in establishing sustainable urban systems with most of the country's population (Conroy & Iqbal, 2009). Many municipalities do not even have access to recycling facilities. It is also my belief that, due to delay in dissemination of knowledge and capacity building at a grassroots level, policy and objectives at the heart of building resilient communities and combating climate change has allowed for the practicalities and benefits to be easily politicized and contested, a task not always easily surmounted when resources in time and money are finite.

The city staff, government officials, and administration labored diligently during my time as an Alder, working to mitigate and solve these challenges through various methods and innovative ideas, overcoming the 'death knell' (Karmarck 2019) of complexity that topics in sustainable development add to an already politically divisive climate in the United States as well as overall awareness, knowledge, and know-how within the community. Our advantage, principally, came with establishing a common goal and vision among city administrators, staff, and elected officials to promote resilient economic growth, infrastructure improvement to address climate change, alongside preserving the city's cultural heritage. This holistic approach was both rewarding and thought-provoking. It also identified limitations that are presented within smaller urban systems.

3. Methodology & Local Government Synergies

The mixed methods empirical research undertaken in this study sought to evaluate and understand the unique social and environmental characteristics and impacts of initiatives and policies enacted in the City of Edgerton, and their influence or hindrance of urban transformation capacity (TC). Urban TC represents a city's readiness to introduce and manage processes designed to improve quality of life and conditions in an urban setting (Wolfram 2016). The qualitative and quantitative data collected offer a basis in which to understand and build on the city's progress in actions taken to increase climate change resilience and the contribution of cultural and social factors in sustainable development. As discussed by Wolfram, Borgström, and Farrelly (2019), the urban TC of the City of Edgerton has "both enabling and constraining effects on actors," and illustrates the significant power of local government and community actors, but also the limitations created by lack of connectivity across other entities, communities, and levels of government.

These findings were summarized using the *In, of, and by* (2021) technique introduced by Hölscher and Frantzeskaki to capture the complex dynamics of urban transformation in a way that provides relevant stakeholders access to actionable information that could be utilized to address limitations and future progress of ongoing and prospective initiatives. With simple yet comprehensive in mind, the biggest takeaway from data collection, interviewing, working with, and discussing sustainable development policy with multi-level stakeholders, is the necessity to have three principal synergies for successful implementation:

1. *Collective Vision, Identifying Local Champions, and Buy-In*
2. *Mobilization and Project Planning*
3. *Access to financial resources and technical expertise*

A favorable outcome — often leading to success — relied heavily on the first principle of collective buy-in and how that translated to transformation in agency and governance, affecting the multi-dimensional system dynamics within the community, and the outcomes of these synergies (Hölscher, Frantzeskaki 2021). Local champions can include a number of stakeholders as catalysts for sustainable development initiatives. In the specific case of Edgerton, the city administrator was a major actor in larger initiatives, with support from the common council, city staff, and local community leaders. Cities are "agents of change," as Hölscher and Frantzeskaki write, and result in a possible ripple effect, influencing agency and governance in surrounding communities. Establishing networks for the connectivity of intermediaries, funding opportunities, and alternatives to existing governance modes to promote local, regional, and national strategic alignment (Wolfram, Borgström, Farrelly 2019) is also imperative for sustainable urban transformation.

3.1 What Worked

During my time spent serving the community of Edgerton, I had the privilege to work with incredibly dedicated individuals who were inspiring advocates for the holistic growth of the community. Each initiative illustrates areas where the removal of "barriers to innovative practices and embedding them into routines, organizations, plans and especially legal frameworks" (Wolfram 2016) were employed to improve urban TC across various community and stakeholder levels. Below are highlights of the most illustrative projects in which I participated directly as a city official. Conventional approaches to sustainable urban transformation (McCormick, et. al 2013) are inadequate to implement effective policy and frameworks for these initiatives. Instead, innovative, collective effort is necessary to affect lasting change.

3.1.1 Lead Laterals

One notable implementation and result of transformation *by* cities was improvement of community resilience and water infrastructure touching Global Goals 6, 11, and 13 principally (United Nations, 2015). In January 2023, our community became a founding national partner in quality, water infrastructure at a national level for the proactive replacement of nearly 100% of the lead pipe laterals in our community – many in our historic district, without cost to the taxpayer (The White House, 2023). This was made possible by city administration accessing available grant funding, council approval and advocacy, and municipal staff mobilization leading to community awareness and participation. Successful urban transformation is possible, and organizing smaller cities and communities is crucial for comprehensive, sustainable urban transformation (Riganti, Throsby 2021).

3.1.2 Climate Change Resilience: Renewable Energy Study & Comprehensive Park Plan

The Wisconsin Initiative on Climate Change Impacts (WICCI) latest report (WICCI 2021) presented findings that temperatures in the state of Wisconsin have been at their warmest in two decades, and specifically in Southern Wisconsin, communities have experienced the highest levels of precipitation since 1950, highlighting weaknesses in critical infrastructure for municipalities, such as roads, culverts, stormwater systems, etc., that would benefit from evaluation and improvement. Post Covid-19, the state also prioritized funding that would address some of these vulnerabilities in climate change and disaster risk management associated with out-of-date comprehensive energy plans for municipalities (City of Edgerton, July 19 2022). Working with these future possibilities in mind, the city was able to explore a new climate and disaster resilience planning initiative together with two other neighboring communities and the feasibility of moving to solar on city buildings. The size, resiliency, and payback, also noting the opportunity to utilize IRA funding together with ARPA monies, were analyzed for the city library, department of public works garage, wastewater treatment plant (WWTP), and the police station with an accompanying battery storage (Slip Stream 2023). An example of one of the approved projects is illustrated below:

WWTP Results

	Roof	Ground	Hill
System Size(kW-dC)	45	45	160
Simple Payback (years)	19.3	22.8	23.6
Percent Renewable Electricity	8%	8%	25%
Lifetime Carbon Savings (metric tons)	1015	1047	3127
Total Energy Savings	$94,240	$96,934	$288,291
O&M Cost (includes replacement of inverters)	$18,000	$18,000	$64,000

Costs	Roof	Ground	Hill
Total Upfront Cost	$112,500	$135,000	$416,000
Focus on Energy Incentives	-$6,125	-$6,125	-$19,000
IRA Tax Credit	-$33,750	-$40,500	-$124,800
Total Cost	$72,625	$88,375	$272,200

Source: Slip Stream Solar Study, 2023

Alongside, addressing climate-related susceptibilities in critical city infrastructure and energy resilience, the city also took advantage of the opportunity to address green urban space in parks and recreational areas by commissioning and approving a new comprehensive park plan by the common council using ARPA funding (City of Edgerton, July 19 2022). ARPA monies are required to fit a specific criterion, be used within a specific timeframe, and took effect in April of 2022 (US Treasury, 2022). What is unique about both urban infrastructure improvement projects is that the funding sources allowed us to address large needs for transformation *of* the city and its climate change resiliency with dollars that would not negatively impact our taxpayer. It is also noteworthy that these initiatives may not have remotely been possible in whole or part without the access to adequate government funding sources.

3.1.3 Redevelopment & PPPs

Municipal infrastructure is crucial in building sustainable foundations for other aspects of urban transformation to flourish, and perhaps the most unique and innovative project implemented during my time serving in local government is the redevelopment of two historic downtown buildings that were nearly vacant. Working with our community outreach non-profit, the local chapter of Veterans of Foreign Wars (VFW), and the private sector owner of the buildings, this collective effort allowed for PPPs to not only preserve two historic Main Street buildings, but also will result in the creation of usable square footage in the downtown economic district. The city provided partial funding for the Edgerton Community Outreach to purchase the building from the owner, as well as a monetary incentive to restore the second historic building under his ownership. Those funds will be distributed to the owner upon completion of the restoration and renovation of the second building. For the first building, the purchase via Edgerton Community Outreach allows for the redevelopment into affordable housing for female veterans (Aarsvold, 2022) a storefront to generate revenue, as well as a new meeting place for all military veterans living in our community, supported also at the federal level by U.S. Congressman Marc Pocan. An incredible example of the power of PPPs working together for the collective benefit with likely potential to contribute to development and urban transformation *in* the city.

3.1.4 Heritage Preservation & Urban Development

Redevelopment and maintaining the historic urban fabric of the downtown area was also a principal part of establishing a Tax-incremental Financing (TIF) District, which is a Wisconsin Department of Revenue program allowing for municipalities to access funding "for infrastructure and other improvements" (Wisconsin Department of Revenue, 2023). The TIF District for the historic downtown area was open from 2001 until 2022. The Redevelopment Authority approved $686,269 (City of Edgerton, July 19 2022) to local business owners in our façade grant program for improvements to the historic buildings in the heart of the city. The Historic Preservation Commission then made sure those improvements were in line with the necessary ordinance requirements to receive a Certificate of Appropriateness.

Finally, new policy (City of Edgerton, 2023) was written to address the need and desire for a mural painting policy. Previously, none had existed within city ordinance for historic preservation, and individuals and groups were prohibited from painting on the exposed surfaces. However, community requests had been made about the possibility of using murals with subject matter reflecting the heritage of the city as both a way to beautify and create new points of interest for tourism (Altshuler, 2020). The resulting policy laid a framework that would adhere to international standards of cultural heritage preservation (the first of its kind in the community) and simultaneously encourage the continued development of tourism sites in the downtown area. The importance of establishing a policy of this nature in the community directly supports the meaningful connection citizens feel to the history, place, and space *of* the City of Edgerton and how that increased awareness also deepens connection and reinforces social sustainability, collective ownership of policies that support sustainable development, and the idea of a rural city as a "relational place" for linkages to climate change mitigation and cultural heritage preservation (Grin, et. al 2017).

3.1.5 Tourism in Edgerton

While still in development, the City of Edgerton's desire to increase responsible tourism and awareness began with the establishment of a Tourism Commission and accompanying Tourism Zone, which includes representatives from the three communities within the established zone. These were enacted in 2019 (City of Edgerton, 2019). Since its creation, the entity has used room tax collected from local lodging to fund marketing efforts, employ a staff focused on building activities in the area, and outreach to both businesses and tourists. The website showcases surrounding area attractions, events, and businesses, and also works directly with local businesses to encourage their own innovative ideas. Last year, the commission awarded $9,750.00 in grant monies to local businesses that supported activities and promoted tourism in the area (Town of Fulton, 2022). The results of the grant program further supported the growth of existing festivals celebrating the city's heritage, like Tobacco Heritage Days, as well as the beginning of new traditions such as a Friday night artisan market showcasing local produce farmers, food trucks, entertainment, and craftsmen.

4. Limitations

The complexities of the diverse network of actors provide a challenge for a cohesive framework in which to build better policy. While we do have some positive, concrete examples within the city of Edgerton, they were not easily won. Challenges for the sustainable development alongside preserving its heritage in small cities like Edgerton include translating their fundamental value to larger audiences. We might ask if it is possible to better translate the cosmopolitan memory (Barthel-Bouchier, 2016) of smaller communities like ours. Is it possible to focus on place-based transformation and grow from the ground up and be woven into the fabric of global sustainable development? I believe it is both feasible and imperative if we are to really address the issue of both cultural heritage sustainability and mitigating climate change holistically.

Without these policy improvements with mulit-level stakeholder buy-in, cities may still enact programs that unintentionally support green gentrification, polarization, and urbanization lacking equity and inclusion (Wachsmuth, et. al 2016). Furthermore, cities continue to lack comprehensive access to knowledge and collaboration at national and global levels, echoing the limitations of collective memory (Barthel-Bouchier) at a local level, especially those in medium and rural communities. In relation to understanding the effects of climate change on our local community, most of the data is relatively new, with the latest report from the WICCI being only the second of its kind (WICCI 2021). Limited availability of resources for global governance processes create stagnation in sustainability and cultural policy advancement, as well as little or no data collection and sharing (Acuto 2016) in a time when shared, systemic transformation is vital to combat climate change, social sustainability, and preservation of collective memory. New benchmarks leave many unknowns for municipalities to navigate in the future, especially when considering brand new policies, for example, a new mural painting policy. Do we understand what the potential vulnerabilities related to climate change will be for new murals and historic preservation in the city, and is the policy sufficient to address vulnerabilities? What resources and knowledge will be necessary for successful urban TC? Is there flexibility in the policy to address necessary changes or adjustments in the future?

Some of these vulnerabilities are beginning to be addressed in research projects, like IN SITU, which aims to "advance understanding of the forms, processes, and governance of innovation involving cultural and creative industries (CCIs) located in non-urban areas of Europe" (University of Coimbra 2022). However, further exploration into the power of place-based approaches in policy development is vital and necessary for advancement of the role of cultural heritage in sustainable development. Using the "*in*, *of*, and *by*" (Hölscher, Frantzeskaki 2021) perspectives allows for continued investigation of these critical and complex relationships in urban transformation (McCormick, et. al 2013) in a way that is perhaps more digestible. Many small and rural communities similar to Edgerton in the United States, lack access to critical knowledge that identifies key factors in sustainable development, cultural policy, and climate change, especially those that illustrate the valuation of cultural heritage assets fundamental in the process of building resilient cities (Riganti, Throsby 2021).

5. Conclusion and Further Research

The limitations experienced while working with the City of Edgerton are not unique to this community alone. While there is no 'one-size-fits-all' formula to implement sustainable urban transformation in smaller communities, the power of grassroots movements is clear. Each of the initiatives that were successful during my time serving with the local government held a thread of three fundamental pieces under the *In, Of, and By* method (Hölscher, Frantzeskaki 2021). These underlying pieces each required community and government support from both the public and private sector (in) cross-sectoral place-making; illustrated benefit of urban transformation of the city, and resources and support from state and national levels in line with larger initiatives. Successful implementation of new policy and innovative projects requires synergistic cooperation across the urban(sub)-systems of the community and how it relates to historic identity of the city's culture and heritage (of). Local government bodies and their collective vision are key in the follow-through and establishment of the policies that shape the sustainability initiatives and programs of the community (by).

As an emerging field of research, particularly at the local level, continued development in identifying key factors and active mechanisms that spur sustainable urban transformation in areas that do not hold the same attention as large metropolitan areas is imperative. In the six years of participating in research and government action, processes often moved at a less than desirable pace, and often in other communities as well, continuity of leadership and policy become an issue. The community of Edgerton was fortunate to have a cohesive vision and governing bodies that shared the same objectives to achieve a thriving and healthy community. The ease at which we operated allowed us to foster relationships with other key stakeholders easily and with a solid foundation, increasing the urban TC of the city and surrounding area. The lessons that can be taken from the City of Edgerton and the work of the city administration, common council, and community champions could be implemented in other medium, small and rural communities in the future as new case studies.

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2. Cultural heritage governance typologies and their role in urban transformation

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Abstract

Climate change has increased the intensity and frequency of disaster events worldwide, which in turn, has forced modern civilisation to reflect on the resilience of its built and natural environments. Within this broader context, urban areas have been forced to adapt to cope with the increasing risk of disaster events, with adaptions often having a direct impact on cultural heritage, especially where this heritage is exposed to the consequences of adaptation that are unplanned or unforeseen. Cultural heritage is, therefore, being reconsidered as an untapped 'opportunity space' disputed by international organisations and stakeholders. These stakeholders include local communities, external visitors, heritage experts and urban planners. Overcoming the challenges raised by the simultaneous urban adaptation to climate change and conservation of cultural heritage requires these stakeholders and decision-makers to enter a 'trading zone'. The trading zone is considered a space where stakeholders can negotiate conflicting or contradictory objectives and explore potential trade-offs between heritage preservation and climate change adaptation, leading to mutually beneficial outcomes. Building such a trading zone requires an appreciation of governance but evidence suggests there is a lack of understanding of governance structures related to climate change, including disaster risk management, disaster risk reduction and climate adap-

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tation. Greater clarity about who does what, how they do it and when they do it within the context of climate change, especially disaster events, would help to facilitate this trading zone, helping to identify potential situations where there may be room for compromise and where mutually beneficial trade-offs exist. Stakeholders can negotiate conflicting or contradictory objectives within this trading zone with a greater appreciation of the different experts' roles in the urban transformation. Furthermore, the stakeholders will also be better equipped to develop more practical and workable solutions, which incentivises all stakeholders. This book chapter builds upon and contributes towards ongoing Horizon research projects. In particular, the Shelter project and the Rescue Me project. These projects explored pre-existing literature to identify four preliminary governance typologies when exploring the anatomy of urban and rural historic areas at different spatial scales. The four governance typologies defined were Hierarchical, Participatory & collaborative, multi-level & networking and Community-led. This book chapter describes these four typologies in greater detail, reflecting upon them with ongoing working examples and exploring them within the context of climate-driven urban transformation. We propose that these typologies form the basis for further research. A refined version of these governance typologies complemented by further examples will help inform the development of the trading zone. In turn, stakeholders identify more adaptive governance processes, allowing them to shift from one typology to another according to the stakes involved. This will provide a theoretical platform to facilitate the integration of CH sites into broader decision-making processes, enhancing the synergies between heritage and other stakeholders.

Keywords

Cultural Heritage; Governance; Governance Typology; Stakeholders; Urban Transformation

1. Introduction

Cultural heritage (CH) is a unique concept encompassing various tangible and intangible elements (Vecco, 2010; Lenzerini, 2011; Munjeri, 2018). These tangible and intangible elements transcend time, connecting people to their past, present, and future (Brumann, 2015; Little et al., 2019 & Jones, 2021). CH is a concept that inherently belongs to local communities (Ripp, 2018), reinforcing their sense of place (Csurgó & Smith, 2022; El-Barbary et al., 2022) as well as reinforcing and even restoring the social cohesion of communities within an area (Reeves & Plets, 2015). Furthermore, CH is a powerful mechanism for social empowerment (Hassan, 2020). In short, CH is an essential concept transcending traditional boundaries with myriad benefits.

In this context, scholars across the academic community have noted a paradigm shift in the CH discourse (Aaroz, 2011; Smelter, 2013; Wiktor-Mach, 2019). Within this paradigm shift, our perceptions of CH and its role in the broader sustainability theory, are changing (Aaroz, 2011; Smelter, 2013; Wiktor-Mach, 2019; Cerquetti & Romagroli, 2022). In part, the paradigm shift is stimulated by the perceived vulnerability of CH to disaster events due to climate change (Sabbioni et al., 2009; Fatoric & Seekamp, 2017; Thomas et al., 2018; Sensana et al., 2020). The paradigm shift can be seen internationally across academia, policy, and practice. By way of example, international organisations such as UNESCO, ICCROM, and ICOMOS champion the importance of CH as a component of sustainability in the urban agenda (Pereria Roder & Van Oers, 2011; UNESCO, 2015; ICOMOS, 2016; Labadi, 2017).

Furthermore, UNESCO continually strengthens its rhetoric and regulatory framework to help align CH with sustainability and climate change (UNESCO, 1972; UNESCO, 2017). In parallel, academic researchers have begun to explore the challenges and implications of integrating CH into many avenues of research. By way of example, many researchers have attempted to build upon the work of Hawkes (2001), who explored the role of CH as the fourth pillar of sustainability (Nurse, 2000; Astara, 2014; Sabatini, 2019). In this research, scholars explore culture alongside economy, environment, and society (Barbier, 1987; Puvis et al., 2019). Similarly, scholars such as Petti et al. (2020) and Aureli et al. (2022) have explicitly explored the harmonisation of culture with our sustainable development targets. Other relevant avenues of research that have emerged within this paradigm shift including the integration of CH into broader disaster risk management (DRM) and disaster risk reduction (DRR) theory and practices (Ravankhah et al., 2017; Staton-Gedes & Soz, 2017; Garcia, 2019). Within this avenue of research, experts are attempting to enhance the resilience of CH sites to natural disasters as a result of climate change (Sabbioni et al., 2019). Also, experts have attempted to apply the concept of circular economy strategies to the management of CH within the context of sustainability (Foster, 2020). Scholars have more recently noted CH's importance in urban regeneration (Boeri et al., 2013; Flores de

Leon et al., 2020). It is also important to note the emerging avenue of research around CH and urban transformation (McCormick et al., 2013; Hölscher & Frantzeskaki, 2021) and growth (Ripp, 2022).

In summary, the ongoing research around CH is an essential component of our sustainable future. CH is no longer a sectoral interest but a seemingly multidisciplinary concept that links people to their environments in unique and powerful ways. As such, successfully integrating CH into broader sustainability thinking provides a vital research opportunity with growing momentum. With more comprehensive research in mind, this book chapter focuses on the role of CH within the broader sustainability space, specifically, how CH stakeholders (and their unique perspectives and knowledge) could be brought into broader discussions and decision-making processes within dynamic urban environments.

It is here that we should link to the research being conducted by Gustafsson (2010, 2011). In short, Gustafsson (2010, 2011) explores the idea that stakeholders can negotiate conflicting or contradictory objectives within a 'trading zone'. The trading zone refers to an application-oriented theoretical platform. The platform provides a place where stakeholders can develop approaches to solving boundary-spanning challenges for regional growth, strengthening competitiveness, and developing building conservation. The trading zone is contested by international organisations and many stakeholders, including local communities, external visitors, heritage experts, and urban planners. Stakeholders can negotiate conflicting or contradictory objectives in this trading zone, explore trade-offs, and define mutually beneficial outcomes. The development of this trading zone, however, requires an in-depth understanding of governance around CH sites. In particular, the stakeholders and governance mechanisms that contest and influence this space. This book chapter aims to clarify the potential stakeholders and governance typologies that can be used to inform the development of this trading zone. To achieve this, the chapter combines two separate, but interrelated avenues of research previously explored by the authors.

The first avenue of research was conducted as part of a Horizon 2020-funded project called The SHELTER Project (Shelter Project, 2023). In this project, researchers from the University of Liege adapted the Organigraph technique (Mintzberg & Van der Heyden, 1999) to co-create detailed governance maps with stakeholders from five Open labs (Durrant et al., 2022; Melandri et al., unpublished). This research yielded various outcomes, including a standardised key for building governance maps, a replicable methodology, five unique Organigraphs, and a plethora of raw data from recorded interviews, informal discussions, and comments. The raw data directly explored the strengths, weaknesses, opportunities, and threats within the governance of the five Open Labs within the SHELTER Project. This research can be found in a deliverable submitted in November 2021 (Durrant & Teller, 2021).

The second avenue of research explores the concept of governance typologies. The term governance typologies build upon the idea that there is commonly observed governance 'types', 'models', 'structures', and 'systems' operating within CH assets. The research aimed to define a replicable schema for pinpointing the different types of governance within heritage sites and how they manifest in practice. The foundations for this research were also established within the SHELTER Project (Shelter Project, 2023) but continue to evolve within another Horizon 2020-funded project called The RescueME Project (RescueMe Project, 2023). The conceptual foundations were published within a deliverable entitled 'D2.3 PART A - Anatomy for Historic Areas' (Tamborrino et al., 2021; see subsection 4.4, pages 34-48). Within this deliverable, the authors distilled four preliminary governance typologies defined from a review of the relevant literature. These governance typologies were defined as:

- Hierarchical Governance
- Participatory or Collaborative Governance
- Networking and multi-level Governance
- Community Led Governance.

The structure of this book chapter is presented in Figure 1. The book chapter begins by briefly exploring the broader literature around CH governance and the idea of the trading zone as defined by Gustafsson (2010). These concepts are presented so the reader can appreciate the conceptual boundaries of the book chapter. Second, the authors present the key outcomes from the two topics of research outlined above. These key outcomes include a comprehensive list of relevant stakeholder groups and their perceived role in CH governance. Finally, a refinement of the four governance typologies outlined previously in the D2.3 PART A - Anatomy for Historic Areas (Tamborrino et al., 2021) within the SHELTER Project.

The Chapter culminates in an exploration of these outcomes in the context of urban transformational literature. The final section of the chapter focuses specifically on the potential value of these research outcomes in the development of the trading zone defined by Gustafsson (2010; 2011). Building on the assumption that greater clarity around *who does what, how they do it, and when they do it* within climate change, especially disaster events, would help identify potential situations where such trade-offs exist. Stakeholders can negotiate conflicting or contradictory objectives within this trading zone with a greater appreciation of the different experts' roles in the urban transformation, overcoming scales within climate change. In addition, all parties will be better equipped to develop more practical and workable solutions, which all stakeholders appropriately incentivise.

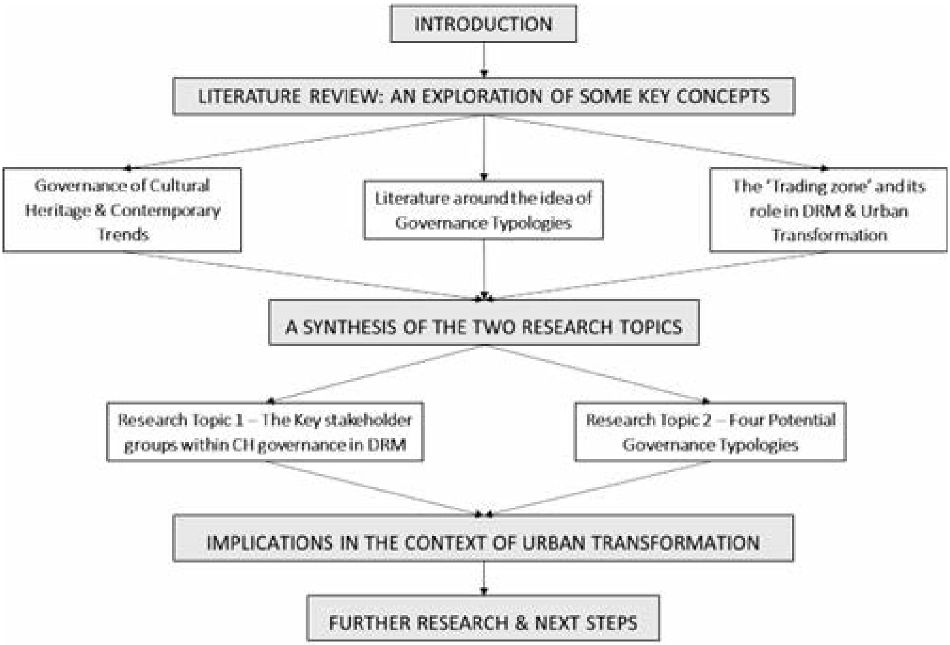

Figure 1 - Structure of the Book Chapter.

2. Literature Review: An exploration of some key concepts

This section introduces some overarching concepts and contemporary research that underpin the contents of the book chapter. Namely, the concepts explored include governance of CH sites. In this section, the authors outline the research around the governance of CH sites and the increasing momentum within this avenue of study. Secondly, the section explores the innovative idea of governance typologies, including what it means, what they are, and their perceived value. Finally, the research introduces the trading zone that Gustafsson (2010; 2011) defined within the context of urban transformation.

2.1. Governance of Cultural Heritage & Contemporary Trends

The concept of governance lacks a unified definition (Ruhanen et al., 2010; Fukuyama, 2013) and continually evolves (Kjaer, 2008), making this challenging. It is essential for any research dealing with the concept of governance to establish, or at the very least, align with a definition (Fukuyama, 2016). There is an abundance of suitable, all-encompassing, definitions provided by institutions such as the United Nations Development Program (UNDP) (UNDP, 2011), the International Institute of Governance (IoG) (IoG, 2023), the European Commission [EC, 2023] and the United Nations Education and Scientific Organisation (UNESCO) (UNESCO, 2023). Many of these definitions share overlapping ideals and perspectives. Therefore, aligning with one another does not have a theoretical implication for the discussions in the rest of the chapter. However, it is essential to select a definition of governance that CH experts will recognise. As a result, we chose to align with the definition provided by UNESCO on their website. Namely,

> "*Governance has been defined to refer to structures and processes that are designed to ensure accountability, transparency, responsiveness, rule of law, stability, equity and inclusivity, empowerment and broad-based participation. Governance also represents the norms, values, and rules of the game through which public affairs are managed in a manner that is transparent, participatory, inclusive and responsive*." UNESCO (2023)

UNESCO forms a critical central management authority for large parts of the Western world's CH sites. It is, therefore, safe to assume that this is the definition of governance with which CH stakeholders will be familiar. Crucially, UNESCO's definition of governance appears to encapsulate many ideals perpetuated across the plethora of research literature. By way of example, the definition acknowledges the structures and processes, not just explicitly defined governance mechanisms such as laws. By doing so, the definition allows experts to engage with adaptive forms of governance that require flexibility not traditionally found in highly administrative governments and laws (Cosens et al., 2017). Second, the definition by UNESCO enforces the notions of empowerment, participation, and inclusivity. The shift from hierarchical governance to more participatory and collaborative forms has become increasingly popular in the shift of CH research (Gonzalez et al., 2018; Sokka et al., 2021). This is because greater emphasis is being placed on the importance of local sources of knowledge and communities' role in disaster recovery.

Now that we have an agreed definition of governance as a starting point for the book chapter, we can explore the idea of governance typologies. Namely, where this collaborative idea started and who has already attempted to explore governance typologies' theoretical and operational applications.

2.2 Literature around the idea of Governance Typologies

As stated previously, the concept of governance lacks a unified definition. Similarly, the notion of governance 'typologies' is equally as fragmented. Using the word typologies, we refer to the idea that standard and replicable governance structures can be observed across different countries, regions, spatial scales and even between different CH sites. The standard governance typologies can be quantified into a series of common governance types. The idea of common governance typologies is not novel. Experts from different disciplines explored and attempted to identify different governance types in many ways. By way of example, Cortés-Vázquez et al. (2017) and Garzillo et al. (2019) refer to different '*models*' of governance. Borrini-Feyerabend *et al*. (2018) and Hall (2011) use four broad '*types*' and several sub '*forms*' of governance within heritage areas. Finally, Bouwma *et al*. (2011) refer to governance '*styles*' and '*approaches*'. To better understand the development of literature in this area and the four governance typologies proposed later in this chapter, it is essential to explore some of them in greater detail. As part of their work exploring governance in protected areas in 2008, Borrini-Feyerabend et al. (2018) identified four distinct 'types' of governance within protected areas:

- Type A: Governance by Government – In this governance type, a government body, agency or ministry has the overarching power in decision-making.
- Type B: Shared Governance – In this type, governance is based on an institutional mechanism and the responsibility of the decision-making processes is shared across a myriad of different stakeholders.
- Type C: Private Governance – within this governance type, the decision-making proof is held under the responsibility of an NGO or private Organisation.
- Type D: Governance by indigenous peoples and local communities – This is a type of governance where the local communities or indigenous peoples hold the governance and responsibility.

Similarly, in 2010, Hall (2011) identified four governance typologies in the context of sustainable tourism. These were defined as Hierarchical – Governance by the national state and supranational institutions, which are hierarchical in steering mode by public actors. Markets - Marketisation and privatisation of state instruments are hierarchical with private actors. Networks - Public-private partnerships, which are non-hierarchical with public actors. Communities – Private-private partnerships communities.

Finally, as a third in-depth example, in A Natura 2000 report entitled '*Current Practices in Solving multiple use issues of Natura 2000 Sites: Conflict management strategies and participatory approaches*', Bouwma *et al.* (2021) outline three main 'styles' of governance. Within the context of more participatory governance approaches. These are as follows:

Hierarchical policy styles and top-down approaches – *"a small set of government actors prepares a policy […]and assume the possibility of a smooth implementation of well-considered plans. The government, as the dominant actor, imposes instruments for policy implementation directly on other actors.*

Networking policy styles - *"Stakeholders and regional actors, mutually dependent on each other, participate in networks on specific policy issues. Decisions are the result of decision-making processes that are characterised by negotiating and striving for consensus. In these networks, power is shared, although the government can still be a dominant actor."*

Communicative styles of governance - *"Focuses on bottom-up processes for policy making and policy implementation in which citizens and communities are involved. Planning, according to the approaches, should be a process of facilitating community collaboration and consensus building […]. A characteristic of these arrangements is that citizens and interest groups are actively involved in the definition of problems and their solutions."*

The examples outlined above are only a few from the broader academic literature. However, they serve the valuable role of highlighting the different types of governance observed within the context of protected areas. Furthermore, even if we compare these few examples, we start to see apparent similarities between the observations made by the different authors. Finally, and more recently, Johansson et al. (2021) have yielded four types of CH governance based on theoretical observations. These four types of CH governance are defined as follows.

1) **Governmental governance -** implies an institutionalised definition of cultural heritage and a lower rate of citizen participation in its protection and management. In Governmental governance, Johansson et al. (2021) state that traditional hierarchical are reinforced.

2) **Corporatist governance -** implies an institutionalised definition of cultural heritage and a higher rate of citizen participation. In this form of governance, the management of CH is often shared between the state and civil society.

3) **Service-led governance** – "*implies a hybrid definition of cultural heritage and a lower rate of citizen participation.*"

4) **Co-creative types of cultural heritage governance – "***The co-creative type of cultural heritage governance implies a hybrid definition of cultural heritage and a higher rate of citizen participation, where citizens contribute knowledge and other resources to solve problems efficiently."*

The first axis expresses the type of definition used to define the CH within a specific case. This definition ranges from an institutionalised definition of CH defined by large overarching institutions. A hybrid definition of CH incorporates local, more fluid perspectives. The other axis expresses the level of citizen participation within the type of governance system. This axis ranges from a low to a high level of participation. A broader version of this literature review can be found within deliverable 2.5 – Anatomy of Historic Areas within the SHELTER Project. However, for this book chapter, the next critical aspect to explore is the concept of the trading zone.

2.3 The 'Trading Zone' and its Role

Finally, it is essential to reflect on the trading zone proposed by Gustafsson (2010). The idea of the trading zone is conceptualised within the Halland Model (Gustafsson, 2011; Gustafsson & Ilja, 2017). The Halland Model states that a trading zone can be used as a democratic meeting place (Gustafsson & Ilja, 2017). This trading zone can catalyse holistic decision-making for sustainable development and is a space for innovation where different stakeholder groups can negotiate, explore, and discuss topics and issues. Gustafsson and Ijla (2017) state that developing such a trading zone could lead to more collaborative forms of governance.

3. Methodology of the two research topics

As stated above, this book chapter draws upon two extensive research areas conducted by the University of Liege. Before proceeding with the findings, it is essential to define how the results were derived for the validity and reliability of the contents herein. The section briefly outlines the methodologies behind the two research topics.

3.1 Research topic 1 – Defining the key Stakeholder groups

The initial list of stakeholders was developed and refined in collaboration with European experts through a four-phase semi-empirical qualitative approach (Durrant et al., 2021). The semi-empirical approach took two years and was designed to co-create, explore, refine, and reflect upon disaster risk management governance maps. However, before detailed governance maps could be created, it was important for the stakeholders to co-create a list of key stakeholders to form the building blocks of the governance maps (Durrant et al., 2021). The list of stakeholders outlined below has been taken directly from the list co-created by the European experts within Durrant et al. (2021). It has been edited and validated several times since 2021.

3.2 Research topic 2 – Four governance typologies

The four governance typologies proposed in this chapter result from previous research from the two EU-funded projects. The four initial typologies were developed due to a preliminary literature review. The literature review attempted to rapidly focus on research articles and papers defining or categorising governance. The literature review was narrowed to 30 core research articles, chapters, and research documents published between 1999-2020. These research and documents explicitly attempted to define different governance typologies or explore one specific type of governance of CH sites in detail. The researchers at the University of Liege synthesised the contents of 30 core research articles, chapters, and research documents into the four preliminary governance typologies (Tamborrino et al., 2021). The qualitative analysis of this material can be found in detail in Tamborrino et al. (2021, Section 4.4.1 Pp. 35- 48).

4. A Synthesis of the Two Research Topics

The following section explores the key outcomes from the two topics of research outlined above. These key outcomes include - A comprehensive list of relevant stakeholder groups and their perceived roles in CH governance. A refinement of the four governance typologies outlined in the D2.3 PART A - Anatomy for Historic Areas. Finally, a consolidation of the relevant material from the plethora of raw data collected on the strengths, weaknesses, opportunities, and threats identified by the five SHELTER Open labs.

4.1 Research Topic 1 – The Key stakeholder groups within CH governance in DRM

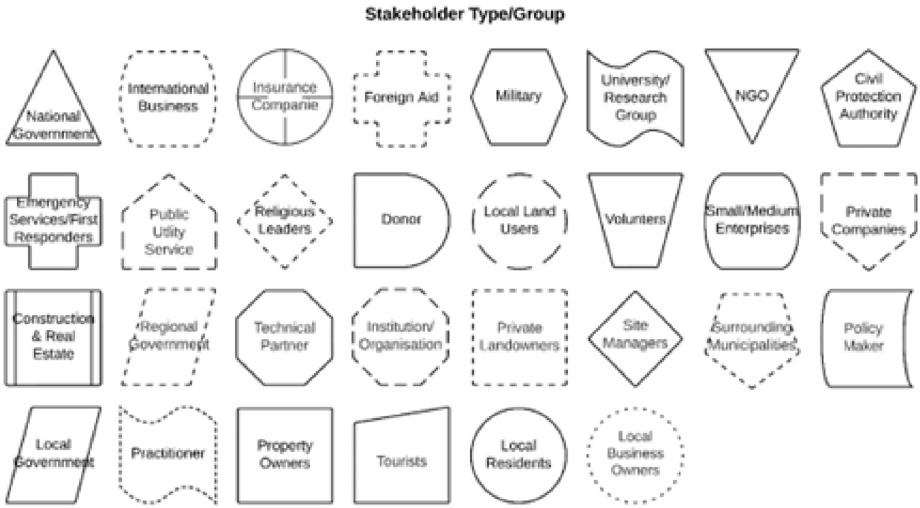

Figure 2 - The 30 potential Stakeholder Groups important within Cultural Heritage Governance Adapted from Durrant et al. (2021)

Table 1 describes the different roles these stakeholder groups have within DRM governance. The descriptions were observed during the development of the five Organigraphs within the SHELTER Project. For this reason, the description of each group should not be considered complete, but instead treated as a starting point for each stakeholder's role. Furthermore, it is also essential to acknowledge that the role of these different stakeholder groups may vary greatly depending on the governance typologies being used.

Table 1 - The key stakeholder groups within the DRM governance of CH sites (listed in no order)

Stakeholder Group	Description of BASIC role in DRM Governance
National government	– Develop the overarching policy and regulatory framework underpinning DRM Governance. – Coordinate DRM in the recovery and response phases. – Form a key funding source and guidance for different stakeholder groups, including CH stakeholders. – Lead the decision-making processes in hierarchical governance typologies.
Regional government	– Interpret or implement DRM policy at the regional spatial scale. – Open lines of communication and dialogue with local communities and stakeholder groups. – Serve as a valuable source of raw data for the prevention phase of the DRM cycle.
Local government	– Interpret or implement DRM policy at the local spatial scale. – Often the first line of communication for local stakeholders and communities on issues related to DRM. – Communicate stakeholders' needs and requirements at the local spatial scale to other spatial scales.
International Business	– Provide support and resources in the recovery phase of DRM.
Insurance companies	– Provide insurance against disaster events. – It can provide economic data useful in the valuation of CH assets.

Foreign aid	– Provide resources from other countries in DRM's response and recovery phases. – Provide long-term support in the recovery phases of DRM.
Military	– Support evacuation protocols. – Provide protection and support in the recovery phase of DRM.
University/research group	– Collaborate and communicate with international bodies, experts and institutions. – Sources of raw data, knowledge, and innovation. – It can help to bring in external funding for solutions and tools.
Non-governmental Organisations (NGOs)	– Offer support and advice to ministries and national government. – Provides resources in the recovery phase of DRM. – Co-ordinator and empower volunteers at all phases of DRM.
Civil protection authority	– Responsible for protecting the local community in the response Phase of DRM. – A key source of knowledge in DRM's prevention and preparedness phase.
Emergency services/ first responders	– Trained emergency services in the recovery phase. – First responders in the event of disasters.
Public utility services	– Have the capacity to cut off water, gas and electricity to damaged areas. – Have specific expertise and knowledge to provide disaster support and recovery.

Religious leaders	– Serve as mechanisms for communication and awareness raising in local communities. – Provide support and spiritual guidance.
Donor	– Stakeholder group who donates resources but is not necessarily involved in the phases of the DRM cycle.
Local land user	– First responder in the response phase of DRM. – Provide a key source of local knowledge. – They are often a key stakeholder in the implementation of DRM solutions.
Volunteers	– Provide support in the response and recovery phase of DRM. – Provide support in preparedness by implementing solutions.
Small/ medium enterprises (SMEs)	– Provide support and resources in the response and recovery phases of DRM.
Private companies	– Provide support and resources in the response and recovery phases of DRM.
Construction & real estate	– Implement safety measures and regulations in the prevention phases of DRM.
Technical partner	– Work within other international institutions. Source for innovation and tool development. – Provide resources, data and tools. – Collaborate with external experts.
Institute or Organisation	– Responsibilities and roles depending on the type of Organisation.

Private landowners	– Act as first responders in the response phase of DRM. – Essential source of knowledge and innovation for DRM's prevention and preparedness phases. – Responsible for the implementation and maintenance of DRM measures.
Site Managers	– Management and preservation of CH sites. – Implement the World Heritage Convention. – Collaborate with UNESCO and other international institutions.
Surrounding municipalities	– Potential collaborators. – Provide additional support in the response and recovery phase.
Policymakers	– Develop an array of Policies, including policies related to DRM. – Provide expert knowledge and support in the Preparedness phase of DRM.
Practitioners	– She was involved in the practical implementation of resilient strategies and solutions. – Source of knowledge and expertise.
Property owners	– Own property or land within an area.
Tourists	– Tourists and visitors to a specific area. – Source of funding and resources.
Residents	– Emergency responders. – Sources of knowledge.

Local business owners	– Can provide first aid and shelter to individuals affected by the disaster. – It can serve as a community hub for resources and first aid supplies. – Can provide places to share news and information about flood events with isolated community members

4.2 Research Topic 2 – Four Potential Governance Typologies

Within the SHELTER Project researchers broadly attempted to explore and define the characterisation of historic areas. As part of this work, the University of Liege explored the notion of governance typologies. Governance typologies refer to replicable DRM governance blueprints that experts can employ. This work aimed to allow other CH sites and experts to understand better how CH governance operates in the event of a disaster. This research used a broader literature review (outlined above) to capture relevant published material, which attempted to explore or define different governance 'types', 'structures', and 'forms. After consolidating the literature across these different sources, the researchers preliminarily identified four broad governance typologies: Hierarchical Governance, Participatory and Collaborative Governance, Networking in Multi-level Governance and Community-Led governance. This section of the book chapter briefly explores these different governance typologies. It is important to note that common governance typologies are not necessarily novel. Researchers such as Borrini Feyerabend et al. (2008), Hall (2011), and Bouwma et al. (2013) have historically attempted to define different forms of governance. In particular, Hall (2011) defined four governance types, forming the basis for this chapter's governance typologies. However, the researchers aimed to revisit, refine and apply the four governance typologies. Hall (2011) and the other researchers defined within the context of CH research as well as attempt to encapsulate the refined governance typologies into accessible and replicable figures, utilising what we have learnt around the research governance Organigraphs (Durrant et al., 2021). As a result, each of the four revised governance typologies is accompanied by a figure to help visualise how the typology functions in practice with different stakeholder groups. It is this figure and the discussion points that it yields that offer new insights to research.

4.2.1 Hierarchical Governance within Disaster Risk Management

The first governance typology distilled from the overarching literature is Hierarchical governance. Hierarchical governance encapsulates the typical top-down form of governance cited in broader academic literature. By way of example, some critical sources that cite forms of hierarchical governance include Hall (2011), in which they refer to governance by government. As well as Bouwma et al. (2013) refer to hierarchical or top-down governance approaches. This typology of governance and how it can function in CH has been encapsulated using the elements of the standardised key in Figure 3 below.

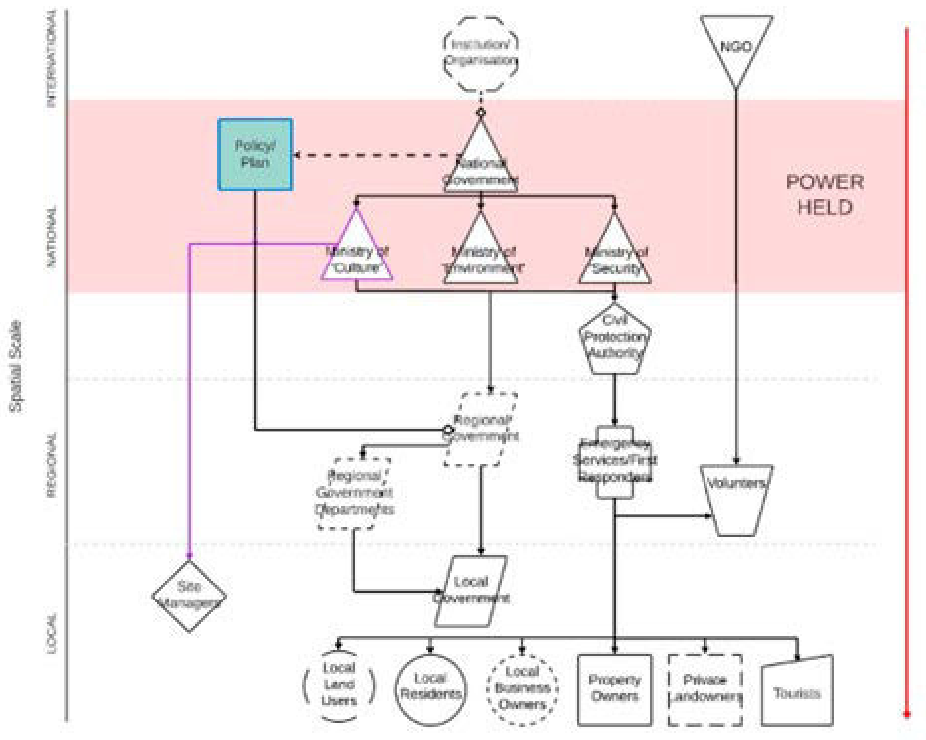

Figure 3 – One of the four potential governance typologies defined in The SHELTER Project - Hierarchical Governance Typology.

The hierarchical governance typology remains commonly employed within heritage and tourism (Wang et al., 2022). This form of governance has been recognised and researched for decades across academic literature (Hall, 2011; Bouwma et al., (2013), and there is seemingly a clear consensus around hierarchical governance and how it functions in practice. The key feature within hierarchical governance is that one or very few stakeholder group(s) hold the power and decision-making responsibility. This stakeholder group is typically at a higher spatial scale, predominantly at the national spatial scale, and guides policy development and decision-making. In the researcher's experience within the scope of CH and DRM, the national government often serves as the critical stakeholder within the hierarchical governance typology. They create and reinforce the policy and regulatory framework, which is then disseminated to lower spatial scales and implemented by lower regional authorities or organisations. Furthermore, they often serve as the overarching authority of specific departments or organisations directly involved in heritage management and disaster responses.

Within the SHELTER Project, a form of the hierarchical governance typology was observed explicitly in the Open Lab of Seferhisar (Durrant et al. 2021). Seferhisar is a small port town located in Izmir, Turkey. The town of Seferhisar is exposed to various hazards because of climate change (Koçer and Ünal, 2023). However, within the SHELTER project context, the local experts were trying to enhance earthquake resilience. The local experts co-created an Organigraph showing an explicit hierarchical governance typology. Within this governance typology, the national government department called AFAD' Disaster and Emergency Management Authority' formed a centralised entity responsible for much of the decision-making processes around DRM. However, it is essential to note that in the SHELTER project, the experts at Seferhisar chose to map the governance structures up to the national spatial scale. As a result, the governance typologies will undoubtedly differ if we change the parameters or scope of the research.

4.2.2 Participatory and Collaborative Governance within Disaster Risk Management

The second governance typologies distilled from broader literature is Participatory and collaborative governance. Participatory forms of governance have been defined and explored by many researchers (Bouwma et al., 2013; Okada et al., 2018). Furthermore, a large body of scientific research explicitly identifies participatory forms of governance in practice (Nkombi & Wentick, 2022). Contemporary research has noted the value of shifting to these governance typologies (Ruszczyk et al., 2020; Sokka et al., 2021). Some researchers even attempt to take advantage of advancing digital technologies (Llovido & Palaong, 2020). At its core, this governance typology holds the decision-making processes within collaborative, multiscale governance mechanisms. In which the participation of different stakeholder groups from across different spatial scales is valued. By way of example, the stakeholders meet in conferences, workshops or meetings to share knowledge, discuss issues, and develop solutions and policies. These policies are then created and implemented throughout the DRM governance structure. Therefore, the power within the governance type is not held by a single stakeholder group but within these governance mechanisms in w3hich stakeholders participate. These mechanisms facilitate avenues for participation across spatial scales between different stakeholders. As a result, the outcomes from these mechanisms led to co-created policy developments and solutions. Figure 4 below uses the elements of the standardised key developed by Durrant et al. (2021) to demonstrate how participatory and collaborative forms of governance operate in practice.

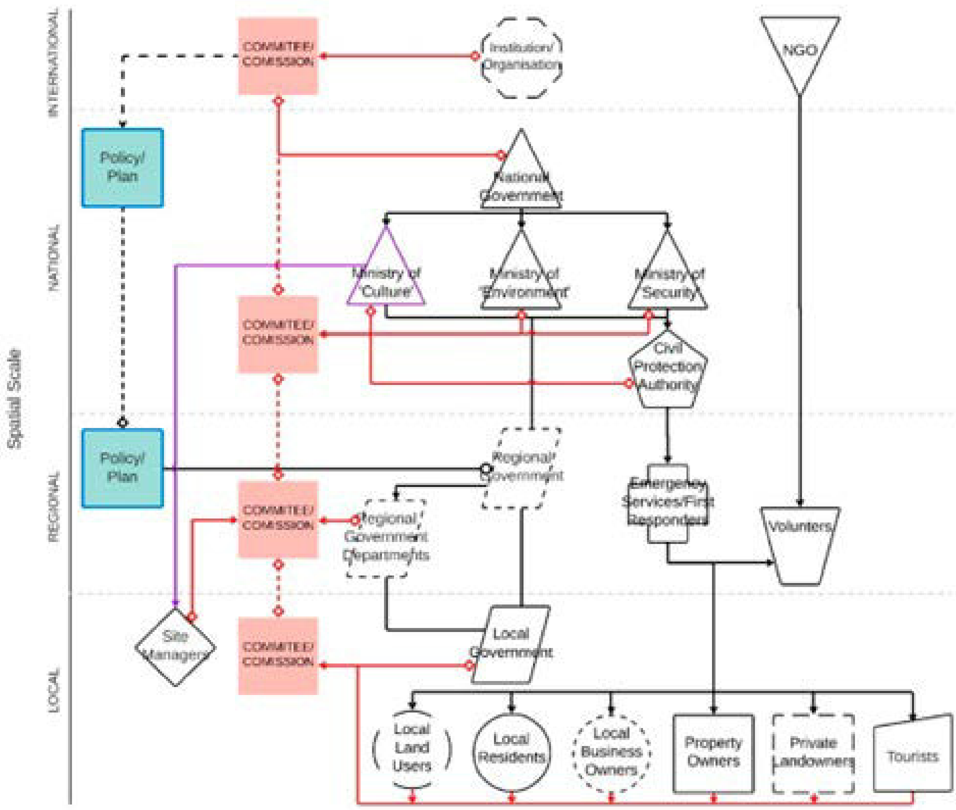

Figure 4 – One of the four potential governance typologies as defined in The SHELTER Project - Participatory and Collaborative Governance Typology

This governance typology was observed within the SHELTER Project within the living lab of the Sava River Basin. The Sava River basin is a large water catchment in southeastern Europe. It covers 97,200 km2, extending into the territory of 6 countries: Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Montenegro and a small part of northern Albania (ISRBC, 2023). The International Sava River Basin Commission (ISRBC) (ISRBC, 2023) is a joint supranational organisational body that facilitates some countries' collaboration across the Sava River Basin. The collaboration of the countries is mandated through different legal instruments. Crucially, ISRBC does not have authority over any of the countries or the participating stakeholders. The ISRBC facilitates the collaboration of the different countries through expert group meetings, workshops and European projects at the supranational scale.

4.2.3 Networking in Multi-level Governance within Disaster Risk Management

The third governance typologies are entitled networking and multi-level governance. In this type of governance, the power is distributed across different spatial scales between stakeholder groups. As a result, not one stakeholder group holds complete authority in coordinating the DRM response. Instead, the power and decision-making processes are distributed amongst stakeholder groups at different spatial scales or across multiple levels. This form of governance typologies differs from Hierarchical governance because each stakeholder can act independently from one another and is not reliant on the stakeholders at higher or lower spatial scales. Secondly, this governance typology differs from participatory or collaborative governance because the power is not in a mechanism for collaboration and participation. Instead, the power is held by one stakeholder group. Hall (2010) referred to this form of governance and has been observed across contemporary academic literature (Frey and Ramírez, 2018). Figure 5 below uses the standardised key from Durrant et al. (2021) to construct an example of networking and multi-level governance.

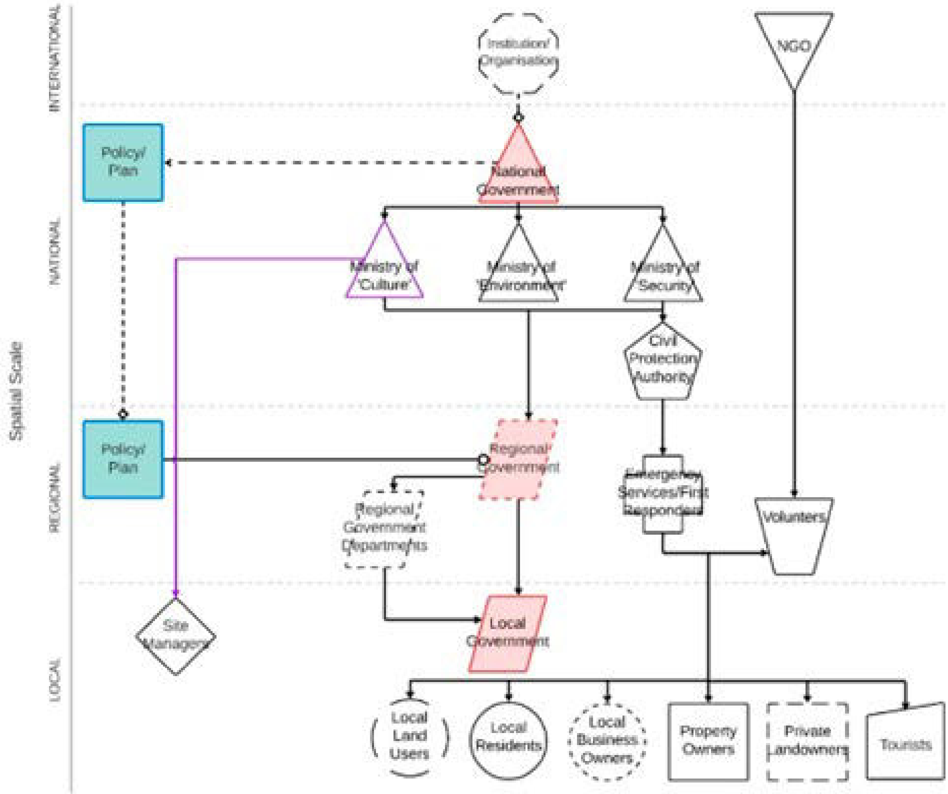

Figure 5 – One of the four potential governance typologies defined in The SHELTER Project - Networking in Multi-level Governance Typology.

This form of governance typology was partially observed in the autonomous community of Galicia in Spain as part of the SHELTER Project. Within this Open lab, the regional authority is responsible to the national government but has the authority to act independently.

4.2.4 Community-led governance within Disaster Risk Management

The final governance typology is referred to as community-led governance. This governance typology draws from the idea of bottom-up governance perpetuated across academic literature. Key authors from the research literature reviewed included (Hall, 2010 and Bouwma et al., 2013), who both note that community-led or bottom-up governance as a form of governance. However, unlike other researchers, community-led governance is not the same as bottom-up governance. Within this governance typology, the movement of knowledge and experience up to spatial scales from the local stakeholders is not required. Community-led governance denotes that the local stakeholder groups and communities lead in the decision-making processes in the event of a disaster. This typology differs from hierarchical governance because the stakeholders and communities at the local spatial scale operate without guidance or support from larger spatial scales. Figure 6 below uses the standardised key to create a model of how community-led governance can operate.

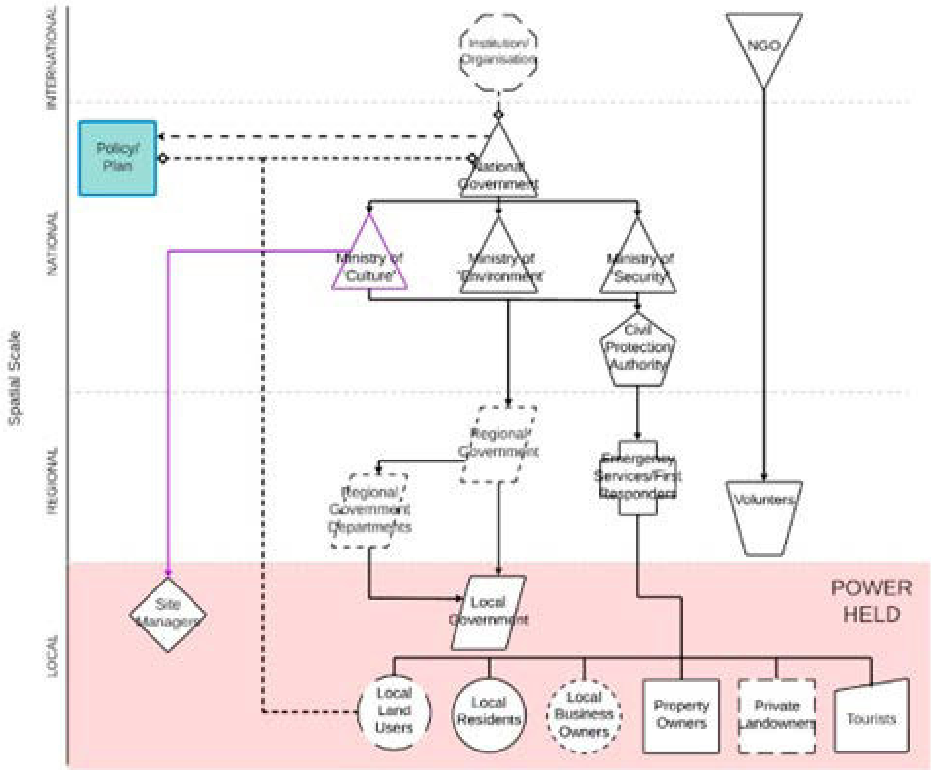

Figure 6 – One of the four potential governance typologies defined in The SHELTER Project - Community-Led Governance Typology.

This form of governance has been observed in the event of disasters worldwide. Examples of community-led governance include the post-earthquake response in L'Aquila, Italy, in 2009 (Alexander, 2010). In which there was a failure to build community resilience to disaster events. As a result, the local communities took it upon themselves to react to the disaster in the post-disaster phase (Alexander, 2010; Imperiale and Vanclay, 2021). Most recently, in July 2021, Western Europe flooded across Germany, Belgium and the Netherlands. Within some Belgian municipalities, the local communities developed community associations. These community associations took it upon themselves to facilitate disaster response in places lacking support (Durrant et al. Unpublished). It is important to note that in these examples of community-led governance, the governance typologies are often a result of frustration by the lack of response or feeling isolated from support or help, driving communities to take matters into their own hands and react independently.

5. Discussion: Implications in the Context of Urban Transformation

The following section discusses the outcomes of the two research topics outlined above within the context of urban transformation. Research around the urban environment is a broader and rapidly evolving avenue of research (Yung, 2010; Mookherjee, 2023). In short, urban environments are a complex melting pot in which we see a synergy between different disciplines leading to urban transformation.

Recently, Hölscher and Frantzesaki (2021) conceptualised the ongoing research within the urban transformation process into three theoretical themes: Transformation *in* cities, Transformation *of* cities, and Transformation *by* cities. At the same time, it is essential to consider the research emerging across the whole field of urban transformation. We believe that the outcomes highlighted in the research avenues above are crucial within the context of research around the Transformation *of* cities. Research on this theme attempts to understand and evaluate the emergence of new urban functions, interactions, and their implications for sustainability and resilience (Yung 2010). The research above focuses on governance and explores different stakeholder groups' roles, interactions, and functions in the urban environment. The following discussion explores three key outcomes from the above research.

1. Gustafsson outlined the potential value of a replicable standardised group of key stakeholders in developing the trading zone. Gustafsson (2021) discussed how that standardised approach could be adapted to facilitate interdisciplinary thinking between human and non-human stakeholders.
2. A practical and theoretical discussion around governance typologies. This section examines the practical added value they could provide academ-

ics, policymakers and practitioners. As well as an exploration of theoretical added value to the research around governance.

3. Finally, the discussion explores the concept of 'power' in the different governance typologies. Exploring what "power "means and its implications for governance, DRM and urban transformation.

5.1 Outcome 1 – Key stakeholder groups

As part of the research conducted in the SHELTER Project, the researchers at the University of Liege co-created a list of 30 core stakeholder groups (Durrant et al. 2021). The core list of stakeholder groups was co-created with European experts and practitioners from the five SHELTER Open Labs (Durrant & Teller, 2022). Durrant and Teller (2022) recorded the specific methodology behind the co-creation. These core stakeholder groups have been outlined in Figure 2 and were initially designed to help draft interactive governance maps in Organigraphs with local stakeholders (Durrant et al., 2021), building on the work of Tiliouine et al. (2018). As a result, the stakeholders had to be presented in a form that could be adapted to suit different requirements and be quickly recognisable so that they could be used to build complex structures rapidly. To achieve this, each stakeholder group was given a unique shape to facilitate the creation of the interactive governance maps. The unique shapes allow experts to edit the named stakeholder group but keep the governance map recognisable to other experts unfamiliar with the governance in that situation. This ensures the consistency between different governance maps allows experts to recognise and engage with Organigraphs from CH sites, countries, or places without being intimately familiar with them. Interestingly, this co-created list of 30 core stakeholders may have broader applicability within the research on urban transformation.

This list of core stakeholders can be considered a foundation for any experts, policymakers or practitioners attempting to explore critical stakeholders within a given context. Research around identification and engagement is extensive, and many methodologies exist to map stakeholders (Yung, 2013). However, to our knowledge, presenting the key stakeholder groups in a format using simple and recognisable shapes that can be edited to suit different contexts whilst remaining recognisable is currently not an aspect of urban transformation research.

Building upon the idea of a recognisable foundation of core stakeholders that can be tailored may benefit the development of the trading zone is outlined within the Halland Model (Yung 2010). As stated, the trading zone serves as a democratic space for innovation. As well as a catalyst for holistic decision-making for sustainable development. Creating this democratic space requires a clear understanding of the critical stakeholders and their function in the broader decision-making or governance processes so that the right stakeholders can be brought into that trading zone.

The standardised group of 30 stakeholders can be used as a starting point for experts to pinpoint key stakeholder groups to facilitate the development of this trading zone. Stakeholder mapping is not new; literature is littered with approaches that can help map stakeholders. However, some of these approaches require significant time and resources, particularly more participatory approaches (Reed et al., 2009). What this research offers are a valid list of key stakeholders which can be used to streamline this work so that limited resources can be focused on the establishment of a trading zone. We must stress that there is not a one-size-fits-all approach to stakeholders. Every situation is unique and benefits from a bespoke stakeholder mapping exercise. However, we suggest that a standardised group of stakeholders provides a foundation to springboard the development of the trading zone in urban settings. They allow experts to pinpoint the key players quickly and develop momentum around the trading zone.

The final aspect of discussion within this outcome revolves around integrating different stakeholders from a variety of disciplines. A vital aspect of the urban transformation literature is the integration of different disciplines. First, the standardised key of stakeholders provides a recognisable foundation in which experts can edit the core stakeholder groups to suit their context but remain consistent with the standardised key. A key focus of the SHELTER Project was to pinpoint the role of CH stakeholders within DRM governance. In this pursuit, stakeholders from the perspective of CH, such as World Heritage sites or the ministry culture, were colour-coded in purple. By way of example, see the Organigraphs published. The same approach could be applied to other disciplines. Building upon this, integrating stakeholders from different disciplines can be taken one step further. The recent work by Hernedez and Santin et al. (2023) highlights the importance of non-human stakeholders within urban development. Specifically, the research focuses on including biodiversity as a non-human stakeholder in discussions around urban development. This is an exciting and potentially very challenging idea fraught with difficulties. By way of example, how can non-human stakeholders be unbiasedly represented within discussions and decision-making processes? We propose expanding the methodologies used to identify the initial 30 stakeholder groups to include other non-human stakeholders, such as biodiversity or specific CH monuments or CH sites.

5.2 Outcome 2 – The four governance typologies

The following outcome we want to explore revolves around the four governance typologies outlined above. Namely, Hierarchical Governance, Participatory and Collaborative Governance, Networking in Multi-level Governance and Community-Led governance. These four governance typologies are in the preliminary testing and refinement phase and should not be considered their final iteration. However, because they built upon the pre-existing literature review [64] and have been supported using the extensive research conducted within the SHELTER Project, we believe they are at a stage which is suitable for presentation and wider academic scrutiny.

First, similar to the standardised key of the 30 core stakeholder groups, the four governance typologies provide a unified platform to explore governance within urban environments. As stated previously, the concept of governance is difficult to define, let alone observe specific forms and types of governance within unique and evolving decision-making systems. These four governance typologies provide a unifying platform for stakeholders within urban settings to identify and begin exploring governance and decision-making processes, aligning directly with potential research gaps identified by past researchers [75]. Moreover, da Cruz et al. stated that much of the research into urban governance revolves around case-by-case exploration rather than a "unifying theory of urban governance" de Cruz et al., 2009. The four Typologies presented above, alongside the standardised key, may help to facilitate a unifying theory.

From a practical perspective, a series of applicable governance typologies is a potentially attractive prospect for researchers exploring governance within urban environments. Governance within urban areas is considered a fundamental and complex process for many reasons (Raco, 2020). First, Urban areas such as cities contain a lot of diverse stakeholder groups. These stakeholder groups can often be highly fragmented despite their seemingly close proximities. As well as have diverse and conflicting opinions exacerbated by proximity and even lack of a sense of community.

As a result, the governance typologies outlined above may provide a platform for experts to begin mapping and exploring urban governance. However, a limitation of the four governance typologies is that they potentially assume that one governance typology is taking place at a time. This leads to a broader discussion around blended and even shifting governance typologies.

The idea of blended governance typologies refers to the idea that two or more governance typologies outlined above may be expressed simultaneously. By way of example, an area may have a predominant hierarch governance structure. However, that governance structure also includes elements of collaborative and networking governance in the form of conferences and workshops - thereby making the governance within that case, a blended governance typology. Secondly, shifting governance typology draws directly from the researcher's experience within the SHELTER Project. It became apparent during mapping the five Open Labs that the decision-making processes within these open labs could change during the different phases of the DRM cycle. By way of example, during the response phase of DRM, almost all the Open labs appeared to utilise a hierarchical governance typology within which the emergency response and recovery were coordinated by stakeholders such as the national government, civil protection authorities and emergency services. However, in contrast, during the preparedness phases of the DRM cycle, the DRM governance within the SHELTER OL contained more collaborative and participatory typologies.

This is unsurprising, given that the different governance typologies have different strengths and weaknesses. By way of example, hierarchical governance leads to a streamlined decision-making process ideal in the response to a disaster event. At the same time, more collaborative and networking forms of governance facilitate innovation and collaboration between stakeholders. This collaboration can be better in the earlier phases of disaster risk management, such as prevention and preparedness. However, they do come with inherent drawbacks. By way of example, elements of collaboration tend to take time. This discussion point is essential to consider as different governance typologies can be used at different stages of the disaster risk management cycle to suit the needs and requirements of the stakeholders. Governance typologies could shift to facilitate a more effective prevention preparedness response and recovery.

5.3 Outcome 3 - Opens the idea of power.

Finally, we would like to discuss the concept of 'power' within the governance typologies and its implications on the urban transformation processes. The concept of power is not very often discussed within the concept of governance. In their discussions, few sources explicitly deal with the concept of power. Within this research, we define power as the ability of one of the stakeholders to influence that decision-making process.

Within disaster risk management, governance has broad implications for urban transformation. It reflected on power forces us as researchers to examine the broader scope of that disaster risk management system. It forces us to ask whether the right stakeholders or governance mechanism holds power within any given context. By way of example, if the stakeholder or governance mechanism that holds power in a disaster risk management governance structure is under-resourced, lacks knowledge, or is damaged during the event of a disaster, then the entire governance structure may collapse as a result. Furthermore, if the governance mechanism within that structure does not yield meaningful outputs or facilitate effective process collaboration, then the whole governance structure is undermined.

6. Conclusions

The Chapter above attempts to synthesise two avenues of research work and explore their application and implications within urban transformations, explicitly focusing on the trading zone proposed by Gustafsson (2011). The contemporary research around CH governance during different phases of DRM has direct applicability to the concept of urban transformation - especially when attempting to operationalise the idea of a trading zone between stakeholder groups within different disciplinary perspectives. Not only does the research within provide a potential foundation for mapping and exploring relevant stakeholders from different disciplinary perspectives but it also provides a series of conceptual governance typologies which can help to inform experts how DRM governance operates and shifts according to the types of hazards and phases of DRM.

However, we must finish this chapter with a caveat. The research avenues being discussed above are in their preliminary phases. The idea of standardised governance typologies. As well as exploring the concept of power within governance is a complex and highly subjective research topic. As a result, we do not suggest that the contents within are to be considered final. They are instead a platform for other researchers to test and adapt.

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3. Contestations to a Climate-sensitive heritage: Examining the Negotiations of Cultural Markers along Mumbai's expanding Metropolitan Coast

Shruthi Ramesh[1], Bhagyasshree Ramakrishna[2]

Abstract

Mumbai's geographical terrain has been historically reshaped and defined by its many rulers and colonising forces, shaping distinct morphologies of socio-cultural markers with the island's spatial territoriality. Throughout this historical timeline of settlements, the coastal edge has been the canvas for defining territorial markers, and thereby redefining the interface between cultural identity and the coast. The linearity of the metropolis has forged intrinsic ties to its coastal edge and imposes unique conditions on its diverse cultural and tourist landmarks along the coast. The colonial practice of land-reclamations has continued into independent India, reinstating distinct coastal-edge meanings. The land reclamation projects introduced new colonial ideals of the coast as a space for leisure, a modality whose replication and continuity into the contemporary master plans has threatened the erasure of natural coastal terrains. The disastrous impact of climate contention is often resolved through concretised manipulations of the coast. The development of the coast, though impacted by Coastal Regulation Zone (CRZ), is a site of coastal manipulations by mega-projects. The chapter argues that Mumbai's kinetic urban development's juxtaposition over its rich, historic, socio-cultural landmarks poses contentions of climate change and there is a need of forging a more symbiotic relationship.

Keywords

Mumbai Coast; Cultural markers; Coastal contentions; Reclamations; Climate Change; Colonial Rupture

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1. Introduction

Mumbai's edge conditions are an integral part of its developmental narratives (Burte and Krishnankutty, 2006). Throughout its history, beginning as fishing villages within the archipelago of seven islands, inhabited by its original settlers - the *koli* (fisherfolk) community, to its metamorphosis into a colonial entrepôt, its coastal edges have witnessed an accruing integration of cultural markers. The original topography of the islands were a part of the hilly terrain of the western ghats, comprising partially submerged sloped landforms, sand bars, salt-flats and marshy mangroves. Domestic habitations along the coastline began with the *koli* villages, extending into the Portuguese hamlets (1534-1665), and later to the series of land reclamations from 1708 by the British for the creation of a singular 'Presidency' Port Island City.

Nakamura (2014) traces a chronological history of Mumbai from the koli communities and native Buddhists to Hindu Kings and Sultanates, and up until the Portuguese and British colonisers. She illustrates how"these embattled, enmeshed, and accumulated histories have marked the landscape with rock cut caves, temples, mosques, churches, water tanks, forts, and urban forms that now make up the more monumental aspects of the urban landscape of Mumbai." (Nakamura, 2014). The onset of the British reclamations starting from 1708 pushed the edges of the city out, seaward. Conversion of a collection of sand bars, tidal flats, islands and hilly terrain, into a single landmass at the behest of the British was for the creation of the colonial Presidency[3] port city (Edwardes and Campbell, 1909).

If the "Victorian Gothic and Art Deco Ensembles of Mumbai" as a UNESCO World Heritage Site[4] represents Mumbai's built heritage, the "Western Ghats"[5] offers a slice of the erstwhile 'natural heritage' of the region. The act of Anthropocene destruction of the ghats within Mumbai, as part of the extensive land reclamations of the presidency town completely alienated Mumbai from this natural heritage. The current delineation of the western ghats excludes the 'urbanised' Greater Mumbai. Some traces of these mountain ecologies like the verdant Kanheri Hills, or urbanised neighbourhoods like

[3] The Bombay Presidency was the administrative boundary of a British Province that included the present Mumbai Metropolitan Region.

[4] 'Victorian' colonial structures, Indo-saracenic buildings and pre and post-independence Art-Deco buildings inscribed as UNESCO World Heritage site in 2018.

[5] Inscribed as UNESCO World Heritage site in 2012.

Pali Hill, Malabar Hill etc., remain. In City Adrift, Naresh Fernandes narrates an interesting case, where a British Naval officer found Early Paleolithic Age remains in South Bombay, only to discover that they were originally from hills on the eastern ridge levelled to provide top-filling for reclamation sites (Fernandes, 2013, p.16). There are over 30 protected forts within the Mumbai circle of the ASI (Archaeological Survey of India). The coastal, as well as hill-top *Maratha* forts[6], in the Mumbai Metropolitan Region (MMR) offer a syncretism of the 'natural' with the 'built' heritage, especially in folds where the 'urbanising' intrusions are minimal.

Within Mumbai's pre-colonial geography, many heritage markers are associated with the sea and the coastal geography. For instance, the earliest Buddhist heritage structures found on the Elephanta islands (c. 2nd century B.C), the religious landmarks of the Hindu Kings (the Banganga temple tank of Silhara Dynasty) (c.1127 A.D[7]) and the tomb of the Sufi saint, Haji Ali Dargah (c. 1431 A.D). The 'natural' harbour and strategic location w.r.t colonial trade routes led to the region's colonisations by Portuguese, and later by British. Thus, many colonial heritage structures- Portuguese and British Forts, Churches and 'The Gateway of India' archway (c.1924 A.D) came to define the territorialities of the coast. Since its post-independence inception as India's financial capital, the city's domestic cultural geography became largely defined by migration, slums and land-evictions.

"Anthropocene epoch bring our attention to the rapid global consumption and regimes of disposability that characterise capital since the mid-twentieth century." (DeLoughrey, 2019).

In recent times, the global flows of capital and investment in mega-projects of urban development brought in constant change to the coastal environment. Coastal environments in-turn became dominant sites for urban development projects, for instance- the upcoming Coastal Road Project, the upcoming Sewri-Nhava Sheva sea link, the recent Bandra Worli Sea-Link, the Eastern Waterfront Development project etc. The financial capital is overburdened with high population influx, evidenced by its crumbling infrastructure. Due to its stressed mobility systems, extensive layers of public and private transit lines (i.e underground metro lines and sea-reclaimed coastal roads) are being proposed to placate the population's needs. Post-independence, the *koli* villages

6 Marathas were regional historic rulers and warrior clans who ruled the Maratha Kingdom across present day Maharashtra from 1674-1818. These forts were built from the 16th century onwards for strategic defence against Mughals and later Colonisers.

7 Destroyed during Portuguese occupation and rebuilt in 1715.

became cultural pockets of 'intangible heritage' enticing tourists, while indistinguishably extending into pockets of coastal slums and contending with mega urban development projects.

The intertwining of culture and religion within urban morphology has created sacred markers at micro-scales within the historical core of the city. They juxtapose and negotiate with the new developments along the liminal spaces of the city (Elison, 2018). These odd juxtapositions of 'coastal heritage' with urban transformation projects, mirrors Mumbai's pro-development ethos and fluxes. The chapter attempts to examine these cultural negotiations that shape and reshape the coast.

2. Research and Theoretical Framework

The chapter examines key socio-cultural markers[8] (landmarks and historic habitats) along the coastal edge, critically reflecting on its changing narratives against the impacts of rising sea-levels and urban development. A qualitative research framework based on textual research, discourse analysis, analysis of spatial maps, secondary data and observation is applied for the research. Using the lens of urban studies, the impact of urban development on cultural landmarks within the coastal landscape of Mumbai is analysed. The chapter engages with secondary data collected from online archives, newspapers, research papers, books and policy documents. By way of a chronological examination through the lens of urban development, the chapter traces historical and contemporary incidences of the city's land and water relations and their connection to cultural markers.

The key research questions the chapter asks are:
How did culture adapt to the coastal geography of the island? How did the manipulations of the coastline facilitate the reimagination of the urban social-culture? How do heritage and cultural markers now engage with transformative contentions in Mumbai's anthropocentric, pro-development, urbanised setting?

This chapter provides a reading of the coast across specific historical timelines and examines the process, intent and extent of alteration of the natural coastal geography. The research speculates the potential of the new spatial

[8] We use 'markers' in reference to specific socio-cultural pockets of heritage that are surrounded by an urban environment under constant transformation. A marker is spatially sited in relationship to a surrounding urban landscape in constant flux.

structuring of the coast to allow for socio-cultural and religious phenomenon. At the intersection of the changing nature of the sea, the nature of the human interaction with the sea/coast is examined specific to distinguished socio-cultural markers, using key historical narratives, cultural adaptations and development trends.

3. Historical Built Coastal Markers

Pre-colonisation, or the period prior to arrival of the Portuguese in Bombay (1534 AD), the interface between the sea and the land harboured sacred and ritualistic practices. The cave architecture of earliest settlers, the Buddhists, between the 1st-5th Century BC, were non-invasive, secluded forms of living that were highly integrated into the mountainous topography of the islands. The series of caves etched within the black basalt rock formation of the islands (Kanheri caves, Mahakali caves, Elephanta caves), spatially continued the ideas of non-materialism, societal disassociation and hermeticism within its architectural language and settlement pattern. The rocks were carved into water holding basins, forming a system of cascading cisterns and catchments (Pandit, 2010).

The dominance of the Hindu Kings across the coastal belt of the Konkan region[9] left prominent morphological markers across the landscape. In 10th Century AD, the Silhara Dynasty's urban settlements emerged with a unique set of spatial patterns that were symbolically composed of the 'temple, tank and tree', nestled within a dense cluster of residential settlements. The characteristic *temple-tank centric*[10] urbanism extended to the islands of Bombay, seamlessly integrating with the coastal-hilly terrain geography. The morphological pattern, combined with the unique geography of the islands, led to the emergence of several coastal temple tanks[11], specifically south of the main island of Bombay. The tanks were located at the base of the hills and built over natural springs.

The research analyses the interface of the Banganga temple tank and the sea, one of the few coastal temple tanks that has remained relatively intact, shielded from the widespread reclamation projects of the modern era. Banganga is located at Walkeshwar, Malabar Hill, the south-western tip of the

[9] Linear coastal belt along the western coast of Maharashtra.

[10] Temple-centric urbanism was an identity to the coastal cities in the Konkan region that was later adapted as a secular characteristic by the Islamic/Jewish settlers.

[11] The Baboola tank, Gowalia Tank, Mumbadevi temple Tank and Banganga Tank.

main island that tapers narrowly into the sea, and north of the Back Bay (a natural harbour). This geographical positioning of the tank in the narrow island, surrounded by sea on three sides and nestled at the base of the hills generated a unique water tank typology (see figure 1). Banganga is believed to be mythically connected to the Ganga River in the Himalayas and was discovered when Lord Rama's bow struck the ground *(Baan*-arrow, *Ganga*-river). The temple tank was originally constructed in 1127 AD by the Silhara Kings[12]. The tank[13] is built on a natural spring and an outlet valve connects the tank to the sea (Mehrotra and Dwivedi, 2006). The heritage site under the protection of the State Archaeological Department is surrounded by 50 odd Dharamshalas (place of rest for pilgrims) and a Brahmin settlement.

Figure 1: Plan of Banganga water tank and its relation to the Arabian Sea (source: Ramachandran, 1998)

[12] The temple was destroyed in the 18th Century by Portuguese invaders, and was later renovated in 1715 along with the Tank.

[13] Banganga tank dimensions: 115 meters long (377 ft.) and 40 meters wide (131 ft.)

The water body served as a source of drinking water to the community, and in extension, as a site of cultural rituals and ceremonies (Ramachandran, 1998). The Brahmin community did not engage in fishing activities. The morphology of the settlement surrounds the tank and is inward-looking, dissociated from the coast. A small, natural pond or the religious 'Ram kund' lies along the old sanctorum wall, situated at 200 metres from the tank that is used for crematorial rituals. The association of the community with the sea was thus, indirect and spiritual. The physicality of the tank edge faces inwards, accentuating the introversion to the coast. The proximity to the sea allowed the tank to act as a coastal reservoir during high tide and as a natural (cascading) catchment area.

The subsequent rule of the Sultanate in Bombay accentuated the establishment of direct linkages between the sea and cultural identity. The Haji Ali Dargah (c. 1431 A.D.), an Islamic tomb and mosque dedicated to the Sufi saint Pir Haji Ali Shah Bukhari, was built on an islet in the Arabian Sea off-coast near Worli, and accessed by a 1 km long narrow causeway. The coastal monument and connecting causeway cutting through the sea creates a cultural symbiosis that could be deemed one of the initial acts leading up to the Anthropocene[14]. The association of the Dargah with the sea is physical and tangible. The walkway can be accessed during low tide, and submerges into the sea during high tide (Swaminathan, 2014).

4. Colonial Urbanism of the Coast

The Fortified area of the erstwhile British colony, now known as the Fort area, situated at the south-eastern part of the island, was guided by a set of urban codes, disparate from the local Indian town (UDRI, n.d). The intentional 'sanitisation' of the presidency town was orchestrated via land reclamation processes to placate the 'health' and 'sanitation' concerns of the colonisers. The swampy 'malarial' conditions were deemed unfit for 'modern' urban living. During the First World War, the British sea-side became the new site of health, recreation and leisure consumption. The coast, viewed as an escape from the dense industrial urban core, emerged as a new cultural hotspot of leisure exclusively for the societal affluent. The production of coastal culture reshaped an urban geography that was defined by a physical and visual proximity to the shore. The coastline was now an element of urban construction and anthropogenic manipulation.

[14] Though the Anthropocene epoch is believed to have commenced in the mid 20th century, there are centuries of human action prior that set the precedent for anthropocentric coastal reshaping.

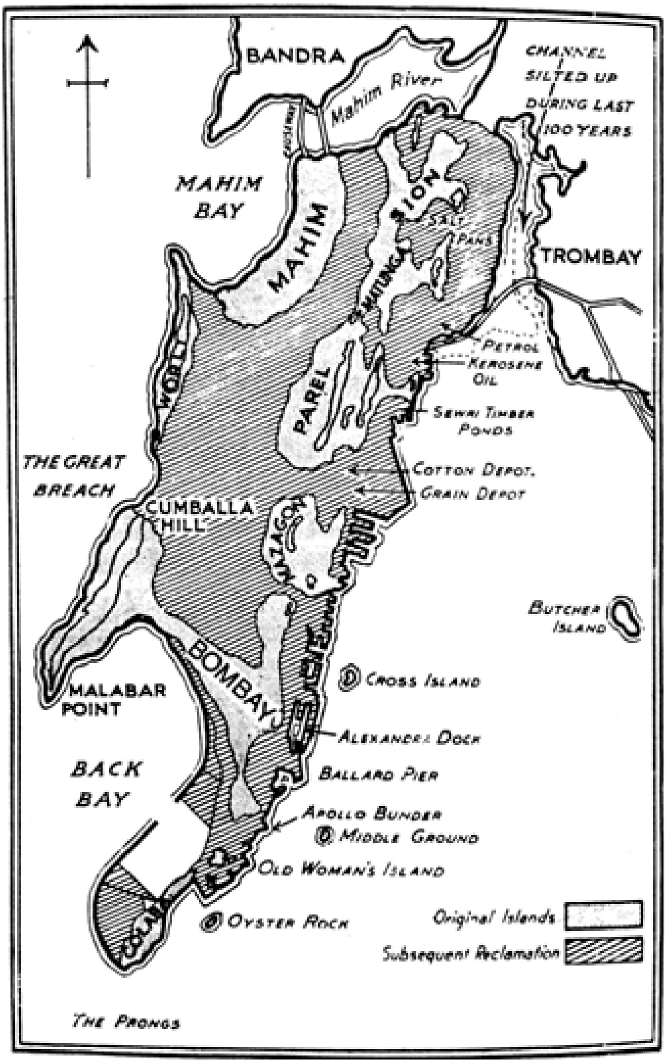

Figure 2: Map of the original archipelago of islands of Bombay, and the areas reclaimed. Source: Gazetteer of India, 1987

In 1862, the Fort walls were demolished, and the water tanks were filled (Ramachandran, 1998). The first reclamation by the British colonisers between 1709-1710 began with the closing of 'breaches' or embankments between the original seven islands (see Figure 2). The terms 'breaches' and 'inlets' ascribed to the existing landscape indicated a narrative conducive to land reclamation projects. The Reclamation efforts were made to reduce the dependency of agricultural imports into the island. A significant reclamation project known as the Backbay Reclamation Scheme was initiated in the 1860s. Parts of the project were realised in the 1920s, such as the Marine

Drive or the ‘Queen’s Necklace’ (Art Deco District), and Nariman Point (established as the new Business District). The reclamation work to the west of the Oval Maidan was completed by 1929, while the Queen’s Necklace of the Marine Drive was completed by 1940 (Riding, 2018).

The implementation of the Back Bay reclamations (although minor in terms of land area), led to significant contributions in altering Mumbai’s urbanism. The physicality of the defined arc (Queen’s necklace) along the coast, presented unique opportunities to control and reimagine the interface between the sea and the land. In Marine Drive, the process and the outcome of reclamation, resulted in a novel publicly accessible space of leisure, defined by a concrete bench that ran throughout the coastal edge, a 4m wide promenade, and a double-laned carriageway, lined by a series of modern Art Deco buildings. The Art Deco movement in Mumbai sought visionary inspiration from contemporary reclamation work of Miami Beach’s Art Deco strip, which represents a spatially segregated, elitist urbanism that prioritised beach-facing urban development (Kumar, 2018).

The Art Deco architectural movement (a continuation from the Parisian Art Nouveau architectural style) reliant on a flat terrain, barrier-free and open-access landscape, characterised by wide streets and promenades, was set against Mumbai’s sweeping coastal landscape. The architecture bears semiotic references to the coast and nautical geometry. The Art Deco precinct was built on a new set of urban building control regulations redefining the architectural form and urban setting, and thereby establishing a new sense of cultural and behavioural conditioning (Brandon, 2020). This coastal landscape was defined by architecture of entertainment, theatres, libraries, museums and other prominent institutions, representing an important shift in the city’s cultural urbanity.[15]

The island of Miami beach was previously a marsh/swamp land, redefined through urban improvements projects affording the contemporary Art Deco strip’s tourist potential (Fisher Island Community Association, n,d). The reclamation provided a canvas for the Art Deco movement, directly supported by the presence of a flat, non-pervious terrain. This reference for land transformation with the coast, shaping the sea edges, and creation of a new beach culture is an innate form of the anthropocene, presenting a dichotomy of culture and nature. In Mumbai, the Marine Drive Back Bay reclamation

[15] (Art Deco cinemas (Regal, Eros, Metro), residential: Rajjab Mahal, Soona Mahal, Empress Court), offices (NewIndia Assurance building, LakshmiInsurancebuilding), Hospitals (Breach Candy Hospital, Dr Purandare Maternity and Gynaecological Hospital)

formed a white-enclave, spatially segregated from the local settlements, supported by the introduction of a storm-water drainage network system. This outward-looking architecture, with curved-cuboidal balconies enabling direct visual connection to the sea, became the new model for coastal urbanism (see Figure 3). Banganga in contrast is an example of 'soft thresholds'. A threshold is a space that has 'dual coding' as a point of separation and connection (Mehrotra, 2021). The strategic positioning of the tank created a symbiotic relationship of the community, culture and coastal inundation. The art deco urban environment, far removed from traditional water harvesting systems and disintegrated from the natural geographical terrains of the islands, reduced the sea to solely a visual feature as a composition of the art deco landscape.

Public activism along the coastal interface was foregrounded during a new wave of pre-Independence struggle movements in Mumbai. Communal festival processions became a subaltern form of public projects and displays of patriotism (Elison, 2018). The Ganesh Chaturthi festive processions (for the commemoration of the Hindu God Ganesh), temporarily transforms the public streets to house semi-permanent enclosures for Ganesh idols. The processions culminate with the sea as a final destination for the immersion of the idols (Mehrotra, 2016). The expanse of the coast (Marine Drive) as a vast unified space allows for mass gatherings as a singular form. The mass (populous) immersion events at the coast made possible by the flattening of the coastal terrain, reduced the possibilities of micro-cultural phenomenon. The city-scale immersions threaten the physical infrastructure of the coast, polluting the sea with increases in metallic content (Lokhande, 2019). This finality of the immersion activates the coastal edge to physically hold the large congregations at the water's edge, unmasking the act of the anthropocene, of breaching the boundaries of nature and culture.

Figure 3: Aerial view of the Marine Drive (as part of the Baybay Reclamations) lined by the series of Art Deco Buildings
Source: https://www.espncricinfo.com/photo/an-aerial-view-of-mumbai-s-marine-drive-938847

5. Contemporary Climate Contentions

The erstwhile Presidency town was equipped with a 'designed' storm-water drainage system with a capacity of about 25 mm per hour. This system with a dense network in the 'island city' (functional despite being 70+ years old), and a sparse one in the suburbs built post-independence tackle stormwater drainage. Over the past few decades, the cases and scale of urban flooding have increased exponentially. An overhaul of the drainage system proposed in the 1990s by Brihanmumbai Municipal Corporation was rejected considering extreme costs. Mumbai receives heavy rainfall between July and September averaging at 2300 mm, and is also susceptible to cyclones during the Monsoon season[16]. High tides coupled with intense rains cause urban flooding and water-logging, predominantly in low-lying 'island city' areas. Urban flooding has become common during monsoons, with the July 2005 floods recorded as a devastating occurrence with 410 deaths and thousands displaced.

[16] Mumbai was subjected to 18 cyclone events between 2011 to 2022 according to India Meteorological Department (Mumbai), as cited in MCAP Summary.

The *koli* community habitats and other informal settlements face extreme flood vulnerabilities. In 2020, the BMC launched 'IFLOWS Mumbai' , an Integrated Flood Warning System. The same year, Mumbai joined the C40 Cities Network for fast climate action. The Brihanmumbai Municipal Corporation (BMC) developed the MCAP (Climate Action Plan) in 2022, an evidence-based plan for climate mitigation and adaptation, aiming for a 'net-zero' and 'climate-resilient' Mumbai by 2050 (C40, 2022). Out of three baseline assessments in the MCAP, 'The Climate and Air Pollution Risks and Vulnerability Assessment' evaluates Urban Flooding, Coastal Risks and Landslides[17]. Building flood resilient systems and infrastructure, localised water conservation, disaster risk and impact reduction, restoring aquatic ecosystems are some of the action tasks outlined in the MCAP. 'Built-heritage' vulnerabilities are not integrated in the MCAP. Some 'natural heritage' agendas like mangrove and biodiversity conservation are discussed, without explicitly foregrounding 'climate risk to heritage'.

The CRZ notification 2019 (earlier 1991, 2011) determines the permitted 'scale' and 'nature' of development across India's 7516.6 km coastlines. Mumbai has a coastline of approximately 150 kms. During the period 2013-22 WMO (World Meteorological Organisation) reported a global sea level rise of 4.5 mm/yr, citing 'human influence' as a primary driver of increases since at least 1971 (WMO, 2023). According to the UCCRN technical report, Mumbai is amongst the top three cities facing the highest risk of rising sea levels (UCCRN, 2018). Mumbai's methods to combat these rises, while constantly reshaping the edge are discussed in a later section of the chapter. Raising of sea-walls to combat coastal flooding, and RCC underground reservoirs to combat urban flooding, both anthropocentric interventions, are employed to tackle climate change brought on by pro-development neoliberal intentions.

6. Anthropocene Contentions at the Edge

The Draft 2020 CZMP[18] (Coastal Zone Management Plan) of Greater Mumbai is an interesting map resource that delineates the CRZ Zones- the CRZ-I, CRZ -II, CRZ-III - based on the 2019 CRZ Notification. Within the CRZ-I category (ecologically-sensitive areas), which is a strictly no-development zone, the map identifies natural edge-conditions such as nesting grounds

17 Along with Urban Heat and Air Pollution

18 The Draft CZMP (provided on the CZMP website) offers a more detailed picture of Mumbai's coastal edge condition than the Approved CZMP(2020). The approved CZMP omits the detail in the draft.

of birds and turtles, mangrove buffers, marine protected areas, corals and coral reefs, reserve forests, salt marshes, sand dunes, mudflats, mangroves, intertidal zones; semi-natural spaces such as beaches and rocky outcrops along Mumbai's urban edge have been distinctly marked. 'Archaeological and Heritage sites' have also been identified as a vertical within this CRZ-I category, but all heritage sites have not been comprehensively incorporated into this vertical. Majority of the heritage sites including Gateway of India, Ensemble of Victorian Neo-Gothic and Art Deco Buildings, Haji Ali etc. have been categorised into CRZ-III no development zones instead. A comprehensive overlaying of the archaeological and heritage sites (including ASI, WHS, natural heritage areas etc), will enable a better understanding of risks from climate-change and coastal contentions.

The 'urbanised' sea-facing western edge as well as the creek-facing eastern edge within the colonial island-city extents) is dominated by tetrapod stabilisation, rocky outcrops and some beaches, intertidal zones, alluding to the heavily urbanised edge. Upto a 500m line, a CRZ-II zone[19] is also delineated along these 'urbanised'/'concretised' edges here. In stark contrast the eastern edge north of Dadar, facing the Thane creek (outside the colonial city extents) is buffered by extensive mangrove cover interspersed with mud-flats (CZMP, 2020). In the northern and north-eastern peripheral regions as well (Manori Creek, Gorai etc), pre-colonial ecologies of salt-pans and mangroves punctuate the coastal edges. Studies have shown that there is an accretion of sediments between 1990-2020 on the eastern edge due to increase in mangrove covers. This has resulted in extensions of the coastline, but also in a shrinking of the Thane creek (MCAP,2022). Detailed scientific studies are warranted to study this 'natural' flux in the coastline and its larger ecological impact. In contrast, the tetrapod edge has not seen much change in the coastal outline between 1990-2020. The 'less' concretised north and north-eastern areas on the western coast (Versova, Juhu etc.) have witnessed some coastal erosion within the same timeline (MCAP, 2022).

Deloghrey (2019) describes "concrete, steel and bitumen of the planet's cities and roads" as 'Anthropocene rocks' holding the record of human civilisation. The globally produced 'imaginary' of Mumbai's coast is replete with the hard edges made of this 'anthropocene rock'- concrete. This 'concretisation' emulates a hyper-globalised urban-edge aesthetics of the Global North, which not only references Western and Gulf countries, but also Asian ones like Japan and South Korea.

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[19] Already 'developed areas', where new developments can also be approved conditionally by the MCZMA.

Along the 3.5 km stretch of the Marine Drive, concrete wave-dissipating 'tetrapods' were installed by the PWD in 1998. Records indicate that tetrapods have been used for a 1.2 km stretch of the Marine Drive since 1959 (Danel and Greslou, 1962). The tetrapod is a four-pronged wave dissipating structure developed in France in the 1940s. Tetrapod structures gained extreme popularity in Japan as "armour against the Tsunami", with reports estimating that over 50% of Japan's 35,000 km long coastal edge is covered by these structures or other forms of concrete (Hesse, 2007). According to Hesse (2007), *"tetrapods and other types of armoring can cause more damage than they prevent because they alter ocean currents and disrupt the natural cycles of erosion and deposition that naturally form and reshape coasts."* Figal (2019) urges to think beyond and deconstruct 'binaries' of 'nature' and 'built environment', observing the adaptation of 'wildlife' and 'human-life' to the tetrapods. He reflects that in Japan, tetrapods "appear naturalised" when sharing coastlines with beach resorts and coral reefs, *"within an understanding of nature that accommodates, rather than excludes by definition, humans and their built environments"* (Figal, 2019).

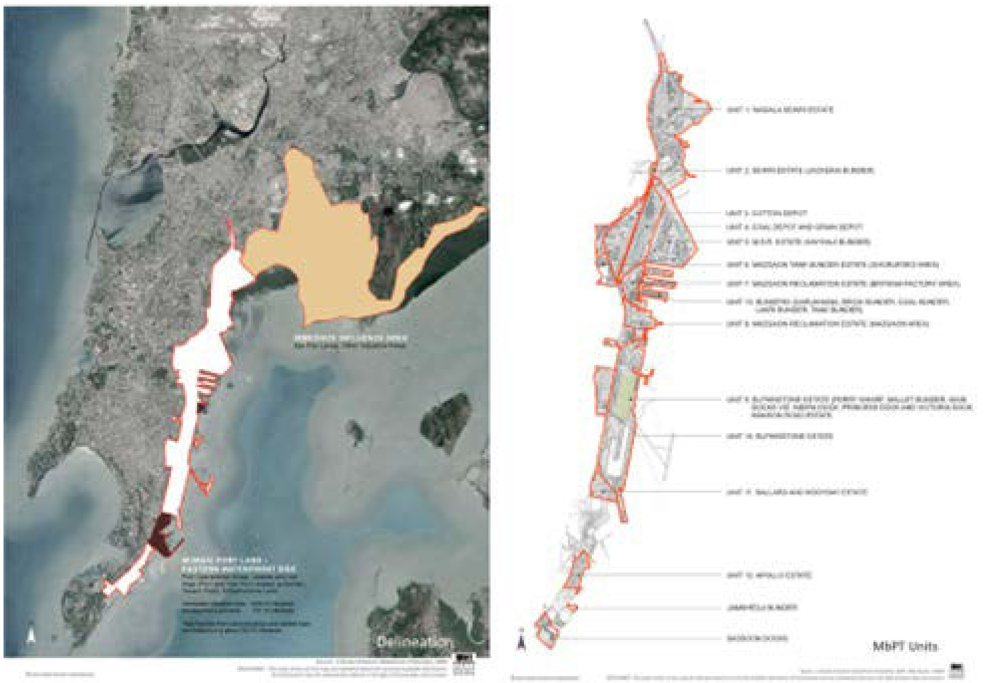

Figure 4: The Eastern Waterfront Development
Source: Login Mumbai (UDRI) Link: http://www.loginmumbai.org/easternwaterfront.html#

In 2020, The MCZMA (Maharashtra Coastal Zone Management Authority) sanctioned the building of a sea wall at the Gharapuri Island which houses Elephanta caves (Naik, 2020). The Elephanta caves - a rock-cut archaeological site with temples linked to the cult of Shiva (Hindu lineage) (5th and 6th century BC) and buried Buddhist archaeological remains (stupas and caves) from as early as 2nd century BC - was inscribed as a UNESCO World Heritage Site in 1987. The construction of this 3.2 km sea wall with sloped ramps, intent on preventing sea erosion began in 2021, undertaken by the JNPT (Jawahar Nehru Port Trust) at a cost of 37.5 crore INR (Kamble, 2021). Incidentally, the increase in port activities and the proposed widening of the water channel of the JNPT located at Nhava Sheva on the mainland directly east of the island factor into the increased erosion risk. The tourists and the 1500 odd residents (of three villages who probably support this tourism industry) are touted as the beneficiaries of this sea wall, which double-ups as a walk-way for tourists. Here, development-induced climate-risk is de-escalated with the pouring of more impervious 'concrete' vis à vis the sea-walls (i.e in essence more irreversible and non-natural urban development).

The Mumbai coast's liminality comes from multiple waves of urban development and their contentions.Wave upon wave of urban transformation projects have been unleashed on Mumbai's urbanised coastal stretches. In July 2022, according to multiple news reports, residents of two Art Deco buildings complained of earthquake-like tremors as an aftermath of the 'temporary' removal of the tetrapods to facilitate construction of the INR 11,000 crore MCRP (coastal road project) from Nariman Point to Kandhivali. The arbitrariness of the CRZ regulations in the CZMP 2020 (MCZMA, 2021) is evidenced in the crescent-shaped Back Bay area where CRZ-II only applies to the first-row of buildings as opposed to 500m elsewhere[20].

The 2004 Indian Ocean earthquake and tsunami marks a critical turning-point in coastal edge transformations across South Asian and South-East Asian borders. Mangrove forests were actively planted in locations across India, to act as a coastal buffer offering resilience against tsunamis (Alongi, 2008). Outside the extends of the colonial delimits, Mumbai's estuarine ecology of creeks and wetlands is intact and replete with 13 of the 35 native mangroves species of India. According to the information of the Conservation Action Trust website (CAT, n.d), continuous cover of mangroves remains lining the Vasai creek, Thane creek, Bandra, Versova, Sewri etc. The significance of mangrove ecologies is significantly demonstrated in India, which

[20] The reason for this arbitrariness needs enquiry.

houses the Sunderbans, an extensive mangrove forest and deltaic ecology on the eastern coast of India that became a UNESCO inscribed 'natural heritage' site in 1987.

Figure 5: Urban Transformations near Haji Ali (Above): The Coastal Road under construction (2023). (Below): Alignment and Creative Visualisations of the Coastal Road Project. Source: Google Earth, MCGM official website

Being a land-mass predominantly forged through reclamation places Mumbai at an increased vulnerability to coastal erosion. Coastal armouring through both 'soft' and 'hard' stabilisation have thus become increasingly common, as a compensatory measure to both erosion and rise in water-levels. Within urbanised settings, the 'aestheticised' tetrapod structures and other hard concrete infrastructure such as seawalls increasingly replace the natural coastal interfaces. The concretised edges are also touted as anti-tsunami measures against erosion, strongly influencing current coastal imaginations.

Recently, the PWD put-forward proposals for 42 sea-walls along the Maharashtra State coastline (including Mumbai) to the MCZMA (Arora-Desai, 2022). These were mobilised despite the NGT's (National Green Tribunal)[21] instruction to coastal states to swap "hard stabilisation" proposals with "softer stabilisation" options like beach nourishment, sand bypassing, dune planting, offshore submerged reefs etc. while preparing Shoreline Management Plans. It is critical to note that ecologically rich areas like Gorai and Madh Island, with natural coastal edges were also proposed sites.

These transforming coastal conditions create fluxes within the seas and oceans. Water extraction and damming for consumption purposes along with other demands of high-density coastal living, create extreme coastal conditions. Construction activities, dumping of the "techno-fossil" plastic wastes, sewerage and industrial effluents into the sea have severely disturbed the marine ecology and resulted in rise in sea temperatures. The 'Bombay duck' (*Bombil* fish) and other local fish once intrinsic to Mumbai, have depleted greatly in number.

Experts raise concerns over the destruction of habitats serving as natural fisheries and bird nurseries in the construction of urban transformation projects (Crossland et al, 2005, p.21) such as road causeways (e.g Haji Ali), coastal highways (e.g the coastal road project), shoreline ribbon developments (e.g Art Deco Building), port linked industries (The MbPT Eastern Water-front Development) etc. The neoliberal orderings of space through these transformation projects in Mumbai thus reinforce the extreme ecological ruptures of the coast initiated by the British colonisers. In the backdrop of the Bandra Worli Sea-link, the symbolic meanings of heritage, culture and the seaward connections of both the Bandra and Worli fort have been permanently altered. The historical lineages of the Eastern Waterfront can be traced to the Colonial Port and 19th century Industrial 'estate' (predominantly mills) and dockland ecologies (see figure). The 'Gateway of India', an arched monument in Indo-Saracenic style erected between 1911-1924 at Apollo Bunder to commemorate the visit of King George V and Queen Mary to British Bombay, is placed 'strategically' within this eastern edge, marking the 'gateway' to the entrepôt. The Gateway is a Grade I 'protected monument' under the ASI. Post-independence, the Gateway attained a new symbolism, marking the exit of British colonisers from Bombay, and the area including the Gateway and nearby Taj Hotel became central to Mumbai's tourism (Diekmann, 2022). Placed angularly at the coastal edge on reclaimed land, the Gate-

[21] The National Green Tribunal is a specialised statutory body that overlooks cases and disputes with regard to environment, forests and other natural resources.

way is subject to coastal contentions. During Cyclone *Tauktae* in May 2021 strong tidal waves hit the Gateway (Ramakrishnan et al., 2022) concerning citizens. The main monument did not suffer damages, but a sea-facing safety wall and iron-gates suffered damages according to news reports (Live Mint, May 2021).

The extremely 'contentious' coastal road project was greenlit by a 2015 amendment to the CRZ notification, and on the recommendation of the MCZMA, making clear the pro-development inclination of the CRZ rules. This amendment made it possible to build the Coastal Road by reclaiming on eco-sensitive intertidal zones (Kadri, 2020). The coastal edge near the Haji Ali Dargah is undergoing extreme urban spatial transformations (see figure 5). There is loss of both visual and spiritual connections with the landmark, traded for a 'car-dominant' urban edge that emulates 'glitzy' neoliberal spaces. The coastal road also became a mechanism for the displacement of the *koli* communities residing in *koliwadas* adjacent to the coast. The easy erasure of these smaller cultural markers of intangible heritage sanctioned by means of urban transformation is disconcerting.

7. Inferences

1. Mumbai's topographical transformations are largely denoted with coastal based cultural associations.
2. The indigenous coastal markers, reliant on temple water tanks, were inward looking, and did not have a direct connection to the coast, minimising the need to alter the coastal terrain.
3. The tomb of the Haji Ali Dargah, as a built form within the sea, is a micro-scale example of the land reclamation and an initial form of the manipulation of the coast. The access to the islet, depending on the tidal currents, allowed for negotiations with the coastal interface.
4. The reclamation erased several hills in Mumbai, flattening the terrain and redirecting the tidal currents within impermeable surfaces, setting the canvas for a new cultural landscape. The iconic Art Deco strip lining the public promenade of Marine drive directly relied on the sanitised urban setting that the reclamations provided.
5. Post-independence, the neoliberal orderings of space through urban transformation reinforce ecological ruptures created by colonisation.
6. The incorporation of heritage (built and natural, largely missing in the Climate Action Plan and CZMP plan is pertinent to the discourse on climate-change and heritage in Mumbai.

7. Climate contensions (erosion, flooding) brought on by urban transformation are tackled with further urban development.
8. The affinity towards a 'concretised' urbanity, as a direct result of pro-development narratives, alienates heritage and their visual, symbolic, intangible and other relationships. Mumbai's numerous coastal built landmarks are vulnerable to erosion, weathering, rising sea levels and extreme weather events.
9. The ambiguity of the CRZ norms has authorised acts of the anthropocene within the coast. Coastal road project's placement in eco-sensitive CRZ-I[22] zones demonstrate the pro-development narratives of the city. The project disrupts long-standing cultural and ecological relationships.

8. Conclusion

Mumbai's coastal edge holds tremendous historical value, as a site of distinguished cultural markers. The case of Mumbai's rich and varied cultural history presents an opportunity to comparatively study its land modifications through the lens of cultural variations. The multiculturality ascribed by Mumbai's vivid socio-cultural markers enrich the everyday socio-spatial sphere of the populace. Within the vicissitudes of excessive urban development, one perceives an increased dilution and erasure of the socio-cultural milieu (e.g the koliwadas). The act of human manipulation to the geographies within the island had historically set up a constant imbalanced duality between anthropocentric cultural habitats and coastal geography. However, post-independence, the city's urban transformations have detached from the burgeoning cultural diversity within its misplaced reclamations. Historically, imperialist, colonialist, and neoliberal ideologies restructured and reshaped the islands' interface with the sea. We posit that the answer to the overarching question of what could be an empathetic anthropocene is found in the construction of a symbiotic relationship between cultural markers and urban transformation (necessary to transcend alienation and anthropogenic ruptures). Sites of culture and sustainability often adapt to new territories, if the construction permits integration, identity and cultural resonance. It is well understood that capital flows and not human desires shape space, from the excessive concretisation of spaces. What 'anthropo' now represents within the 'anthropocene', and the value of humanity is up for contest.

[22] No development zone.

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4. The Vulnerability of Historic Urban Landscape Triggered by Improving Visibility

The Case of Visual Integrity of the "West Lake Cultural Landscape"

Yijin Zhang[1]

Abstract

As air governance has achieved positive results, improving atmospheric visibility has expanded the range of sight. As a result, some heritage property, particularly Historic Urban Landscapes, have begun to face new threats from urbanization. Within these heritage sites, construction projects are restricted by visual analysis in order to preserve the spatial pattern or texture with historical value. Thus, this study helps establish the "Visibility Changes—Urbanization—Value of HUL" linkage model, discussing how the positive effects of air governance affect or even break the original balance between the city and the heritage.

As a typical Historic Urban Landscape, Hangzhou and its world heritage "West Lake Cultural Landscape" will be incorporated into this model to complete an empirical study. The actual scenario of visibility changes and urban expansion is utilized to explain the cumulative effect, which alters the visual integrity of the historical spatial pattern and thereby worsens the vulnerability of heritage. This study essentially employs Outstanding Universal Value to analyze the solutions to the various practical challenges faced by the property. Moreover, it is necessary to include potential impacts within the wilder settings into the heritage management framework and to improve heritage management processes and technologies to be much more methodical, forward-thinking, precise, and intelligent.

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Keywords

Visibility, Visual Integrity, Urbanization, Potential Vulnerability, Historic Urban Landscape

1. Introduction

As stated plainly in "UNESCO's Recommendation on the Historic Urban Landscape", the impacts of climate change as well as rapid and uncontrolled urbanization may cause fragmentation and degradation of Historic Urban Landscape (HUL). Besides, because of the incorporation of the broader urban context and its geographical setting (UNESCO, 2012), HUL is more sensible to changes in the natural and urban environment than any other ordinary World Heritage properties. Therefore, it is crucial to consider how heritage protection should respond to urbanization and climate change.

Approximately one-third of the World Heritage Sites on the "List of World Heritage in Danger" are threatened by excessive urbanization, which has resulted in a weakening of authenticity and integrity (World Heritage Centre, UNESCO, 2023), specifically including the disappearance of traditional urban textures due to historical building damage, boundary erosion caused by construction in the buffer zone, the visual integrity of historical city monuments destroyed by high-rise structures, etc. As can be seen, striking a balance between urbanization and heritage protection is difficult. As a result, heritage managers pay more attention to urban expansion, particularly the supervision of tall buildings. In the UK, for example, in addition to management requirements such as "Tall Buildings: Historic England Advice Note 4" (Historic England, 2022), there are also some specific practical manuals such as "Guidelines for Landscape and Visual Impact Assessment" (Landscape Institute, 2013) and "Visualization of Development Guidance" (Landscape Institute, 2019) that were released. Furthermore, for a monographic study on height restriction and visual integrity, several experts provide technical optimization alternatives for city planning and urban design for historical cultural cities such as Beijing (Wang, 2010) and Quanzhou (Wang, et al., 2016).

Climate change is a fairly broad topic, and studies on it tend to concentrate more on its negative aspects, including air pollution, rising temperatures, the recurrence of extreme weather, etc. (WU, et al., 2022). Among air pollution studies, scientists such as Qu Jing (Qu, 2022) and Tan Chen (TAN, et al., 2019) concentrate on the disintegration and destruction of surface materials caused by air pollutants. However, research on the long-term effects of positive climate change is scarce. Improving air quality, for instance, is only mentioned as an example of potential future changes in "Guidance and Toolkit for Impact Assessments in a World Heritage Context" (UNESCO, et al., 2022), but has not been further discussed or studied. In order to close the research gap, this study uses improving visibility as starting point.

Without a doubt, both climate change and unrestricted construction impose a strain on heritage protection, but the combined impacts of them are dismissed. Even though "Guidance and Toolkit for Impact Assessments in a World Heritage Context" mentions that "the cumulative effects of several elements or projects may make a World Heritage property vulnerable and that other factors, such as climate change, may amplify the effects of a proposed action" (UNESCO, et al., 2022), it only draws attention to the impact of potential changes, but has not developed specific cases. This paper, however, in order to fill these research gaps, examines the medium mechanism of visibility under the linkage frame of "Visibility Changes—Urbanization—Value of HUL", forming a model that can demonstrate cumulative effects. Moreover, improving visibility derived from air quality improvement is used as a meta-change to study how it catalyzes the contradiction between urbanization and HUL protection.

The World Heritage property "West Lake Cultural Landscape" with vast urban geography is a classic example of HUL. The West Lake is surrounded on three sides by "cloud-capped hills" and on the fourth by the old town of Hangzhou, which is a unique city-lake-hills spatial landscape. The visual integrity of this characteristic landscape pattern is used as an example to demonstrate how the "Visibility Changes—Urbanization—Value of HUL" model works. On the basis of simulation outcomes, the development tendencies are explored in relation to the wilder setting and cumulative impacts. Based on these findings, mitigations for sensitivity induced by visibility changes and urbanization, in conjunction with actual heritage management, were developed. Additionally, it considers strategies for balancing the interests of more stakeholders, as well as developing more advanced and refined specifications for the current heritage management paradigm.

2. “Visibility Changes—Urbanization—Value of HUL”

2.1 Visibility and Urbanization

Atmospheric visibility, which can represent the transparency of the atmosphere, is an essential measure of air quality. Human activities and pollutants produced alter air visibility under the combined action of meteorological elements (Baumer et al., 2008). Pollutant concentration, which is heavily influenced by urbanization, is a key and important influencing factor for visibility change (Chang et al., 2009).

The academic community generally believes that the urbanization process will be accompanied by a large number of infrastructure construction and real estate investment, which will increase demand for high-energy consumption and high-pollution products such as cement, coal, and steel, thereby exacerbating haze pollution (Hao, 2014). Existing research findings on the relationship between China’s urbanization promotion and atmospheric governance show that there is a linear correlation between the level of urbanization and air pollution. Most cities’ urbanization processes are still exacerbating air pollution, while in the eastern regions that are economically developed, there is a substantial “Inverted U” curve link between urbanization level and air quality. It has demonstrated that the increase in air pollution is not an unavoidable result of urbanization but a periodic manifestation of it (SHAO, et al., 2019). According to the “Ecological Modernization Theory”, as the social economy progresses from the low to the middle stage, the ecological environment will worsen, while air pollution will be mitigated through technological innovation when urbanization progresses to a higher stage (Sadorsky, 2014).

It can be shown that widespread urbanization in the early stages will exacerbate air pollution; however, in the high-level development stage of urbanization, the government will regulate air pollution by a variety of means, including restrictions on urban construction behavior. As a result, while there is no direct causal relationship between urbanization and air quality, they do impact and constrain each other to some extent. In addition, the level of air quality correlates with visibility. Consequently, the link between visibility and urbanization is as follows: when urbanization increases air pollution, overall atmospheric visibility drops; when air pollution is appropriately controlled, visibility increases.

It is important to note that visibility in this study primarily refers to annual average visibility, indicating the overall shift trend of air quality when stated. In truth, instantaneous visibility is a figure that varies greatly affected by a variety of factors, such as aerosol concentration, air humidity, atmospheric stability, and so on. Taking Hangzhou as an example, the monthly average visibility is better in the summer and worse in the winter. Besides, the daily visibility is typically poor between 7:00 and 8:00 a.m., while the best visibility occurs around 15:00, and the gap between their values can be more than 5 kilometers (Liu, 2018).

2.2 Visual Analysis for HUL

For HUL, it is essential to maintain a sustainable balance between the urban and natural environments, although there is frequently conflict between them. Therefore, it is especially vital to limit construction height and scale with landscape approaches in order to preserve historical spatial characteristics, as indicated by the "Recommendation on the Historic Urban Landscape". There are some examples that many countries or locations around the world have performed exploration on landscape approaches. The "Visual Management System" was developed in the United States as early as 1970 (BILLINGTON, 1987). Paris had identified 45 landscape control regions as of 1999. Germany manages the urban landscape by building grading (Lv & Chen, 2019). London has an advanced HUL management system with defined tiers and linked systems, owing to its rich historical heritage. Since 1938, the London government has controlled the height of structures surrounding St. Paul's Cathedral and the Monument to the Great Fire of London by "Strategic View". The "London View Management Framework" published in 2012, set up a comprehensive high-level control system, identifying 27 "Designated Views", 13 "Protested Vistas" and a number of "Protected Silhouettes" associated with world heritage in order to balance the conflict between historical visual protection and urban expansion (Mayor of London, 2012).

The core of the landscape approach is visual analysis. The book "Foundations for Visual Project Analysis" goes into detail about the physical ideas of visual analysis (air refraction, the effect of earth curvature on sight), visual physiology, and the basic paradigm (Smardon, et al., 1986). The visual analysis, which is a reasonable and scientific urban planning aid, is based on the human visual sense, in which people perceive urban space by "seeing", while urban landscape illustrates its visual worth by "being seen". Visual analysis can quantitatively analyze the construction relevant to historical landscape viewing corridors and skylines, as well as in and between landscape nodes, and then convert people's spatial perceptions into quantifiable indicators in order to protect the historic skyline, texture, or space pattern.

2.3 Model with Visibility Changes as Meta-Change

According to the study above, there is a natural conflict between HUL and urbanization, and visibility has a correlation with urbanization. When Visibility Changes and Urbanization collaborate on heritage site, the "Visibility Changes—Urbanization—Value of HUL" linkage model (Figure 1) is produced, which will directly disclose HUL's vulnerability owing to changes in visibility.

Some unanticipated vulnerability of HUL has evolved in recent years as a result of extraordinary success in air pollution management. As air governance enhances visibility, allowing people to see farther during more periods, some proposed or even existing buildings will be seen in critical sight directions. When visibility was poor, these buildings were not visible, while now that visibility is good, they are exposed. However, these structures are frequently legally compatible. They got construction approval because they met heritage preservation standards, despite the fact that the standards were enacted at a time when visibility was previously poor. Consequently, changes in visibility have a cumulative effect on urbanization, which causes new problems for heritage protection.

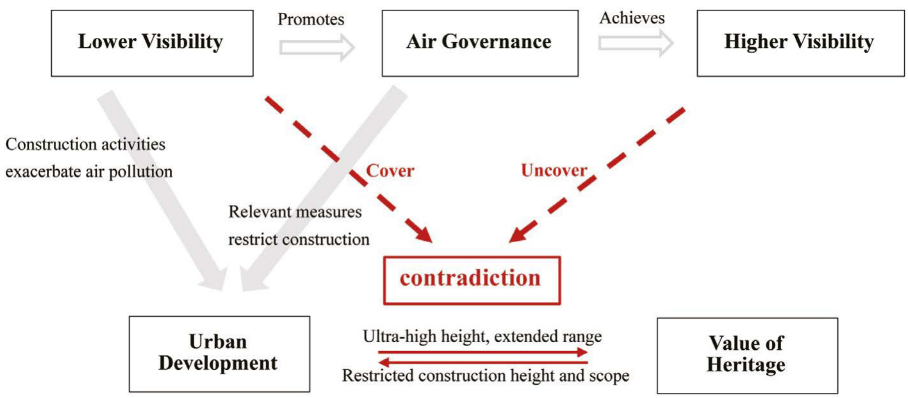


Figure 1: The Interaction between Visibility Changes Urbanization Value of HUL Conservation - Imaged by author.

2.4 The Role of Visibility in the Model

An obvious example can demonstrate how visibility variations affect different visual experiences. The two photos (Figure 2) were shot at different levels of visibility, and they were taken in the same location with the same

Figure 2: Photos of the Same Scene with a Visibility Difference of more than Five Times Photograph taken by the author in 2023.

camera settings to reduce the influence of insignificant elements. It is seen that the city behind the mountain ranges goes from being plainly visible to virtually invisible, and the view interaction between the lake and the city is quite different when the visibility varies by more than five times.

In fact, "air with specific visibility" acts as the medium or even a mask in the "Visibility Changes—Urbanization—Value of HUL" interaction paradigm. When visibility is low ("mask" with low transparency), the degree of invisibility of the city is higher, meaning that tolerance for construction within the context of heritage value is higher. However, even buildings that originally adhered to the heritage protection standards may have a detrimental influence on heritage value owing to being "re-seen" after the visibility is significantly improved ("mask" with high transparency). In other words, the level of visibility "determines" the extent to which the city impacts its heritage.

The greater challenge, however, stems from the volatility of this mask, because instantaneous visibility is not a constant value that might shift substantially over the seasons or even a single day. In other words, the same urban construction state will be perceived differently within varied degrees of visibility. The randomness and unpredictability caused by this have also posed significant obstacles to the harmony between heritage and city. Therefore, similar unexpected crises may arise near properties that are maintained based on visual analysis. In the context of China's rapid urbanization, the balance between urban expansion and heritage protection is anticipated to be challenged more frequently as the "mask" becomes more transparent. Thus, heritage and city administrators should be on the lookout for such changes.

3. Visual Integrity of the "West Lake Cultural Landscape"

3.1 Maintain the Authenticity and Integrity of the World Heritage "West Lake Cultural Landscape"

The West Lake (Figure 3) is a "famous cultural lake" with water as its main scenery and culture as its key asset (Chen, et al., 2012). On the basis of criteria (ii), (iii), and (vi), the "West Lake Cultural Landscape" of Hangzhou was successfully inscribed on UNESCO's World Heritage List as a cultural landscape property in 2011.

Figure 3: Snow Scene of the West Lake - Photograph taken by the author in 2018.

West Lake is surrounded on three sides by "cloud-capped hills" and on the fourth by the city of Hangzhou (Figure 4). It is a unique urban-lake spatial character that is essential to the authenticity and integrity of the heritage, as the World Heritage Committee emphasized in document "WHC-11/35. COM/8B" that "ICOMOS considers that it will be absolutely crucial that this skyline is maintained.

The State Party should give consideration to maintaining the skyline of hills to the north and south as viewed when looking east and ensure that there is no encroachment of the city behind those hills that are visible from the lake and that all relevant development is subject to a HIA that considers impact on the attributes of Outstanding Universal Value (OUV)" (World Heritage Committee, 2011).

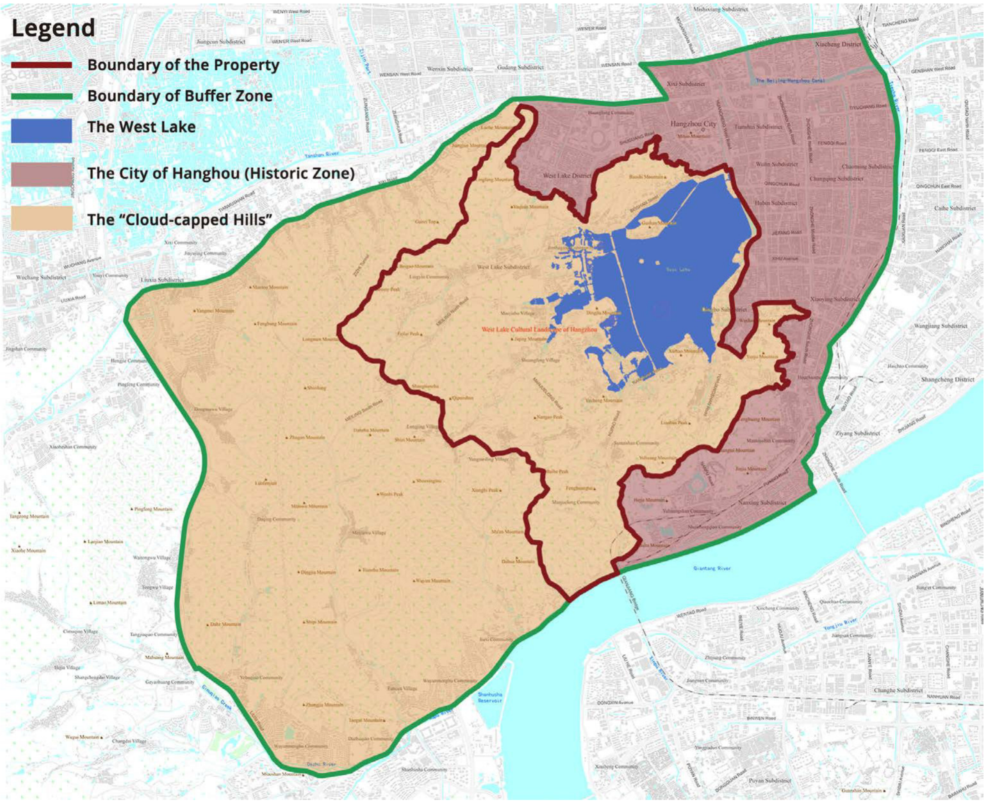


Figure 4: The Unique City-Lake-Mountain Spatial Character
Imaged by author. Reference: Hangzhou Municipal Government, 2008. Planning for the Protection and Management of Hangzhou West Lake Cultural Landscape (2008-2020). Hangzhou: Hangzhou Municipal Government.

3.2 Measures to Limit Building Height in Hangzhou

Similarly, "Planning for the Protection and Management of Hangzhou West Lake Cultural Landscape (2008-2020)" uses visual analysis to specify 20 viewpoints and 4 sight lines (Figure 5) to protect the distinctive spatial pattern, the integrity of the mountain skyline, as well as the urban landscape to the east of the lake. Look straight ahead from these crucial viewing zones when cruising around the West Lake, there should be no encroachment of the city behind those surrounding hills that are visible from the lake (Hangzhou Municipal Government, 2008).

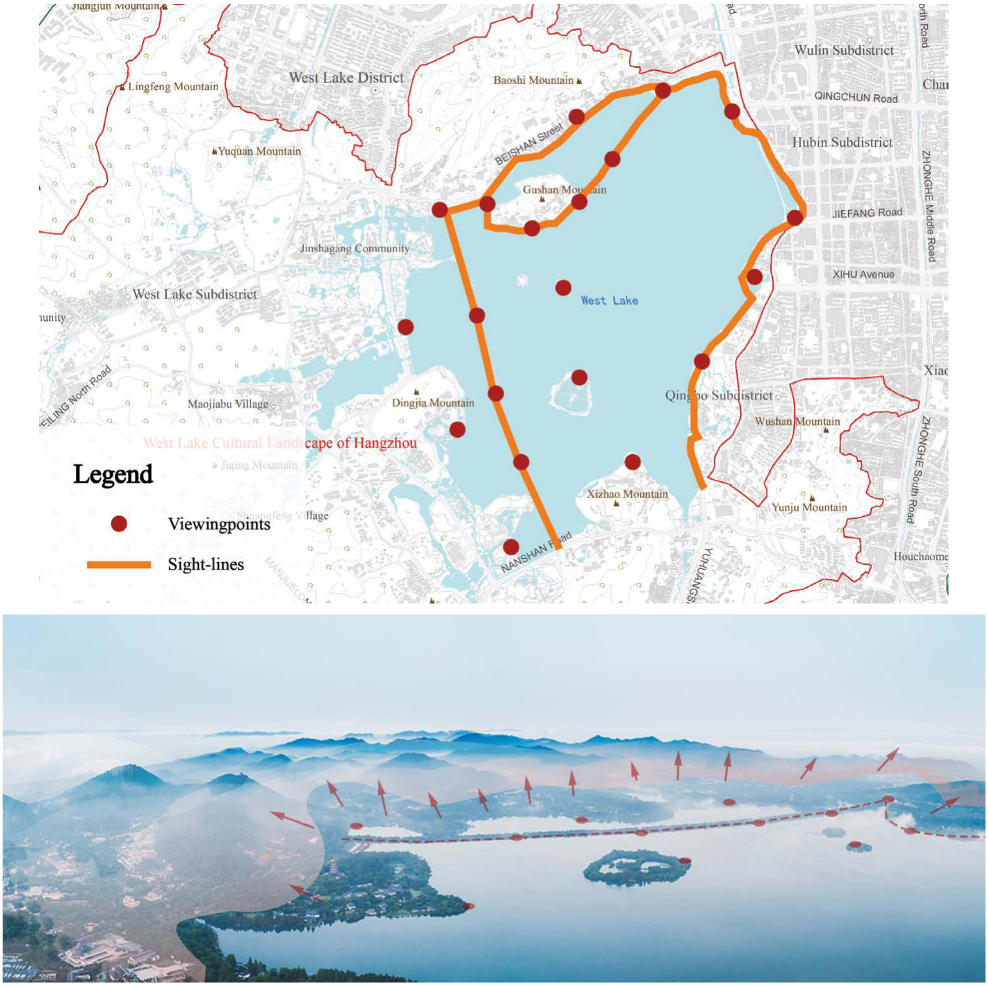


Figure 5: The Viewpoints and Sight lines
Imaged by author. Reference: Hangzhou Municipal Government, 2008. Planning for the Protection and Management of Hangzhou West Lake Cultural Landscape (2008-2020). Hangzhou: Hangzhou Municipal Government.

The "Planning for the Protection and Management of Hangzhou West Lake Cultural Landscape (2008-2020)" conducts visual analysis with 20 viewpoints and 4 sight lines, dividing the height control system of surrounding buildings into eight levels: 12 meters, 15 meters, 15-18 meters, 18-20 meters, 25-28 meters, 30-40 meters, 40-55 meters, and 55-70 meters (Hangzhou Municipal Government, 2008).

In addition to the aforementioned "Building Height Restriction Zones", a broader city region is designated as "Areas of Potential Impact" (Figure 6), whose boundary is approximately 12 kilometers away from the center of the West Lake. For the construction projects in this area, Hangzhou Municipal Government conducted a HIA at first, then further determined the features such as height, volume, and color.

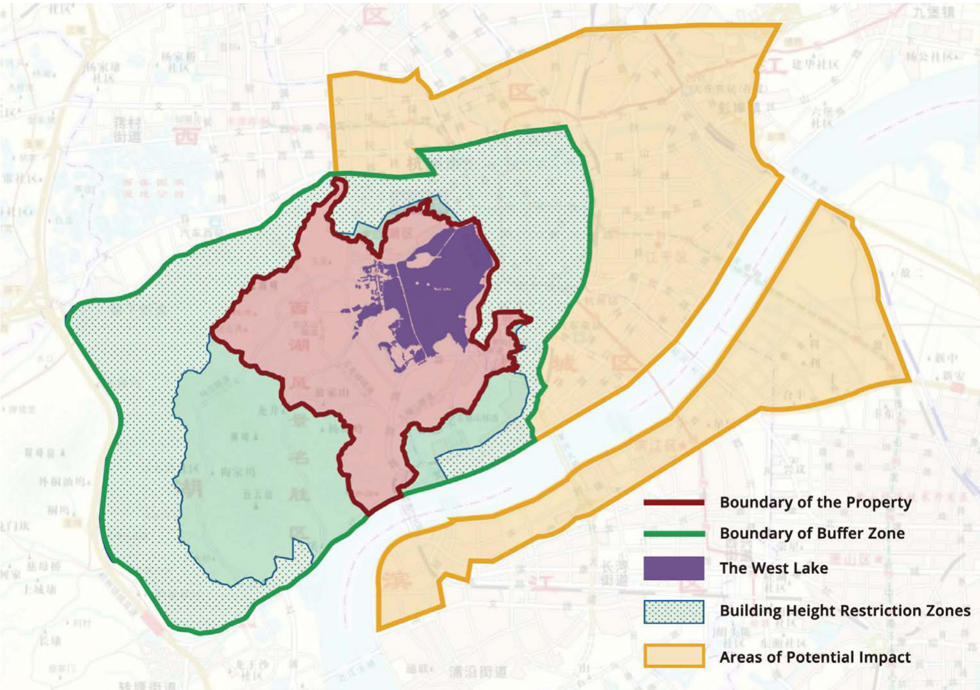


Figure 6: Areas of Height Limitation
Imaged by author. Reference: Hangzhou Municipal Government, 2008. Planning for the Protection and Management of Hangzhou West Lake Cultural Landscape (2008-2020). Hangzhou: Hangzhou Municipal Government.

3.3 Procedure for HIA of West Lake Cultural Landscape

ICOMOS requires that "Impact assessment processes should be embedded in the management system of the World Heritage property" (UNESCO World Heritage Centre, 2021), so the Hangzhou Municipal Government promulgated the "Regulations on the Administration of Hangzhou West Lake Scenic Area" (Hangzhou West Lake Scenic Area Management Committee, 2011), requiring construction projects that may affect the OUV of West Lake Cultural Landscape to conduct HIA to ensure that the site selection, layout, height, volume, shape, style, and color are in harmony with the landscape and its surroundings. It is worth emphasizing that the Hangzhou Municipal Government formed this HIA process spontaneously, which is extremely different from when the World Heritage Committee or the UNESCO World Heritage Center demands the submission of an impact assessment. In addition, "HIA should begin at the earliest consideration of a proposed action", so the procedure of HIA (Figure 7) includes an encompassing survey, evaluation report authoring, collaborative review by multi-professional experts, online and offline public notification, and so on. After that, the outcome of the HIA will be

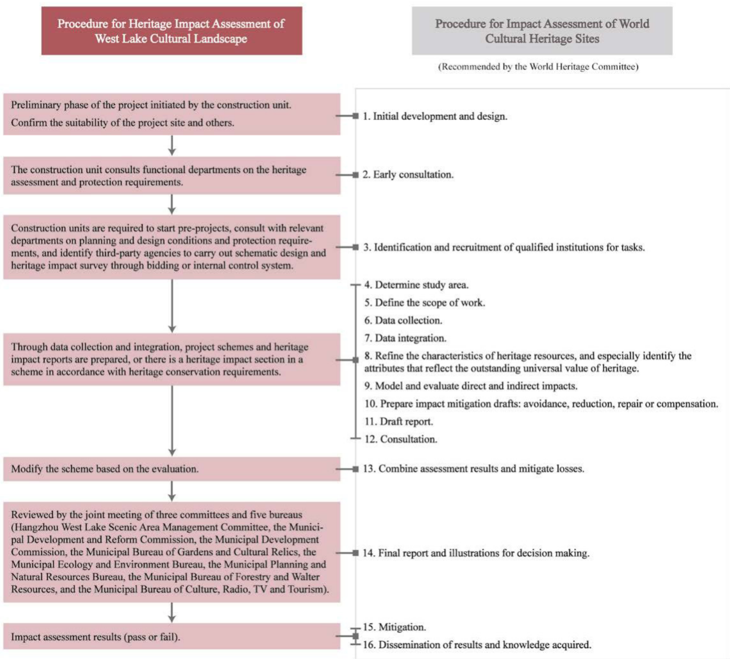


Figure 7: Procedure for Heritage Impact Assessment of West Lake Cultural Landscape - Imaged by author.

used for a joint meeting by three committees and five bureaus of the Hangzhou Municipal Government, affecting whether or not the project can be approved (UNESCO World Heritage Centre, 2021).

It has resulted in HIA being an essential venue for equal talks because it incorporates several parties in the decision-making process, including the government, management, stakeholders, and specialists from various sectors.

4. Empirical Case of "Visibility Changes Urbanization Value of HUL"

The "Planning for the Protection and Management of Hangzhou West Lake Cultural Landscape" issued in 2008 is still in effect today, mandating several heritage conservation and management criteria, including urban height limitations. Thus, 2008 is a significant time node in this study when analyzing and discussing the changes between now and then. The changes in the urban and natural environments of the West Lake cultural landscape since 2008 will now be incorporated into the "Visibility Changes—Urbanization—Value of HUL" model, and the potential impacts on the visual integrity or OUV of HUL will be disclosed.

4.1 Visibility Changes in Hangzhou

Average yearly visibility in Hangzhou from 1994 to 2022 reveals a nearly "smiling" curve as the overall changing pattern (Figure 8). Annual average visibility declined from 1994 to 1999, fluctuated from 2000 to 2015, and has increased significantly after 2016, which reveals that air pollution governance in Hangzhou has been effective over the last ten years and visibility has improved. This is because Hangzhou has reduced air pollution over the years through a variety of measures, including reasonable planning of urban layout and transportation systems, more efficient use of land resources, and improvement of the actual efficiency of urban space, as well as strictly limiting construction activities to reduce site and road dust (Hangzhou Municipal Ecology and Environment Bureau, 2021).

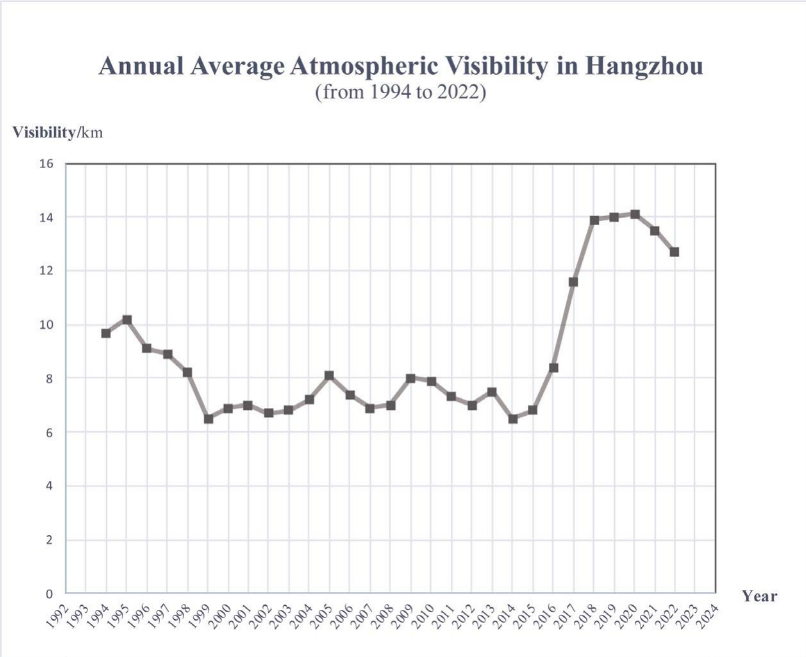
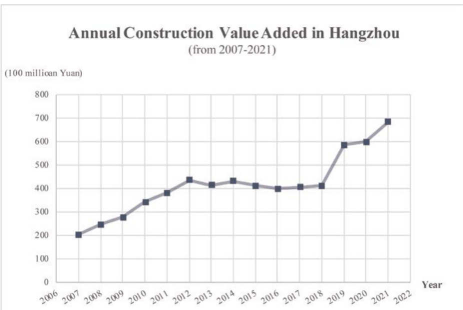
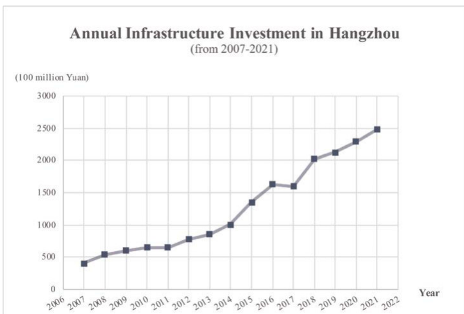


Figure 8: Annual Average Atmospheric Visibility in Hangzhou (from 1994 to 2022). Imaged by author. Data Sources: Hangzhou National Reference Climate Station. Reference: Liu, R., 2018. Characteristics of Visibility and its Relationship with PM2.5 in Hangzhou from 1994 to 2017. Zhejiang Meteorology, 39(3), pp. 17-21

4.2 Urbanization in Hangzhou

China's economy has grown significantly in recent decades, and the urbanization rate has risen from 19.39% in 1980 to 64.7% in 2020 (National Bureau of Statistics, 2022). As one of the most economically developed areas in eastern China, Hangzhou has maintained a significant development rate, with an urbanization rate of 83.6% in 2022 (Zhejiang Provincial Bureau of Statistics, 2022), which is significantly higher than the national average.





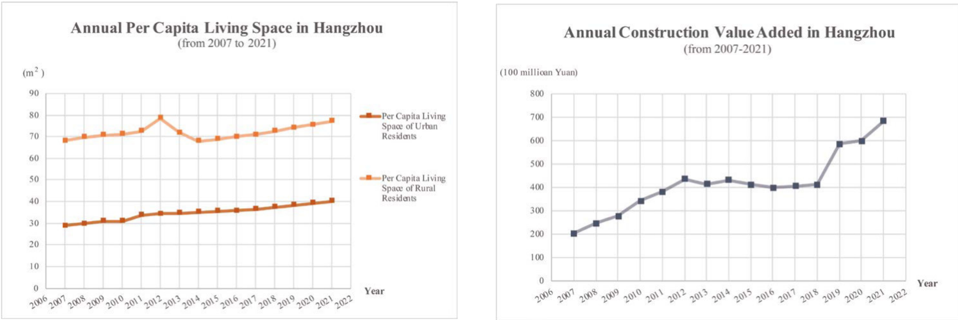


Figure 9: Construction in Hangzhou (from 2008 to 2021)
Imaged by author. Data Sources: Hangzhou Municipal Bureau of Statistics, 2008-2022. Statistical Bulletin of Hangzhou National Economic and Social Development.
[Online] Available at:
http://tjj.hangzhou.gov.cn/col/col1229279682/index.html?uid=7298287&pageNum=2

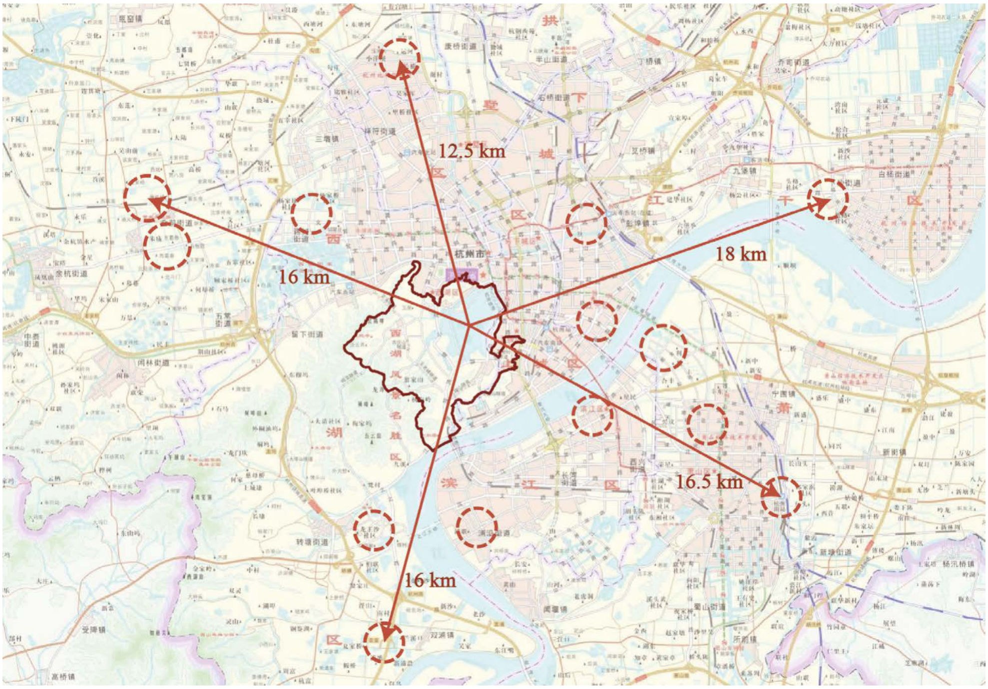


Figure 10: The Proposed High-rise Complex in Hangzhou
Imaged by author. Reference: Hangzhou Bureau of Planning and Natural Resources, 2021. Explanation on the Acceptance of Public Participation Opinions in the Announcement of "Hangzhou Master Plan (2021-2035)" (Draft).
[Online] Available at:
http://ghzy.hangzhou.gov.cn/art/2021/9/7/art_1229369034_3930971.html

From 2008 to the present, data on construction in Hangzhou (Figure 9) have generally increased, including infrastructure investment, construction value added, per capita living space of urban residents and rural residents, completed area of real estate commercial housing, and so on. In general, the total quantity of urban construction in Hangzhou has been increasing during the last fifteen years (Hangzhou Municipal Bureau of Statistics, 2008-2022). Furthermore, the “Hangzhou Master Plan (2021-2035)” projects that by 2035, Hangzhou will have diverse groups of super high-rise buildings (Figure 10), with a permanent population of around 15 million people (Hangzhou Bureau of Planning and Natural Resources, 2021).

4.3 Visual Analysis Simulation

One of the 14 proposed high-rise complexes located roughly 17 kilometers from West Lake was chosen to run a visual analysis simulation. Assuming that people stand at one of the 20 viewpoints, stare at one skyscraper (assuming it is 300 meters high) of the high-rise complex. The visual simulation results reveal that, in theory, this tall building would be exposed behind the mountain (Figure 11). So, will this structure actually be exposed?

Figure 11: Visual Analysis Simulation
Image Sources: Simulation Results from Hangzhou Planning and Design Institute.

Because the average annual visibility has been above 12km since 2018, and the number of days with visibility above 20km has increased significantly, the likelihood of this building being seen is increasing even more, causing the building to appear and disappear. However, if the visibility is similar to that of 2008, the average yearly visibility in Hangzhou was approximately 7km, and more than 80% of the days had visibility of less than 10 km (Hong, et al., 2019), making the building nearly impossible to expose practically. Therefore, even if the urban development situation remains constant, changes in visibility will significantly impact on visual integrity.

The simulation findings demonstrate that at the current visibility level, encroachment of the city is beginning to be visible behind the hill, which may threaten the heritage's integrity. Nevertheless, this structure is legal under the current heritage management system. In reality, it is completely unexpected that this tall building would damage the ridgeline's integrity, given that the existing management system places no constraints on construction beyond 12 kilometers from the lake (Figure 12). Outside theproperty area and the buffer zone, there is a larger area of potential impacts among the existing management system, but most of the high-rise clusters planned for the next 10 years are even outside this wilder area. If the same simulation is run for these planned tall buildings, the negative effects of exposure may reoccur and lead to even worse cumulative outcomes.

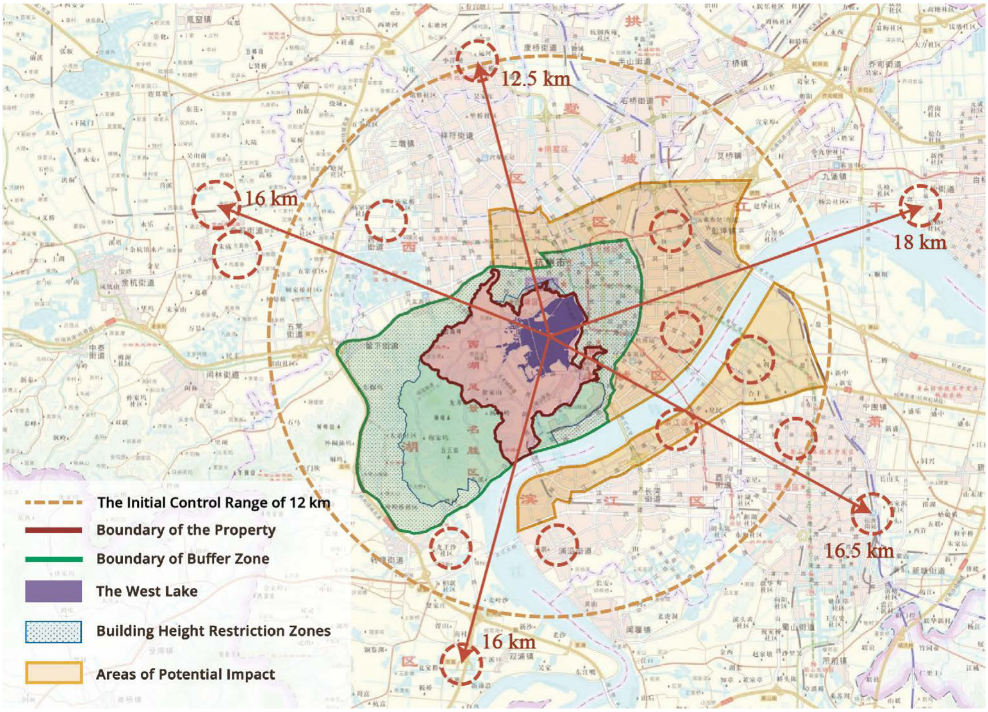


Figure 12: The Initial Control Range within 12 km
Imaged by author.

Therefore, it is revealed from the "Visibility Changes - Urbanization - Value of HUL" model that the relationship between heritage and the city, which was already difficult to achieve a balance, has become more precarious, and unexpected vacancies in urban management have quietly arisen.

Consequently, it must be evaluated as quickly as feasible that will the issue simulated above have to be resolved? How can this be resolved? And how can we avoid similar problems in the future?

5. Discussion

5.1 Is heritage Value Truly Threatened?

The first point to address is whether the scenario depicted above genuinely affects heritage values. ICOMOS defines visual integrity as "maintaining the skyline of hills as viewed" with the specific constraint that "there is no encroachment of the city behind those hills that are visible from the lake" (World Heritage Committee, 2011). Thus, the heritage protection should base on the human sense of looking out, although computer-assisted analysis is essential when employing visual analysis. Similarly, Historic England issued the most recent "Tall Buildings: Historic England Advice" in 2022, and continues to emphasize how visualizations might best "reflect the human visual experience, particularly that from street level" (Historic England, 2022). Because the landscape approach is based on human viewing behavior, this form of analysis is fundamentally subjective and constantly changing in its randomness.

In truth, the simulation results of visual analysis are defined as "Zones of Theoretical Visibility" (Historic England, 2022), which are used to show the visual "line of sight" or catchment area from which a development can potentially be seen. As the human visual experience gains focus, what people can truly perceive requires greater thinking. The ability of human vision to perceive objects in the atmosphere is dependent on a variety of factors, including atmospheric qualities, distance between the object and the observer, physical characteristics of the item, and so on (Rao, 2010). First, based on current visibility levels, the simulation above predicts that the building behind the hills will be visible at times and invisible at others throughout the year, implying that this tall building is largely a looming shadow. Furthermore, human perception of spatial patterns differs from that of computers, as people observe the skyline of hills, they will reorganize the information they perceive and gain an overall picture. In other words, human perception will most likely interpret the distant, looming shadow as something on another layer that has nothing to do with the integrity of the hills' skyline. As a result, if the simulation result becomes reality, the influence on visual integrity or even heritage value will be limited. However, this does not mean that it can be disregarded, because the trend of urban expansion suggests that similar shadows will continue to appear. A looming shadow can be ignored by human vision, but a large-scale shadow cluster cannot, putting visual integrity at risk.

5.2 How to Reduce Adverse Effects

Although the possible implications of simulated buildings on visual integrity are limited, the greater risk is caused by the fact that city and heritage managers did not anticipate such potential impacts at present. It is possible that the structure might be discovered by chance after it reaches a certain height. In accordance with its emphasis on historical protection, the Hangzhou Municipal Government will promptly activate a reactive system. The next steps could be to immediately halt the construction project, organize a team of experts to conduct hazard analysis, and then take measures such as lowering the initial floor height, changing the facade style of the structure on the upper floors, and so on. It would result in large direct or indirect economic losses and significant coordinating strain on city administrators and heritage managers. Besides, due to the enormous amount of economic loss and compensation, reaching a consensus among the stakeholders will be difficult, increasing the risk of unfavorable outcomes such as project delays or even incompleteness.

Although the aforementioned reactive technique can fix the problem to some extent, the cost is prohibitively expensive. Obviously, identifying potential impacts and considering alternatives prior to project implementation is a superior strategy.

5.3 How to Deal with Potential Impacts in the Future

5.3.1 Visibility as Meta Change

Although the tension between urbanization and heritage conservation has been exacerbated by successes in air governance, the favorable trend of visibility will continue because the government is still actively promoting environmental governance. In addition, the global climate governance system is being upgraded. The Transnational Municipal Network, for example, has been formed by the United States, the European Union, and other developed countries (Setzer, 2015). It is considerably more difficult to predict where the limit or threshold of visibility will be. Although the limit of visibility enhancement is not equal to the limit of human visual cognition, it is nevertheless required to "integrate urban heritage values and their vulnerability status into a wider framework of city development" (UNESCO, 2012).

5.3.2 Wilder Settings

The World Heritage Committee describes the city of Hangzhou's relationship with the lake as follows: "The lake is closed on its fourth side by a low-lying town that relates in scale to the overall landscape and is in itself beautiful (as Marco Polo described) (World Heritage Committee, 2011)". After thousands of years, despite the relative positions of the West Lake and the low-lying town keeps the same, the city of Hangzhou has expanded and encircled the West Lake, transforming it from being "on the west side" to "in the city". Consequently, the organizational relationship between the city and the lake has undergone tremendous shifts (Figure 13), so it is natural for the geographical relationship between the two to shift as well. Over the last few decades, Hangzhou has continuously absorbed other nearby cities and their residents, establishing a larger regional city, which provides the required managerial foundation for addressing potential impacts in wilder settings.

The "Centripetal City Theory" asserts that "balance in agglomeration" (Lu, 2022), which is the objective law of urban development, will continue to govern population concentration in major cities like Hangzhou. Indeed, by the end of 2022, Hangzhou's permanent population had grown from 8 million in 2008 to 12 million, with a projected increase to 15 million by 2035. There is an urgent need to widen the borders of heritage management in the face of blooming urbanization, but how can it be expanded in a sensible and feasible manner?

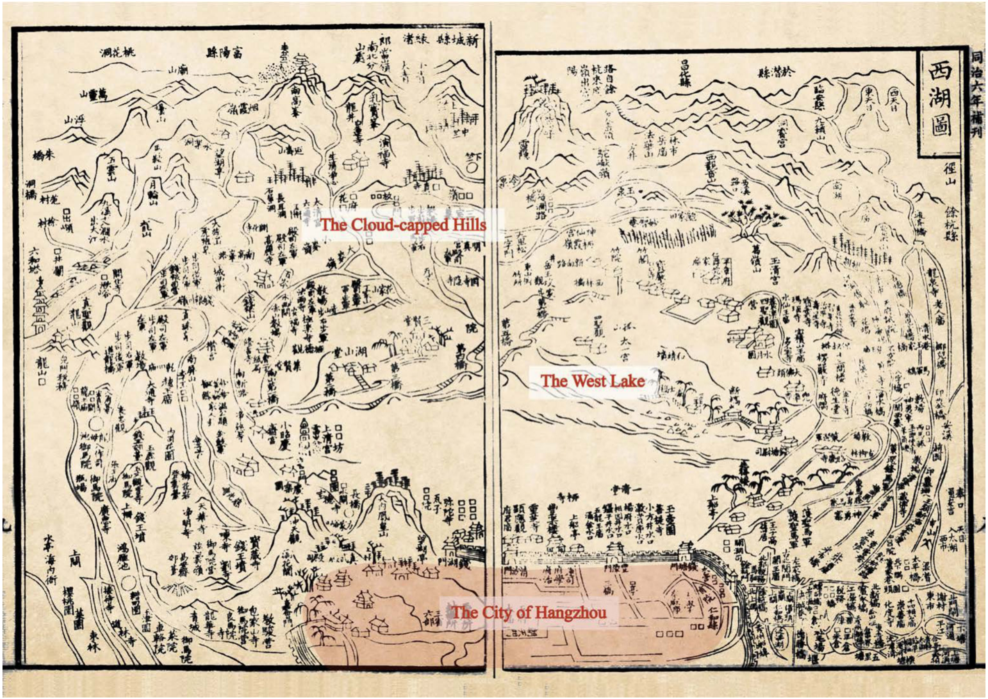


Figure 13-1: Hangzhou and the West Lake in the Song Dynasty (10th-13th century A.D.)

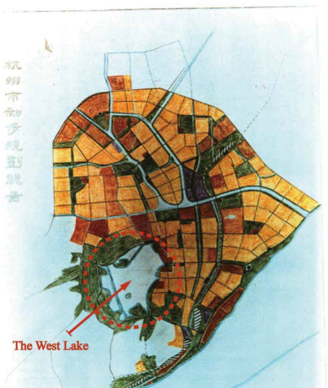


Figure 13-2: Hangzhou and the West Lake in 1957

Figure 13-3: The Core Blocks of Hangzhou and the West Lake in 2023

Figure 13: Changes in Relationship between West Lake and Hangzhou
Image Sources: Que, W., 2000. Historical Illustrations of Hangzhou City and West Lake. Hangzhou: Zhejiang Public Press.

In reality, current height regulations are effective in the relevant locations, nevertheless, the potential impacts of high-rise buildings in wilder settings have not been anticipated. Consequently, it merely needs to broaden regions of heritage sensitivity on the basis of the existing heritage management system, as well as be vigilant for tall building construction actions.

5.3.3 Heritage Management should Have Boundaries

Being aware of the potential impacts of tall buildings does not imply that they should be fully prohibited. Instead, an HIA of projected actions should be performed, with the impact on the OUV being assessed before deciding whether or not to implement them.

However, it is evident that heritage management should have boundaries, as suggested by various international documents that it is not completely unacceptable that the city has an impact on HUL. "Tall Buildings: Historic England Advice Note 4", for example, recommended that, when compared to dispersed tall buildings, a "well-defined, well-designed, integrated, and managed" tall building cluster can minimize cumulative impacts that may be harmful to the historic environment by delivering high densities (Historic England, 2022). This is essentially founded on the acceptance that high-rise structures must be created, with the goal of minimizing the impact on heritage rather than eliminating it entirely. Another important example is that ten years ago, the World Heritage Committee still praised that "the property's visual integrity toward the city side is well managed, considering the drastic urban changes of Hangzhou city over the past 10 years, from a regional town to a metropolis of eight million people", despite the fact that "Hangzhou with its tall buildings dominates the view to the east and tends to dwarf the lake buildings" (World Heritage Committee, 2011).

As a result, the perspective on heritage protection must shift in response to current urbanization situations. Given that Hangzhou's permanent population is expected to double by 2035, the connection between this "mega-new city" (Hangzhou Bureau of Planning and Natural Resources, 2021) and its heritage will definitely change. The city's relationship with HUL has always been fluid, so in the "Visibility Changes—Urbanization—Value of HUL" paradigm, heritage management is not absolutely prioritized above urbanization, and it is unreasonable to prioritize heritage while ignoring the regular necessities of urban development. Therefore, the balance should be based on the best answer available in the current conditions, through multi-stakeholder debate and collaboration.

6. Conclusion

6.1 Keeping a Dynamic Balance

Air pollution must be regulated, cities must continue to flourish, and cultural heritage must be preserved, the three exert impact and restraint on one another in the "Visibility Changes—Urbanization—Value of HUL" linkage model. Consequently, a balance of the three should be sought to ensure that the model does not collapse, rather than infinitely growing one component while suppressing the other two.

As the long saying "prevention is better than cure" has long reminded us, compared to emergency or rescue protection, prevention intervenes before issues even exist can maintain heritage value while sparing people and material resources. In today's increasingly complicated environment, heritage protection must be watchful for all types of changes, whether positive or negative, and respond quickly.

This study gives an example of cumulative impacts on heritage vulnerability, only focusing on the increased visibility and urbanization. Every World Heritage property is surrounded by a wider setting, which relates to the "property's topography, natural and built environment, land use patterns, spatial organization and visual relationships, and intangible dimensions such as perceptions and associations, social and cultural practices, etc. (UNESCO, et al., 2022)". In order to prevent these factors related to heritage sensitivity from adding up to create heritage vulnerability, even in unexpected ways, more forward-thinking and systematic preventive linkage systems must be established to combine multiple potential impacts in order to maintain the dynamic balance. When new projects are added to the system, these models will offer early warnings, allowing managers to execute HIA in a timely manner to limit risks in the early stages.

6.2 Optimizing Management Tools

The use of more intelligent tools will make it easier to improve management tools like HIA and visual analysis. Due to the numerous influencing factors involved in the property itself and its wilder setting, the use of computer-aided tools can establish a digital analysis platform that accumulates more factors, and can also have the ability to continually accept and conduct thorough analysis of later-appearing relevant elements in order to assist with overall urban governance. The benefits of intelligent tool-assisted analysis for visual analysis are even more obvious because it can provide a lot of accurate calculations from different angles. It is especially useful in a location with complex mountain formations like the West Lake Heritage Area, where viewers will see 360 degrees as they wander around the crucial viewpoints and sight lines. Consequently, to assist with the HIA, it is necessary to develop an objective digital analysis platform that can quantify the visual space of the urban landscape by researching the city's landscape pattern with digital tools such as GIS, computer science, 3D laser scanning technology, graphics, Python, and so on. Combined with factors that may cause heritage sensitivity such as visibility, natural and urban environments, the comprehensive and accurate analysis results obtained can aid in multi-dimensional evaluation for projected actions, maintaining the balance of heritage protection, as well as maximizing the balance of interests of all stakeholders.

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Innovation, Adaptation and Reuse

5. Cultural Heritage Through the Lens of Urban Acupuncture: A Possible Roadmap for Expanding Heritage Practice Path[1]

Xinghan Lou[2]

Abstract

Urban acupuncture is an urban regeneration tactic proposed by the Spanish architect Manuel de Sola Morales. In recent years, this intervention, characterized by its low cost and high efficiency, has shown the possibility of being applied to new scenarios. As an element of the urban context, cultural heritage confronts the same sustainability challenges as urban development. By leveraging the power of cultural heritage to comprehensively address the relational conflicts in the space in which it is located, it has the potential to be an attempt to integrate cultural heritage into greater social issues. In this chapter, I will examine a possible pathway in which cultural heritage serves as an acupuncture spot to provide turning points in the trajectory of sustainable urban development. In the case of cultural heritage from an urban acupuncture perspective, the first concern to be explored is the justification that this new perspective engenders, which will include explaining how cultural heritage is morphing into a form of 'futurology' by being integrated into a wider discourse. This is followed by a discussion of how the acupuncture approach can be applied from merely urban design to the domain of heritage. Through these explorations, this chapter presents a new roadmap of heritage practice via which a multidimensional perspective is arising to tackle urban development issues that cannot be addressed with established technical frameworks and mechanisms.

Keywords

Cultural heritage, urban acupuncture, multidimensional, holistic

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1. Introduction: emerging trajectory for cultural heritage practice

Theoretical and practical explorations in recent years have propelled cultural heritage beyond a single and consistent definition to a search for diverse narratives, presentations, meanings, and values. In terms of conceptual frameworks, Gustafsson (Gustafsson, 2019), building on the Culture 3.0 theory introduced by Pier Luigi Sacco and his colleagues (2018), proposed that the development of heritage conservation can also be studied in three stages. After Conservation 1.0 and 2.0, which emphasize the preservation and restoration of historic sites while these practices produce no or only limited economic value, Conservation 3.0 moves beyond the concept of preservation to seek the next level of application strategies. In this new phase, the conservation and development of cultural heritage shifts to a sustainable perspective, to transform itself into an investment in the future and pursue a multidimensional exploration.

In heritage practice, new interpretations have emerged and are being refined by linking heritage to the construction of social responsibility. Examples include, but are not limited to, employing cultural heritage practices as a tool to enhance social justice (Kiddey, 2018), instead of merely existing as an object passively awaiting protection; or improving the quality of life in local communities by adopting cultural heritage as a model for regional development (Gustafsson & Ripp, 2022). These new interpretations often use cultural heritage as a mediator, a tool, or a system that is sandwiched between temporal and spatial senses, geared towards embedding it in a specific scene to realize the concrete value of heritage in the present. In parallel, several recent heritage-centered research initiatives are exploring cross-regional, cross-sectoral, and cross-disciplinary pathways of practice under the new concept of heritage. Heritage Hub and EU Horizon 2020, for instance, both seek to introduce cultural heritage as a springboard for innovation, underscoring the notion that cultural heritage is rooted in and for the real world.

All these reflections and endeavors have in fact pooled into a common denominator: the studies of cultural heritage are gradually pushing beyond the confines of pre-existing conceptions, both in terms of theory and in terms of practice. They have started a journey of discovery that is loaded with reflections on the present value and even the future value of cultural heritage, rather than simply maintaining the physical structure or the historical significance of the heritage itself.

According to some scholars, heritage should be actively incorporated into modern social and cultural life in order to be considered a living heritage rather than a dead object on display in a museum (Jones, 2017; Holtorf, 2018; Henderson, 2020). Community involvement, retrofitting, technological enablement, etc. are typical strategies for keeping heritage alive (Hambrecht & Rockman, 2017; Rudl *et al*., 2019). These practices capture real-life cultural demands and modernize the value of cultural heritage by integrating it into modern scenarios. Moreover, pathways for heritage to achieve social cohesion or to demonstrate contemporary values have also emerged in specific contextual cases, which have very skillfully facilitated the integration of cultural heritage with alternative domains. During the lockdown period caused by COVID-19, compared to its inherent qualities of beauty and history, etc., that were used for appreciation, it was the spiritual strength that heritage conveys more strongly to the public, which to a certain extent reveals the value of heritage concerning the mental health of the visitor (Sofaer *et al*., 2021).

Heritage practices that go beyond traditional paths as outlined above allow for a rough summary of the development of heritage studies. Today and in the foreseeable future, the practice of cultural heritage is poised to progressively move towards an open paradigm that will place new demands on interdisciplinary, imaginative, and multidimensional exploratory approaches. However, a realistic concern arises: while cultural heritage has evinced the ambition to be integrated into a larger vision, it remains challenging to achieve these macro goals within a specific context where the most fundamental living systems are included. And in terms of pathways involving fragmented stakeholders, there are open areas that are worth exploring in depth. I therefore propose to situate heritage within a more specific context and to consider the magic that heritage can exert. The purpose of this chapter is to put forward a potential strategy for bridging cultural heritage, urban transformation, and the broader social issues exemplified by climate change. Specifically, the chapter explores a methodological question: can the concept of urban acupuncture be mediated by cultural heritage to foster innovative solutions to urban transformation problems?

To clearly demonstrate how cultural heritage is linked to interdisciplinary issues and approaches, in the first half of this chapter, I will first introduce the concept of "futurology" in the field of heritage. This concept helps to theorize how heritage values can be flexibly scaled across time and disciplines to contribute to the evolution of societal visions, as exemplified by climate change and urban transformation. This will be followed by an analysis of acupuncture as a method of practice in the field of urban planning, which will be situated within the discourse of cultural heritage. The holistic and systemic thinking highlighted by this approach is instructive for modernizing the path of cultural heritage preservation.

In the second half of this chapter, possible routes for applying the acupuncture approach to cultural heritage scenarios will be discussed. Cultural heritage, as a category of public space in the urban environment, can itself be viewed as a point, a line of networks, or a scene for the implementation of acupuncture treatments. From mapping acupuncture spots to capturing the relationships between elements; from how individual points can be strung together to form a system, to how the publicness of an area can be shaped by the cultural potential of heritage – this is a multidimensional process, which encompasses many urban elements and considerations, will be explored in detail.

2. The futurology of cultural heritage

The change in conceptual theory and the increasing inclusiveness of conservation practices have opened up the possibility of reflecting on heritage more imaginatively, and such imagination is urgently needed to locate the future of heritage. It can be perceived that the studies on the "heritage future" based on the futuristic stance have mapped out some forward-looking ideas (Spennemann, 2023) These studies have, on the one hand, moved us generally beyond how history has made heritage what it is today, as the focus has shifted to how heritage can steer us toward molding the world of tomorrow (DeSilvey, 2017). On the other hand, the recent heritages, such as abandoned nuclear power plants (De Haan, 2013; Holland *et al*., 2023)suggest that heritage, placed in future contexts, is expected to be increasingly dynamic in its form and presence (Harrison *et al*., 2020)

Heritage researchers today show considerable flexibility in understanding the temporal dimension of cultural heritage and the cultural continuity associated with time. In the temporal dimension, it has been argued that heritage may be more valuable than history (Sandford, 2019). Compared to other traces of history, cultural heritage offers a consolidated perspective, a more veridical point of contact, where multiple ties between individuals, communities, and contexts can be fully established, and where novel life experiences can be gained. Such connections and experiences are potentially trans-temporal; and such comprehension, brought about by the temporal dimension of heritage, has been demonstrated in studies related to urban development. For example, to predict the possible path of urban transformation in the future, one can start by reviewing the history of a city from the perspective of its heritage. Studying heritages that perform different or even contradictory public functions – which may be religious versus secular, or cultural versus utilitarian – to see how the urban life model involved in these heritages has dealt with complex issues (Rudokas & Grazuleviciute-Vileniske, 2021). The observations gained may form a repository of experience in dealing with future problems. At this point, reading the previous cultural space-time allows for the writing of the future cultural space-time. The value of heritage, in this process, "lies in its ability to anticipate and create the future by revealing the presence of cultural singularities in a continuum of development" (Rudokas & Grazuleviciute-Vileniske, 2021).

Whilst the above temporal dimension of cultural heritage has become accepted among scholars, the scope of futuristic research in the heritage field has yet to be fully explored (Holtorf & Bolin, 2022). Beyond the theoretical re-emphasis, the impact the futuristic research will have on heritage practice remains to be mined. A recent thread reflected in the existing studies is that cultural heritage will no longer exist as an independent individual, but will be understood as a dynamic social process (Jones, 2017). It has the potential to be a chain in a social development strategy or a factor of production. It can also, of course, be an inclusive system, and time is merely one of the myriad variables in the system that, together with other elements, constitute the future of heritage. As Rodney Harrison (2015) suggests, in exploring and constructing models of heritage practice, we can "acknowledge the different future-making capacities of different heritage ontologies",

> "This might be undertaken with a view not only to enriching our understanding of the range of different ways of caring for and making the future, but also exploring areas where they overlap, which might form the focus for creatively collaborating across these different modes of heritage making to work toward shared, common heritage futures." (Harrison, 2015, p. 33-34)

Or, heritage can be fused with other variables and elements to give rise to new – and sometimes unexpected – visions of development, that is, a cross-disciplinary and interactive development.

The interaction between cultural heritage and climate is one of the manifestations of interdisciplinarity, and the link between the two has been verified to some extent by recent studies. In general, this nexus encompasses both the forced changes that climate change imposes on cultural heritage at both the material and immaterial levels, as well as the positive impact that the cultural power of cultural heritage has on climate mitigation. Heritage, for example, can be a transitional tool for achieving climate mitigation (Hambrecht & Rockman, 2017), a dynamic resource that provides resilience (Crowley *et al.*, 2022)delivers capacities, and exposes vulnerabilities, yet cultural heritage value and vulnerability are largely missing from conventional risk assessments. Risk assessments are a fundamental first step in identifying effective mechanisms for Climate Change Adaptation (CCA, or an engine for embracing change and reinventing the place meaning (Fresque-Baxter & Armitage, 2012; Henderson & Seekamp, 2018).

Recent works have justified the inclusion of climate change as a meta-challenge in the context of cultural heritage, and top-down action has taken the first steps. In certain cases, cultural heritage can inform decision-makers and policymakers in achieving climate change adaptation and mitigation (Fatorić & Egberts, 2020). Nevertheless, the potential of cultural heritage to address a vast array of social issues still needs to be supported by an emergent, multifaceted approach. This is because, in the case of cultural heritage issues related to climate change, top-down efforts led by cross-sectoral collaborations between governments, cultural institutions, and research institutes are more often seen than bottom-up initiatives. These efforts, which are temporarily challenging in terms of harnessing the collective energy of the various elements of the city, may still fall far short of the results expected from the climate vision.

Climate change is an example of how cultural heritage can be integrated into broader societal issues. Working at this interface, I will analyze how cultural heritage can practically morph into "a form of futurology" (Harrison, 2015) by engaging with transformation at a society-wide level through a methodology.

3. Acupuncture for mapping the extant world

In 1982, the Spanish architect Manuel de Solà-Morales first proposed urban acupuncture as a treatment option for Barcelona's urban renewal problems (De Solà-Morales, 2004). Borrowing from traditional Chinese medicine, he analogously viewed the existing urban fabric as a living body with flows and blockages, wounds and self-healing, pain and relief. In the traditional view of acupuncture, a healthy body depends on an energy cycle in which health and disease have certain patterns of transformation that need to be captured in a dynamic, holistic perspective. For example, acupuncture treatment of the forearm acupoints is claimed to have a beneficial effect on the relief of gastric disorders, while at the same time having a parallel healing effect on intercostal neuralgia. Similar to this therapeutic act, the acupuncture approach in urban design targets a specific pain point in the city, which will ultimately exert a positive impact on the entire organic system (Petrova *et al*., 2016). With the prick of a needle, the acupuncture approach has been demonstrated in numerous urban practices as a way to achieve maximum effectiveness through minimum intervention.

In his work *A Matter of Things*, De Solà-Meorales states his project acupuncture is "less concerned with the small, the minute or the delicate than with the strategic, the systemic and the interdependent" (De Solà-Morales, 2008, p. 24). This idea was concretely exemplified in the urban planning projects he conducted in Barcelona in the 1980s. He transformed and created, for example, hundreds of innovative urban public spaces in a short period, connecting these small-scale spaces into a network of accessible urban public spaces where a wide range of activities could then take place (Lerner & Margolis, 2014). The purpose of such efforts is to reshape the old city environment and thus revitalize the urban dynamic there.

Although concepts such as "systemic", "holistic" and "organic" can be found in other approaches to urban studies, the acupuncture approach seems to be the one that best incorporates a wide range of considerations when it comes to the integration of environmental, economic, social, cultural, and other elements, whether macro or micro. Urban metabolism is one of the most well-known approaches that makes similar claims as acupuncture. This approach applies the organism metaphor to the formation and development of cities, and it advocates the mimicking of organisms and natural ecosystems in the exploration of ecologically constructed paradigms (Ariyaningsih *et al*., 2023). The various zones or layouts in a city are analogous to different organs:

buildings are the bones of the body, and transport roads are the veins or arteries; wetlands and waters are comparable to the liver, kidneys, and lungs in the purifying roles they play; and the governmental system acts as the brain, issuing instructions on coordination, regulation and so on (Zhang, 2023). As with the acupuncture approach, the metabolism concept gives recognition to the linkages between the various ecological elements of the city and the dynamics that are interspersed within them. In urban metabolism practice, the ability of an urban area's social and economic activities to maintain a sustainable flow of resources within the larger context of urbanization and industrialization, however, is given greater priority than the cultural dimension, thus the latter has received less exposure during the development of the urban organism.

The first step in analyzing an acupuncture approach is to learn about the target context based on similarities to the organism, yet such similarities go beyond superficial metaphors of individual bodily functions. Figure 1 summarizes the parallels between the acupuncture approach in urban contexts and the medical acupuncture treatment pathway it draws on. The process of acupuncture practice necessitates recognizing both the complexity of the organism and the complexity of the urban. That is, drawing on the systemic concept of the organism, but at the same time retaining respect for individual characteristics in real spaces. We cannot, for example, empirically predict what narratives will play out in the "scenes" formed by "small-scale spaces" and "spatial networks". It is the living dynamics within the urban system, and the constantly renewed networking of its subsystems, that provide the impetus for the restructuring of the entire urban system.

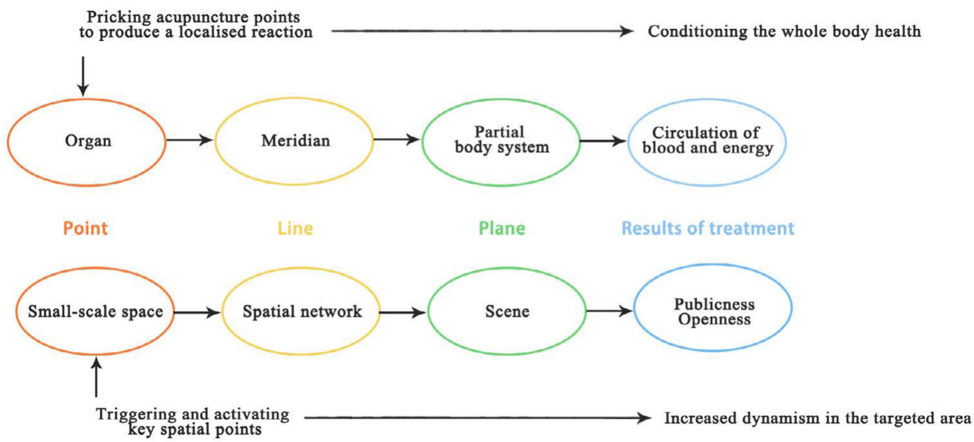

Figure 1. Structural hierarchy of medical acupuncture and urban acupuncture

A further key element in the concept of holistic nature conveyed by the acupuncture approach is publicness, which can also be interpreted as openness. The most common practice of acupuncture in the urban context, as seen in most cases, occurs often in public spaces such as underused plazas, deserted streets, and small-scale neighborhood parks. They are, however, according to Jane Jacobs (1961), the theatre of urban life and the most vibrant places. Here, the flow and exchange of experiences and stories is the key to rejuvenating the space. To achieve this, a multi-dimensional synergy of "points", "lines" and "planes" is inevitably required. I will expand on this in detail in the sixth section of this chapter, concerning the topic of cultural heritage.

The acupuncture approach applied to a diverse and complex urban context has given rise to some cross-cutting projects with transdisciplinary potential. In parallel with typical urban renewal themes, emerging projects are aimed at addressing regional environmental challenges. In Melbourne, the research unit Victorian Eco-Innovation Lab has launched Eco Acupuncture, an ecological intervention project to achieve a low-carbon future for the region (Ryan, 2013)transformative, change requiring the restructure of the most fundamental systems for urban living. But rapid structural change is hard to negotiate within existing communities. In Melbourne Australia, a research unit known as the Victorian Eco-Innovation Lab (VEIL. The acupuncture spots or intervention sites in this project are chosen in abandoned buildings, parks, and redundant infrastructure spaces. Several subsequent initiatives have attracted citizen attention, including the creation of a "food corridor" to connect two communities and their gardens, as well as food markets and community cooking facilities; the diversion of stormwater from the roof of a factory adjacent to the park to divert it into the park and create a series of small wetlands (Ryan, 2013) transformative, change requiring the restructure of the most fundamental systems for urban living. But rapid structural change is hard to negotiate within existing communities. In Melbourne Australia, a research unit known as the Victorian Eco-Innovation Lab (VEIL. This project ultimately turns the city's green vision into an intervening force that facilitates the rapid transformation of the current environment. Another recent example of urban ecological improvement is in Poland. To reduce urban heat zones and improve the comfort and quality of spaces, 27 green acupuncture sites were selected to apply interventions in areas where extensive greening was difficult. According to the researcher's design and filtering, these interventions included improving local water storage, developing green roofs, and green vertical walls, among others. These actions followed a bottom-up action plan, which involved urban facilities, street art, regional identity elements (e.g. visual messages), as well as potential beneficiaries and stakeholders in the community (Stangel, 2023).

The advancement of online interactive technologies and the widespread digital participation of the public in social life have expanded the operational space for the practice of acupuncture. Around 2015, the examination of digital elements, as well as the energy, interest, and knowledge they engender began to be incorporated into acupuncture projects (Houghton *et al*., 2015). Digital acupuncture is an example of the evolution of the acupuncture approach in an ever-changing research topic. The emergence of networked interaction has empowered the circulation between the physical and digital world, and to some extent has shaped human physical perception (Iaconesi & Persico, 2014). When it is tailored to an urban context, a new digital access and sharing-based urban ecosystem is born. Grounded in this idea, Iaconesi and Persico (2017) consider that human perceptions of digital information and knowledge flows in cities as needle points. By activating the information, narratives, and emotions within, they seek to motivate residents (and their expectations, tensions, conflicts, and agreements) to initiate actions to reform the communal living environment. In some other scenarios, urban acupuncture is possible to be mediated by a certain social media, where the role of acupuncture is usually a non-confrontational approach to contain negative influences rather than a direct approach to provide specific solutions. Within interaction design, for instance, and especially concerning observing the relationship between online and offline behavior, social media and its underlying design framework provide a testing venue where it is evident how a good design logic can counteract a community's disruptive interaction and its negative influence (Messeter, 2015).

The above examples verify that the acupuncture method, with the changing stages of urban construction, the metabolism of social focus, and the emergence of new urban elements, possesses in itself a certain inclusiveness that makes it potential to be adapted to varying specific research topics. Before exploring how it can be translated into the realm of cultural heritage, I would like to highlight a few of its key features. First, the principle that encourages minor reforms is grounded in a macro background interspersed with the limited budgets of municipal schemes and the conservative nature of landscape changes in urban neighborhoods. Second, many cases show that the acupuncture approach not only actively embraces bottom-up participatory actions, but also stimulates communicative interactions between diverse urban roles or elements. Similar to the uncertainty faced in the implementation of many qualitative methods, however, the interaction of elements arising in urban acupuncture programs is sometimes irregular, unexpected, and detached from the original design. Therefore, adopting a multidimensional mindset, rather than a linear one, to frame the entire design is crucial to the meaningful employment of the acupuncture approach. Finally, there are other uncertainties regarding the application of this approach, such as the lack of a standardized, systematic theory for identifying and resolving key pain points (Hemingway & De Castro Mazarro, 2022). And, considering the different realities of the implementation sites, the acupuncture approach also has filtering steps or localization modifications in the actual method design (Nassar, 2021).

4. Cultural heritage through the lens of acupuncture

Contemporary urban development research is facing a delicate problem: both the spatial and social sustainability of cities are encountering transformational challenges, while traditional technical frameworks and mechanisms are sluggish, if not inadequate, in perceiving new urban phenomena (Apostolou, 2015). A related observation is that, in recent years, some critical reflections on the urban transformer (which can be an architect, planner, or other role in a particular scenario) and on the principal position of architecture in the city have emerged in the discussion of urban planning and transformation. In the past, buildings played a central role in the urban organism, yet today, such a role has been lessened since "reality often forces architecture to a large modesty by adopting a different set of strategies" (Enia & Martella, 2019). As a result, the quest for alternative urban elements that might catalyze sustainable vision has commenced. Professional insights that are low-intervention and conducive to minor actions of the urban environment, along with urban transformers who have such insights, are gaining importance.

During this quest, urban acupuncture can be employed as a "metaphor" or a "heuristic" (Hemingway & De Castro Mazarro, 2022). Specifically in the context of cultural heritage, if we abstractly interpret the relationship between urban elements in the acupuncture approach as space and actor, then cultural heritage as an urban element may be either a space or an actor (Figure 2). In a certain urban organism that contains qualitative networks, cultural heritage as public space is an arena where the reconciliation, conflict, and compromise – between community and individual, obsolete development inertia, and nascent urban vision – are performed. And when cultural heritage (especially intangible cultural heritage) as an "actor" externalizes its cultural connotation into an expressive and appealing power, seeking an optimum "space" as a stage to promote its own sense of value, or binding together with the "space" to promote multiple values in a composite form, "space" then becomes a quarry providing inspiration.

Cultural heritage as a space or as an actor, in conjunction with acupuncture practice in the contexts described above scenarios, will drive problem-solving thinking from a linear view to a systemic or multi-dimensional one. According to acupuncture theory, there are 361 interconnected meridian spots throughout a human's body where acupuncture can be administered, and the effects of one prick are transmitted to all parts of the body in the form of dots and chains. In urban acupuncture with a cultural heritage theme, sometimes, a pinpoint implementation of acupuncture can lead to "broader cultural changes" (Lerner & Margolis, 2014).

Figure 2 depicts the process of generating energy circulation in the context of cultural heritage and acupuncture approach, and the resultant "broader cultural change". Therein, the urban elements and the cultural heritages are simultaneously visualized as systemic entities that assume the role of spaces and actors. Through interventions, they form minor and major energy circulations respectively within and between each other.

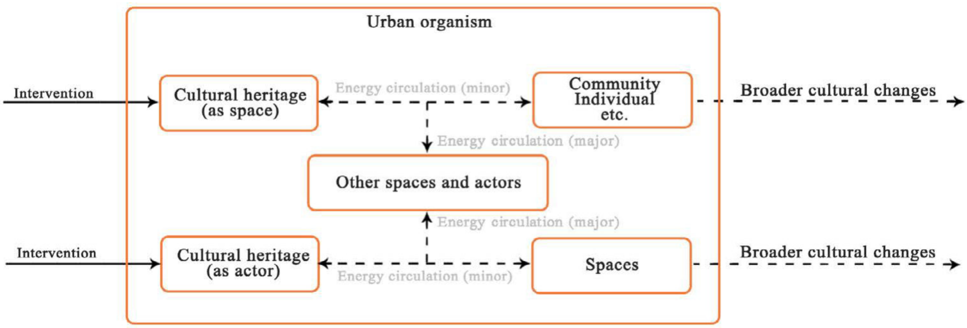

Figure 2. Energy circulations facilitated by the acupuncture approach in the context of cultural heritage

5. Therapeutic relations: reflecting the tangible and intangible

Although as in urban acupuncture, the location of the sensitive point is the start of the strategic treatment of the urban skin (De Solà-Morales, 2008), still, before focusing on points and needles, a pre-comprehension regarding the ills, the story, the terrain of the "patient" would be needed. Without this background, we are just treating symptoms.

Therapeutic relations are present throughout almost the entirety of the acupuncture action. Typical interventions in urban acupuncture usually proceed on two "visible" levels, physical and sensory: by observing conflicts in the circulation paths of objects in physical space, or by examining conflicts in the interaction between spatial users and space. Often, these conflicts imply therapeutic relations within the organism. Acupuncture spots, then, are decisions made after a comprehensive consideration of the macro- and micro-environmental elements of therapeutic relations; whilst specific interventions, either adding, removing, modifying, or enriching a space, are solutions designed to respond to conflicts in therapeutic relations. Significantly, the observation and resolution of conflicts are never parallel behaviors, as they are always situated within a holistic system of cultural heritage. In other words, both physical level and sensory level interventions are different options contained in a complete toolbox, which can be adopted individually or combined when necessary.

A number of cases reveal how therapeutic relations are seized and repaired at a visible level, and the experiences gained through which are applicable to acupuncture actions in the context of cultural heritage. Scenario creation, customization, and relocation is one example that combines physical level and sensory level interventions. Specifically, it is a practice of constructing or expanding scenarios in response to the relationship between a space and its users (Jaoude *et al.*, 2022), and resolving existing "illness" by invigorating new spatial usage and cognition. Such scenario planning also promotes a holistic mindset. This is because, from a temporal perspective, the process of scenario planning considers events and factors, past and present, and their interrelationships in order to understand their impact on future developments (Van der Heijden, 1996).

Conflicts observed from visible levels including physical and sensory ones, at the same time, precisely require a comprehensive understanding in conjunction with a temporal dimension. What we have seen is that this understanding tends to happen in the context of adaptation and transformation of tangible cultural heritage, typified by the revitalization or conversion of dilapidated churches.

Therapeutic relations, though, may also be traced from a non-physical and non-sensory perspective. To achieve this, I would imagine expanding the scope of the previous definition of urban acupuncture from a material to an immaterial context so as to attempt to propose an entry-level definition for the involvement of intangible cultural heritage (ICH) as a space or an actor in acupuncture initiatives. As the complexity of urban elements changes, the channels of circulation of urban energy are no longer limited to information and knowledge generated by nature or the human-built physical environment. Iaconesi and Persico (2017) collectively refer to all the new possible elements generated in the urban context as "Third Infoscape",

> "… the Third Infoscape would refer to the information and knowledge generated and exchanged through microhistory, through the progressive, emergent, and polyphonic sedimentation onto the city of the expressions of the daily lives of city-practitioners, through their spontaneous, unconscious, or conceptual performance of the city." (Iaconesi & Persico, 2017, p. 23)

Within this description, boundaries between "space" and "actor" are relatively blurred, as the cultural identities contained in these urban elements are allowed to adapt and negotiate within the Third Infoscape context. In the meantime, Third Infoscape paves the way for ICH, a mix of cultural perception, awareness, custom, and continuity, to serve as one side of the therapeutic relationship. Consequently, in the extant world, the location, mode, and channel of exchanging information may occur in an immaterial environment. This also indicates that a new form of urban acupuncture makes it possible to construct the progression of reality in such a manner on an occasion that is independent of physical space.

To further develop this practical pathway, a deeper therapeutic relationship and a more precisely fitted intervention toolkit need to be explored. This is because ICH in the context of acupuncture interventions – including intangible elements of cultural heritage, emerging digital cultural heritage, and digital representations of cultural heritage enabled by technologies – facilitates the flow of unseen energy outside of physical space. To a certain extent, ICH provides a virtual "space" for the public, which can be digital, memorial, and spiritual. There, the locus for capturing blockages and conflicts shifts to reflections such as perceptions, attitudes, and emotions. The purpose of acupuncture extends from improving environmental conditions and the public space's function to facilitating a cognitive shift of stakeholders. This level of effectiveness is precisely linked to maintaining the sustainable dynamic of ICH – only through constant interaction with people can ICH effectively survive in the context of a constantly changing society. This therapeutic relationship, which exists between stakeholders and ICH, contributes to the understanding of how cultural heritage can be preserved alive in the urban transformation setting, and at the same time highlights the potential of the acupuncture approach in realizing various types of visions in urban transformation.

6. Reconstructing publicness after acupuncture

How can we ensure that the effects of the interventions reach the widest possible range of the region and, in tandem with the public cultural values embedded in the cultural heritage, produce a publicness that can extend invisibly to a deeper social sphere? This is a fundamental question facing the acupuncture initiative for cultural heritage. Most likely, the answer is inclusive and critical as well, as the construction of publicness is a multidimensional process that cannot realistically be expected to have a one-fits-all trajectory from vision to outcome.

What needs to be done first is to structure a theoretical framework that encompasses the data and information on the various urban elements related to cultural heritage. It is possible to erect a complex system of correlations that provides a multidimensional understanding of the efficacy of an intervention: how its effects are manifested and where they are delivered; whether there are other factors that enhance or weaken its delivery; what kind of correlations it creates among elements such as stakeholders, time, space, events, and behaviors; whether these correlations share the same theme; and what meaning it will continue to engender. These points of reflection are not connected by a cascading, linear relationship; they are almost always interrelated and entail efforts to depart from the defined cultural heritage trajectories in order to reconfigure new ones.

Since it does not adhere to a linear mentality, the framework is probably not enclosed. Thereby it will allow for both entry and exit mechanisms. On the one hand, room is always reserved for the occurrence of new correlations. Whereas on the other hand, one must always be open to compromise on lapsed correlations. There are even moments when the emergence and demise of correlations conflict, as certain cultural heritage issues (such as future-oriented conservation) may remain thought of inconclusive, with room for democratic discussion.

The more malleable part is that the urban environment in which cultural heritage is situated is itself a non-enclosed scene in which an ecosystem of relationships is, from time to time, being constructed, evolved, and dissolved. Cities, as described by Kevin Lynch (2008) in his book The Image of the City, can be envisioned as complex time-based media. Using macroscopic imagery, he compares urban space to a symphony composed of millions of people simultaneously acting, moving, interpreting, perceiving, and transforming the surroundings around them: an enormous, fluid, instantaneously, jarring and randomly harmonic piece of time-based art with millions of authors who are constantly changing. This also gives a hint that a macro ecosystem of relationships appears less straightforward and obtainable, but that the old and new turnover surrounding it is easily discernible.

Nevertheless, extracting the relevance of fragmented events may still be an actionable way to complement this publicness-themed puzzle. Citizen feedback enables cities to function, resulting in a self-sustaining mechanism (Bracken, 2019, p. 11), Episodic aspects of human activity can therefore assist in capturing the sporadic clues that promote publicness, which can then be integrated to produce a shared theme. Examples include the knowledge and narratives generated by residents in their everyday interactions, as well as the private perceptions generated by visitors during their visit or participation. It's just that, sometimes, these subtle pieces of information must be seized in the public digital space, where they inconspicuously weave an ecosystem of relationships for cultural heritage in the invisible urban scene.

7. Conclusion

By investigating the new concept of heritage and its new social role, this chapter proposes a systematic perspective, or rather an implementable approach, to scrutinize the intrinsic dynamics of cultural heritage in the context of urban development. Specifically, it introduces the concept of acupuncture as a complement, or an imaginable research approach, to the premise that cultural heritage exists in a systematic form. This new perspective simultaneously considers the means to leverage as many beneficial outcomes with as few interventions as feasible. Moreover, it is more likely to be blended with the complexities of real life, facilitating future social or cultural policies to be better designed and rooted in real-world experiences.

Before discussing specific acupuncture strategies, I first clarified from a conceptual level by asking why cultural heritage can be used as an acupuncture spot. This entails investigating how heritage is morphing into a form of 'futurology' through its integration into a broader discourse, and how it is facilitating future-oriented collaborative solutions. Climate change is a plausible example, as one that is both being merged into the context of cultural heritage conservation considerations and is intimately linked to a sustainable development vision of urban transformation.

It is also explored that the role of cultural heritage in urban acupuncture can be positioned as either a "space" or an "actor". This flexibility is granted by the tangible and intangible nature of cultural heritage. In addition, an acupuncture strategy based on the theme of cultural heritage, considering the power of cultural heritage in shaping identity and transmitting cultural values, will also construct a "publicness". To capture, manage, and synthesize the threads of publicness – which are sometimes sporadic and sometimes ephemeral – a framework is suggested that encompasses the data and information on the various systematic elements related to cultural heritage.

The future path of this acupuncture exploration will be to generate a refined theoretical framework. Key indicators in the ecosystem of relationship towards cultural heritage will be extracted as details of the framework to be applied to the practice within a specific scenario. The ecosystem of relationship that cultural heritage weaves in the urban context can be observed through the entanglements, discrepancies, and tensions that emerge when heritage flows in the physical and virtual scenarios. These scenarios may include decision-making, public involvement, digital practices, and innovative conservation, among others. It is also possible to arrive at a practical and concrete proposal for urban acupuncture based on the indicators in this framework.

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6. Adaptive Reuse of Industrial Heritage in the era of Radical Climate Change Related Urban Transitions

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Abstract

The adaptive reuse of industrial heritage, a critical component in addressing radical climate change-related urban transitions, is increasingly pertinent. This paper distinguishes 'urban transitions' from 'urban transformation,' emphasizing a more gradual, adaptive approach to urban development under the pressures of climate change. It explores the repurposing of industrial buildings and spaces, maintaining their cultural and historical value while meeting current urban needs. Through a mixed-methods approach, the paper analyses how adaptive reuse contributes to sustainable urban development, examines the scale and impact of such projects from local quarters to city-wide implications, and discusses the potential negative consequences, including gentrification. The study spans various global regions, including Europe, the United States, Latin America, Canada, and Australia, using case studies to illustrate the effectiveness of adaptive reuse in promoting sustainability, revitalizing urban areas, and preserving cultural heritage. The paper questions the viability of traditional long-term sustainable urban development strategies in the face of rapid environmental and societal changes, suggesting a potential need for paradigm shifts in urban planning.

Keywords

Adaptive Reuse; Industrial Heritage; Climate Change; Radical Urban Transitions

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1. Introduction

The adaptive reuse of industrial heritage, as explored in the case studies from my studio course, highlights its vital role in fostering sustainable and resilient urban development across various regions. These cases illustrate the transformative potential of adaptive reuse in different contexts: In Europe, the conversion of abandoned factories into mixed-use developments in Germany and the UK exemplifies how industrial spaces can be repurposed to serve contemporary urban needs while preserving cultural and historical values (Salama, 2015). Similarly, in the United States, the transformation of a disused industrial site into a public park in New York City demonstrates the creation of valuable urban green spaces (McPeek & Morthland, 2010). In Latin America, the conversion of an industrial building into a cultural center in Mexico City shows the adaptability of industrial heritage for community and artistic purposes. In Canada, repurposing an abandoned factory into a residential complex in Toronto addresses urban sprawl and housing issues. Finally, in Australia, the transformation of an industrial site in Melbourne into a community park highlights the role of green spaces in enhancing urban sustainability.

The backdrop of these adaptive reuse projects is set against the historical context of deindustrialization and decarbonization, where 'industrial heritage' has emerged as a key focus within heritage studies. To effectively implement preservation and adaptive reuse methods, it is crucial to classify 'industrial heritage' into distinct categories, considering factors such as the existing infrastructure, extensions, semi-open areas, and urban platforms (Mehan & Stuckemeyer 2023 a; 2023b). UNESCO's inclusion of various industrial legacies in its World Heritage List underscores the growing recognition of these sites' cultural and historical significance (Mehan & Casey, 2023; Mehan & Abdul Razak, 2022).

The studio projects align with the United Nations' Sustainable Development Goals (SDGs), yet they also strive to address local community needs and specific demands beyond these global objectives (Kincaid, 2002; Mehan & Mostafavi, 2023; 2022). Focusing on industries such as Natural Resources, automotive, technology, and textiles, these projects span diverse geographical locations, including North America, Latin America, Canada, Australia, and Asia. Each project targets either an abandoned or malfunctioning industrial site, proposing adaptive reuse strategies to revitalize post-industrial landscapes.

2. Methodology

This chapter addresses the socio-political and spatial-cultural challenges faced by post-industrial cities during deindustrialization, decarbonization, energy transition, and rapid technological innovation. Drawing from the 'Adaptive Reuse of Industrial Heritage' studio course at Texas Tech University, the research utilizes a multifaceted methodology that intertwines critical, historical, spatial, and analytical dimensions. This approach, highlighted in Qureshi (2020), is problem-oriented, aiming to evaluate and influence policies that foster new urban identities through adaptive reuse, aligning with sustainable local development objectives and the protection of industrial legacies (Mehan 2024; 2023a; 2023b).

The methodology integrates architectural, urban planning, and environmental sustainability perspectives, providing a comprehensive understanding of the impacts of adaptive reuse projects. It involves a comparative analysis of international case studies, highlighting the varied applications and outcomes of adaptive reuse in different urban contexts. This approach assesses the broader implications of these projects on city-wide development, infrastructure, and policy, ensuring alignment with sustainable urban development goals. Furthermore, the study engages local communities, planners, and policymakers, ensuring that adaptive reuse strategies are contextually relevant and socially equitable. The temporal aspect is also considered, examining the longevity and adaptability of these projects over time in response to changing urban needs. Additionally, the study critically assesses current urban development paradigms, especially considering rapid environmental and societal changes, advocating for more flexible and responsive urban planning strategies. This comprehensive approach aims to advance the understanding and application of adaptive reuse in creating sustainable and resilient urban environments.

3. Urbanism and Post-Industrial Transformation

The transition from industrial to post-industrial societies has profoundly impacted worldwide urban landscapes and social dynamics. In the study of landscape transformations in post-industrial cities, scholars have identified several key factors that shape the evolving post-industrial cityscapes. For instance, Pytel et al. (2021) provided a comprehensive analysis of post-modern urban areas by considering the localization trends in post-industrial economic activity and the development of new city management strategies, based on land use patterns, urban morphology, and density. In addition, the researcher emphasized the importance of new city management strategies in shaping post-industrial cityscapes. These strategies often prioritize sustainability, livability, and inclusivity, leading to the implementation of policies that promote public transportation, green spaces, affordable housing, and the revitalization of underused or abandoned areas (Mehan 2020; Pytel et al. 2021).

The decline of traditional manufacturing and heavy industries has led to a rise in knowledge-based economies, service sectors, and technological innovation (Mehan et al., 2023). In addition, the progressive transformation of the prevailing land use model has shifted towards the creation of 'selective territorial concentrations' (clustering) of new urban economic activities (Smith et al., 2018). This change reflects a strategic approach to urban development, where cities foster synergies and collaboration among businesses, institutions, and communities within specific sectors or industries (Berens, 2020; Mavratzas, 2008; Hudson, 1994). Clustering can enhance urban innovation, productivity, and competitiveness by promoting knowledge sharing, resource pooling, and establishing specialized infrastructure and services. This new model aims to drive sustainable economic growth while preserving and enhancing the unique qualities of urban spaces (Palermo & Ponzini, 2018).

This shift has transformed how cities are structured and influenced various aspects of urbanism, including land use, built environment, socio-economic patterns, and cultural practices. Holgersen and Hult (2021)'s research on Malmö's transformation from an industrial city to a post-industrial hub mirrors the shift seen in many European cities, driven by globalization, economic changes, and technological advances (Holgersen & Hult, 2021). This transition from a Fordist-Keynesian to a post-Fordist/neoliberal foundation has prompted a focus on tourism, culture, knowledge-based industries, and efforts to attract wealthy taxpayers (Meneses & Prats, 2018). While this has allowed cities like Malmö to diversify and become more resilient, it has also led to rising inequality, social polarization, and gentrification. Thus, cities need to develop inclusive strategies that ensure the benefits of this transformation are shared equitably among all residents (Holgersen & Hult 2021). One of the most visible impacts of post-industrial transformation is the physical change in urban landscapes. As industries decline or relocate, vast land areas previously occupied by factories, warehouses, and related infrastructure become vacant or need more utilization (Douet, 2018). This creates urban redevelopment and regeneration opportunities as cities seek to repurpose these spaces for new uses. Post-industrial urban landscapes have often shifted towards mixed-use development, incorporating residential, commercial, and recreational spaces (Storm, 2019; Stead, 2016). This usually includes creating new public spaces, such as parks, waterfront promenades, and cultural institutions, which reconnect communities with their urban environment and foster a sense of place (Haupt et al., 2022; Overmann et al., 2016).

4. Adaptive Reuse and Sustainable Development Goals (SDGs)

Adaptive reuse, as a strategy, focuses on repurposing existing buildings and infrastructure for new uses instead of constructing new buildings (Conejos, Langston, & Smith, 2011). This approach has been recognized for its potential to significantly contribute to achieving Sustainable Development Goals (SDGs) by fostering sustainable development, economic growth, and environmental protection (Chusid, 2013). It is important to highlight that adaptive reuse has the potential to be a powerful tool in achieving the SDGs, advancing sustainable development, economic growth, and environmental protection. Some keyways adaptive reuse can support the SDGs include:

SDG (Sustainable Development Goals) 11: Sustainable cities and communities: Adaptive reuse can facilitate the development of sustainable, livable cities by preserving historic buildings and landmarks, mitigating the environmental impact of construction, and promoting the efficient use of existing infrastructure (Bullen & Love, 2010).
SDG 8: Decent work and economic growth: By creating new job opportunities in the construction, restoration, and operation of repurposed buildings, adaptive reuse can stimulate economic growth (Douglas, 2006).
SDG 9: Industry, innovation, and infrastructure: Adaptive reuse can contribute to sustainable infrastructure development by encouraging the efficient use of existing resources and minimizing the need for new construction (Langston, Wong, & Hui, 2008).
SDG 12: Responsible consumption and production: Supporting responsible consumption and production, adaptive reuse can reduce waste and encourage the reuse of existing resources (Yung & Chan, 2012).

SDG 13: Climate action: Adaptive reuse can help combat climate change by lowering the carbon footprint of new construction, preserving existing green spaces, and endorsing energy-efficient building practices (Mısırlısoy & Günçe, 2016).

5. Heritage Values and Meanings in the Post-Industrial Context

This section will discuss the role of values and meanings in adaptive reuse strategies, highlighting the importance of considering local contexts and cultural significance in shaping post-industrial urbanscapes (Adams & Larkham, 2016; Bianchi & Parkinson, 1993).

Heritage values and meanings in the post-industrial context relate to the significance and interpretation of former industrial sites, buildings, and artefacts, often viewed as symbols of a bygone era. The transformation from industrial to post-industrial societies has led to the decline of many traditional industries and the closure of numerous factories and industrial facilities. This shift has created a need to reinterpret and repurpose these spaces while preserving their historical and cultural significance (Castells 2010; Montella, 2009).

In the post-industrial context, heritage values and meanings can manifest in various forms such as historical significance, architectural value, cultural memory, and social and community values (Foster & Curtis, 2020; Valdpaus, 2018; Smith et al, 2018). Many former industrial sites hold immense historical value, representing the period of industrialization and its impact on society, economy, and urban development, while their unique architectural features can be creatively utilized in adaptive reuse projects. These sites also serve as symbols of cultural memory for communities once heavily dependent on these industries, and by preserving and repurposing them, communities maintain a connection to their past while adapting to new economic realities (Mehan et al., 2022). Many scholars have been argued that post-industrial sites have the potential to become vibrant public spaces that foster social interaction and community engagement through cultural, recreational, and educational facilities, strengthening communities and promoting social cohesion (Kozlowski et al., 2020; Khasraghi & Mehan 2023; Roberts & Sykes, 2019).

6. Radical Transitions and the Changing Structure of Post-Industrial Urbanscapes

The structure of post-industrial cities has undergone radical transformations due to industrial revolutions, energy transitions, and rapid technological innovations. These abrupt changes have altered how buildings and cities function over time. In this section, we will examine the implications of these shifts on urban spaces and their social, political, and cultural contexts (Mehan, 2022; 2015). We will focus on the challenges and opportunities arising from these radical transitions. Radical transitions signify significant shifts in societal, economic, and technological paradigms that profoundly impact urban landscapes. The transition from industrial to post-industrial societies has led to substantial changes in the structure of urban environments. Post-industrial urbanscapes are characterized by the decline of traditional manufacturing and the rise of knowledge-based industries such as technology, finance, and creative sectors (Kabisch et al., 2017; Bonino & Pieri, 2015).

Deindustrialization has left abandoned industrial facilities, known as brownfield sites, in urban areas. These sites require remediation due to environmental contamination and present opportunities for redevelopment, such as adaptive reuse, green spaces, or mixed-use development. Post-industrial cities often experience gentrification as former industrial areas become attractive to investors and middle- to upper-class residents. This can lead to the displacement of lower-income communities and increased social polarization as neighborhoods become increasingly stratified by income and social status (Graham & Marvin, 2001; Jacobs, 1961). Post-industrial cities have seen the emergence of innovation districts, where knowledge-based industries, research institutions, and creative enterprises cluster together. These districts are characterized by mixed-use development, vibrant public spaces, and a focus on sustainability and walkability. The decline of traditional industries has prompted many cities to focus on urban regeneration and revitalization efforts to improve residents' quality of life and attract new businesses. This can include redeveloping brownfield sites, investing in public infrastructure, and creating cultural and recreational amenities (Zukin, 1995; Harvey, 1989).

In this sense, Post-industrial urbanscapes often prioritize sustainability and resilience, incorporating green infrastructure, energy-efficient technologies, and climate-adaptive design in new developments (Misirlisoy & Gunce, 2016). This shift recognizes the need for cities to mitigate and adapt to climate change's impacts while promoting a more sustainable urban environment. Radical transitions have led to significant changes in the structure of post-industrial urbanscapes, presenting challenges and opportunities for urban planners, policymakers, and communities. Embracing these changes while addressing social polarization and environmental degradation is crucial for creating inclusive, sustainable, and resilient urban environments in the post-industrial era.

7. Resilient Post-Industrial Cities: Navigating Energy Transitions and Climate Challenges

The territory's energy and social construction are closely intertwined with the radical transitions and changes in post-industrial urbanscapes. At the same time, the territory's social construction involves society's collective efforts to shape and adapt urban environments to new realities. Both these concepts play a crucial role in addressing the challenge of climate change and transforming metropolitan areas (Bulkeley & Castán Broto, 2013; Graham et al., 2000).

To achieve sustainable development, post-industrial cities need to adopt several strategies (Robiglio, 2017). Decarbonization and renewable energy are essential to reducing greenhouse gas emissions and mitigating the impacts of climate change. Energy-efficient urban design can help manage and distribute energy more efficiently. Adaptive and resilient infrastructure can protect against extreme weather events, and urban green spaces can reduce urban heat island effects (Luederitz et al, 2016; Hospers, 2002). However, social equity and environmental justice must be addressed to create inclusive and sustainable urban environments (Navrud & Ready, 2009). This involves ensuring all communities have access to resources and opportunities to adapt to climate change. Participatory planning and decision-making processes are crucial to building a shared understanding of the challenges and opportunities of the energy transition and creating a collective vision for a sustainable and resilient urban future (Landorf, 2018; Romero-Lankao & Dodman, 2011).

It is essential to highlight that the territory's energy transition and social construction are integral to transforming post-industrial urbanscapes in the face of climate change (Wu et al., 2022). By incorporating sustainable energy sources, energy-efficient design, adaptive infrastructure, social equity, and participatory planning, cities can rise to the challenge of climate change and create more inclusive, resilient, and sustainable urban environments for future generations (Swyngedouw, 2010; Hakuta & Ben-Joseph, 2017; Stead, 2016).

8. Case Studies: Adaptive Reuse of Industrial Heritage in a Transnational Perspective

With a comparative approach and through a transnational perspective, projects in this studio identify and study urban-rural buildings, infrastructures, sites, and contexts that can be categorized as industrial heritage. Projects may consider the sustainable development goals of the United Nations, known as SDGs, as an overarching framework but still may go beyond these goals to engage with local communities and serve context-specific demands. This section will present selected case studies from different locations in North America, Latin America, Canada, Australia, and Asia, showcasing innovative adaptive reuse frameworks and design strategies that revitalize post-industrial urbanscapes.

At the beginning of the studio, students researched abandoned structures and explored industrial heritage. They were asked to pick one industrial heritage structure and explore the design, construction, usage, and eventual collapse or desertion of the building. From these selections and research, students were clustered thematically in the same industrial heritage groups according to their respective structure's history, consisting of the automotive (auto and railway), technology, natural resources (oil and water), and textile heritage groups. The formation of these groups allowed students to collaborate on their research, designs, and presentations. In each group, they shared mappings, historical significance, and heritage specific elements between their peers culminating in a greater understanding and appreciation of the selected heritage focus. Presenting together, these groups shared class wide and received feedback from classmates sorted into a different heritage group, generating a broad understanding of industrial heritage and adaptive reuse. The deliverables at the conclusion of this stage consisted of a poster from each student that examined the site and surrounding region, cultural and historical factors related to the structure, and images of the adaptive reuse building in its current, unrenovated state. The peer learning and collaborative aspects of the studio allowed for similar explorations into distinct and disparate site conditions, allowing each student to learn and develop their designs without being isolated by the varied industrial heritage, considerations, and project specific needs.

Figure 0: Peer Learning and Correlation Between Heritage Groups,
Figure 0a: Lapham Woolen Mill – Millbury, Massachusetts (Wall 2022),
Figure 0b: Kiddie Kloss Factory – Lansford, Pennsylvania (DeGrande 2022),
Figure 0c: Suyeong Factory – Busan, South Korea (Chung 2022).

The class wide exploration and collaborative design research culminated in a second set of groups that each focused on specific needs and improvements that can be made to communities located in or near to a postindustrial urbanscape. Each group set out to fill a niche within their respective community and provide infrastructure through adaptive reuse that would increase the quality of living, the built environment, and community cohesion. These groups, referred to as ARD (Adaptive Reuse Design) groupings, spanned adaptive reuse proposals pertaining to outreach, community, shelter, recreation, knowledge, and education. Each group contained 2-3 students and were instructed to research, collaborate, and ultimately present their designs together to highlight the potential of their adaptive reuse focus across several cities, cultures, and design restrictions. The ARD group began to show adaptive reuse on a macro-scale as the students learned and developed in varying considerations while sharing an overall purpose, respecting the larger idea of communities, industrial heritage, and the sustainable development goals. To a more limited extent, the individual case studies integrated their reconceptualization of industrial heritage and adaptive reuse and sought out to design for the micro-scale, respecting the community members, cultural significance and history, and necessities unique to the selected area.

The first group formed dealt with outreach to the respective communities, addressing a direct problem and attending to the people. These designs are highly site specific and rely on existing features in the structures that are proposed to be used in new and more beneficial ways.

The designs include the adaptive reuse of the Richmond Power Plant to a hydroponic greenhouse that will combat food insecurity in the Port Richmond area of Philadelphia, Pennsylvania. This greenhouse aims to reduce pollution in the area, create a community hub for occupants to enjoy nature and learn about hydroponics and industrial heritage and to provide accessible and nutritious produce to all residents (See Figure 1a). As another design of the outreach group, this adaptive reuse will renovate the F1963 wire factory in the Suyeong-Dong district of Busan, Korea. The wire factory is proposed to be developed as a community center with vital support systems, including a mental health clinic, physical health clinic, and childcare services to improve the quality of life for residents in a highly suicide and mental health crisis prone location (See Figure 1b). The final design proposes a solution to rehabilitate the infrastructure and surrounding areas of the American Diversion Gated Dam in El Paso, Texas, rejuvenating the site and benefitting the nearby New Smellertown with potable water, flood management, and a potential community gathering area (See Figure 1c).

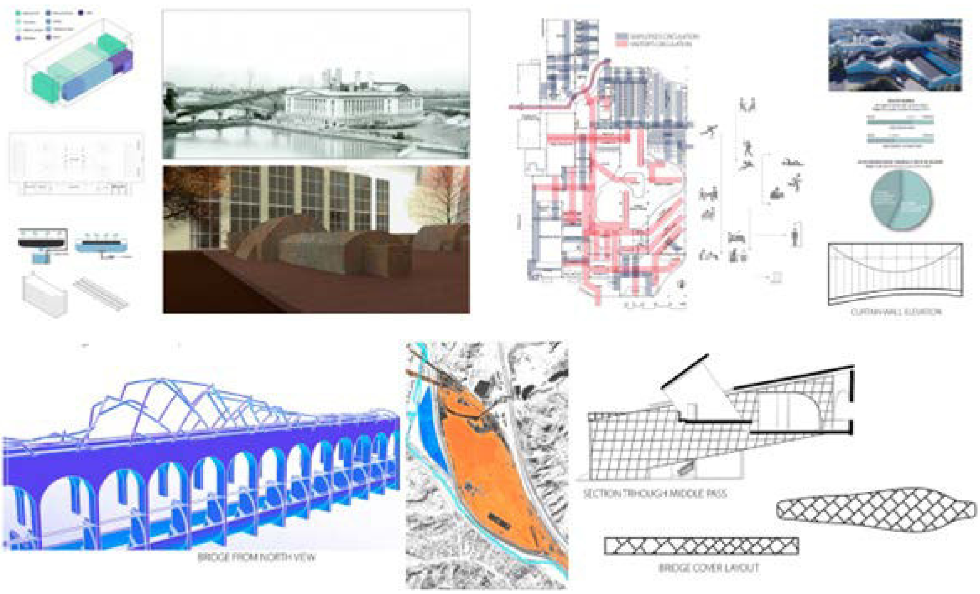

Figure 1: Outreach ARD Group,
1a. Richmond Power Plant – Philadelphia, Pennsylvania (Stuckemeyer 2022),
1b: Suyeong Factory – Busan, South Korea (Chung 2022),
1c: New Smelltertown – El Paso Texas (Arturo-Villegas 2022)

The second group was clustered together as community-based, focusing on implementing support systems and attracting local people to inhabit the space for the area's betterment. This group differs from the outreach ARD group through the wider attention to the community, focusing on infrastructure that benefits the identity and cohesion of the people rather than on a specific lacking factor of the area.

Designs from the community ARD group include the renovation of Maestranza San Bernardo, a historic train station located in San Bernardo, Chile. The adaptive reuse of this structure proposed a celebratory space to uphold cultural values and create a space for community members to bond with their respective identities and people This was inspired by the requests of Chilean residents who felt they were losing opportunities to embrace their culture (See Figure 2a). The next design addresses the community through transforming the Ford Geelong factory, a large-scale relic of Ford's automotive industry, in Geelong, Australia into a multipurpose adaptable design. This proposal forms a structure that can be used for any range of community needs, from simple gatherings to crisis where the building could, for example, provide space for vaccination and testing sites or other short term medical necessities (See Figure 2b). For the final project in this group, the adaptive reuse was focused on overhauling the Linseed Oil factory in Toronto, Canada, which features a large, unused site surrounded by an emerging neighborhood with many young families. Efforts had already been made by residents of the area through the construction of a park and outdoor gathering space, so the design became focused on creating a community center with a gymnasium, pool, and lounge that can be occupied throughout the cold season (See Figure 2c).

Figure 2: Community ARD Group,
2a. Ex Maestranza - San Bernardo (Medina 2022),
2b: Ford Motor Company – Geelong, Australia (Johnson 2022),
2c: Linseed Oil Factory – Toronto, Canada (Gomez 2022)

The following groups, groups three and four, contained projects with similar effects on the community, providing practical necessities such as housing or the creation of entertainment and leisure opportunities. Overall, these two groups, divided into the shelter ARD group and the recreation ARD group, were designed with the intent to generate reliable and compelling spaces that people would inhabit in their everyday lives. These groups are unique across the class as the adaptive reuse inspiration was much more generalized, necessitating designs that mandated the consideration of long-term occupancy and frequent usage across a wide range of community members.

The first design from the shelter ARD group proposes the adaptive reuse of Lapham Woolen mill, a historic building that is the largest and most preserved structure in this region that was erected during the industrial revolution, located in Millbury, Massachusetts. The town lacks accessible housing to bring in a new talent pool and a newer generation of workers, and as proposed by the Millbury planning committee, the historic mills across the region will be adaptively reused for mixed-used housing (See Figure 3a). With a similar goal, the second design of this group intends to address rising numbers of homeless youths and students in Mesa, Arizona by repurposing the F.P Nielson Grain Elevator. As a relic from the industrial heritage of cotton, the grain elevator boasts enough space to accommodate a 10-story building and is close to public transportation of the industrial, residential, and commercial areas of Mesa. The design proposes varied housing options, from single occupancies to family-scale occupancies, and addresses environmental concerns in the area with an occupiable green façade to mitigate heat gain and filter fine dust storms (See Figure 3b). Regarding the recreation ARD group, the first design proposes utilizing the TXU North Power Plant in Fort Worth, Texas to create a restaurant and bar for nearby residents. The power plant is located closely to Tarrant County Community College and downtown Fort Worth and strives to create a sustainable and appealing location for these differing groups of occupants. The design heavily utilizes the nearby river and redirects the water flow to include a watermill that will generate renewable energy for the restaurant and additionally, remind occupants of the industrial power plant heritage that allowed for this renovation to occur (See Figure 4a). The second design in the group focuses on creating a multi-use recreation space for residents in McKinney, Texas through the adaptive reuse of the historic McKinney Cotton Mill. The proposal takes advantage of the large square footage and history of the mill being used for weddings and events and offers additional amenities such as a wedding reception area, rooftop patio, restaurant, and entertainment such as a bowling alley and an arcade. Careful attention to materiality was a key design consideration and the final product intends to complement the original structure while bringing modern forms and activities in to fit the current demographic of McKinney (See Figure 4b).

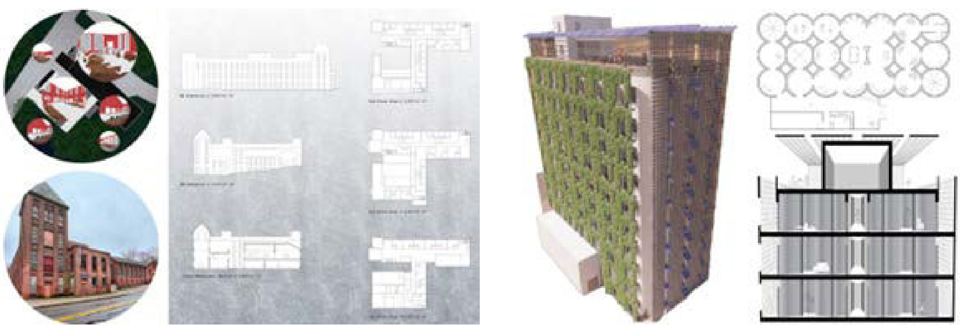

Figure 3: Shelter ARD Group,
3a. Lapham Woolen Mill – Millbury, Massachusetts (Wall 2022),
3b: F.P Nielson and Sons Grain Elevator – Mesa, Arizona (Mccune 2022)

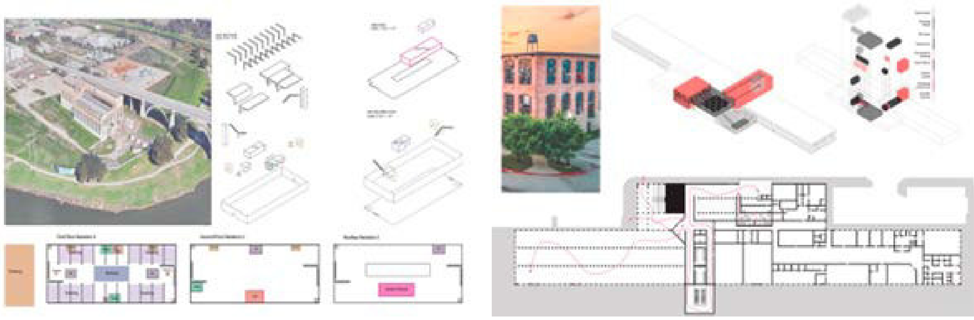

Figure 4: Recreation ARD Group,
4a. TXU North Power Plant – Fort Worth, Texas (Lopez 2022),
4b. McKinney Cotton Mill – McKinney, Texas (Hanson 2022)

The fifth ARD group, knowledge, was concerned with addressing the community through information sharing and rethinking known topics, providing education, and prompting the community to learn. Unlike many designs in this class, the knowledge group did not intend to solve a problem or supplement the community, but instead focused on providing unique opportunities and experiences in the form of museums.

The first adaptive reuse proposal in the fifth ARD group sought to transform Fort Tilden in Queens, New York into a military history museum that allows visitors to explore the historic site. The fort sprawls across the coast of New York and has been dedicated as a National Recreation Area for citizens to embrace the military history, but as it is partially abandoned, covered in graffiti, and overgrown, the adaptive reuse proposal aims to rehabilitate these neglected spaces. The new program includes outdoor areas to appreciate the scenic coastal views, gathering spaces and collections of the military artifacts left behind, and access to the structures that once held artillery and ammunition. Delicate changes and renovations are a key consideration in this design to bolster the existing infrastructure and restore the area to a point that reflects the history of American militarism and allow visitors to increase their knowledge in a safe and accessible space (See Figure 5a). The following design takes a different approach, generating a new type of museum and a unique way to understand varying movement types and learning styles, overall proposing knowledge that is not solely based on history. This project explores the adaptive reuse of the Ford Piquette Factory, a notable example of automotive heritage, located in Detroit, Michigan. The existing factory features a multi-story structure with large vehicle bays lining the bottom floor and apertures in the levels above, granting the opportunity to design a structure that utilizes sub-levels and irregular heights across the multitude of proposed spaces. As occupants move throughout the building, they will be able to increase their awareness of learning styles such as auditory, visual, and tactile, while learning about movement styles in real time, either taking a meandering, non-linear path or opting to travel directly throughout the design (See Figure 5b).

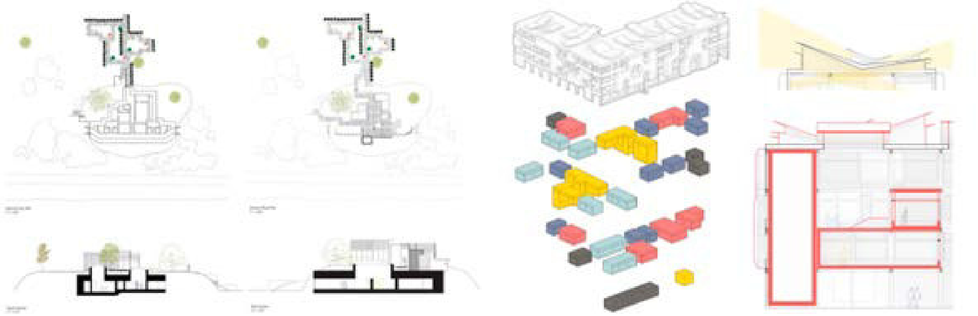

Figure 5: Knowledge ARD Group,
5a: Fort Tilden – Queens, New York (Avila 2022),
5b: Ford Piquette Factory – Detroit, Michigan (Palady 2022)

In contrast to the fifth ARD group, the sixth group titled education, sought to provide specialized infrastructure that will create accessible education and research opportunities that are uniquely suited to the community or location. The designs in this group are deeply connected to the benefits of accessible education and research that could begin to bolster the quality of life for their respective communities. The education ARD group ranges from micro-scale impact design that responds to a specific type and need of education to a macro-scale impact design that intends to generate research and studies that would benefit worldwide.

The first design focuses on the tradesmen and local industry of Orange, Texas, proposing to adaptively reuse Emma H Wallace High and create an education center that provides specialized training for recent high school graduates to enter the petrochemical industry with all necessary training and skills to secure a job. This reuse will generate a vocational school that partners with local industry recruitment specialists, offering an alternative to traditional universities and encouraging residents of the area to consider a trade that will later bolster the community in return. Necessary equipment and workshops are included in the design to centralize the training needed for potential tradesmen and the design can be adapted later if a different industry grows in Orange and requires a new form of vocational training (See Figure

6a). The next proposal focuses on the MacKay Marine Station, a former oil rig that has been repurposed as a mobile aquatic structure, utilizing the oil rig and its capability to be adhered to the sea floor temporarily to form the environment needed for mussel reefs and seagrass beds. This structure is in Cromarty Firth, Scotland but can be moved freely throughout the ocean. The adaptive reuse proposal aims to facilitate a second layer of benefit, creating a sustainable research station on top of the oil rig. As the rig moves locations and promotes marine life formation, the research station will analyze and document the behavior of marine life worldwide. Features such as water filtration, a self-sustaining garden and area for livestock, and adequate housing/recreation spaces are provided to allow this proposal to be as independent as possible and grant the opportunity for the oil rig to stay long enough to form the mussel reefs and study the formation without excessive transport of supplies or boat travel for the researchers (See Figure 6b). The last design proposes the renovation of the abandoned textile mill, the Kiddie Kloss Factory, in Lansford, Pennsylvania. The surrounding community faces high rates of poverty, excessive travel time for accessible employment and childcare, and a lack of space for businesses to expand. The adaptive reuse of the historic textile mill will change the structure into a sustainable structure that provides workshops for office or study settings, a community center that aims to compile and distribute resources for the community, exhibition spaces that respect the heritage of Lansford, and childcare resources. As a design that must respond to changing factors and needs of the community, the adaptive reuse focuses on being multi-usage and adaptable, intending to grow with the community while maintaining a link back to the historical importance of the region (See Figure 6c).

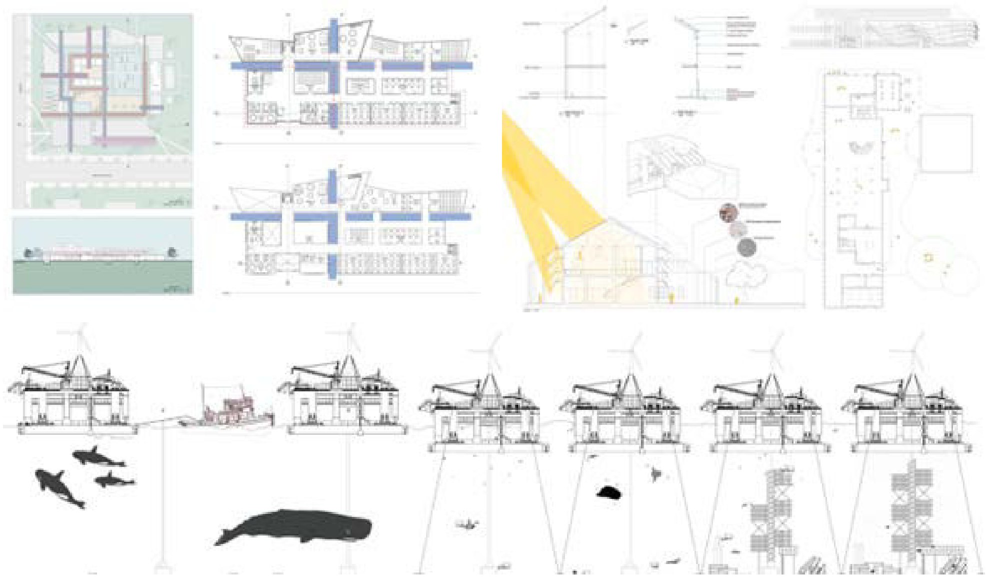

Figure 6: Education ARD Group,
6a: Emma H Wallace High – Orange, Texas (Casey 2022),
6b: MacKay Marine Station – Cromarty Firth, Scotland (Rice 2022),
6c: Kiddie Kloss Factory – Lansford, Pennsylvania (DeGrande 2022)

9. Concluding Notes and Further Discussions

The legacy of various industries, such as oil, textile, and automotive, continues to reshape industry, society, culture, and politics. This article argues for the need to critically engage with the conservation and adaptive reuse of industrial heritage in the context of radical transitions, emphasizing the importance of sustainable local development goals and the integration of social, political, and cultural dimensions in shaping post-industrial urbanscapes. Through various case studies, tis chapter delves into the complexities and challenges of transforming post-industrial cities through the lens of industrial heritage and adaptive reuse. The case studies presented within the chapter highlight the diverse strategies employed by students in the “Adaptive Reuse of Industrial Heritage” studio at Texas Tech University. These projects address various social-political and spatial-cultural challenges in cities that have experienced the impact of industrial revolutions, energy transitions, and disruptive technological innovations.

While the studio projects emphasize the importance of reimagining and revitalizing industrial heritage sites through adaptive reuse, focusing on the needs of local communities, and incorporating sustainable development goals, they are deeply rooted in the local context and culture, illustrating how the legacy of oil, textile, and automotive industries continue to shape the urbanscape and influence how buildings and cities function over time. By employing a critical, historical, spatial, and analytical problem-based approach, the chapter sheds light on current policies and strategies that promote sustainable local development through the conservation and adaptive reuse of industrial heritage sites. The case studies are powerful examples of how urban environments can transition from their industrial past towards a more sustainable and inclusive future.

Through preserving the legacy of various industries, such as oil, textile, and automotive, these adaptive reuse projects create new urban identities and images, fostering a sense of community and cultural continuity. The collaborative and transnational approach taken by the students in developing these designs highlights the importance of engaging local communities and incorporating their needs and aspirations in the decision-making process. This chapter underscores the significance of adaptive reuse strategies in transforming post-industrial urbanscapes into sustainable and inclusive spaces capable of addressing the complex challenges of radical transitions in industry, society, culture, and politics. As a valuable resource for architects, urban planners, policymakers, municipalities, citizens, and communities, this chapter provides insights and inspiration for the conservation and revitalization of industrial heritage in the context of sustainable development goals and the rapidly changing urban landscape.

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7. Historical spatial-functional network system and Smart City strategy as an opportunity for the sustainable development of Kolobrzeg

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Abstract

Kołobrzeg is a medium-sized city located in north-western Poland by the Baltic Sea. The historical urban environment was based on a tripartite functional structure which was separated by numerous parks and green areas. This layout has remained legible despite the enormity of the destruction caused by the war effort in 1945, as a result of which the urban tissue of Kolobrzeg was destroyed by approximately 90%. The system transformation in Poland led to the dynamic development of tourism and the consequent uncontrolled growth of the development of the coastal strip and suburban wetlands. This has introduced a disproportion in the historical functional system and led to an urban-functional monoculture subordinated to tourism. The intensity of holiday and spa travel resulted in the erection of residential housing, often used seasonally. The development challenges overlap with ongoing reconstruction and regeneration efforts - in addition, these transformations are taking place in the face of new problems mainly related to climate change. The article shows the correlation between the historical urban network character and the spatial-functional balance as well as contemporary adaptation necessities. The preservation of the historical structure with consideration of the current needs of tourists and residents provides an opportunity to restore the principles of sustainable development. The strategy, together with the adopted objectives based on creating the best conditions for living and recreation, cooperation between inhabitants and authorities, and an innovative economy, will provide an opportunity not only for the development but also for the preservation and adaptation of urban heritage objects in the face of the city's green transformation.

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Keywords

Cultural Heritage, Sustainability, Urban Transformation, Historical urban space, Smart City

1. Introduction

Kolobrzeg is a medium-sized city located in north-western Poland on the Baltic Sea and has been a tourist and spa mecca since the mid-19th century. The historic urban environment was based on a tripartite functional structure - the spa, the port and the city centre, which were separated by numerous parks and green areas. This arrangement had the hallmarks of sustainable urbanism, which resulted in a spatial balance around these three centres. Developed until the outbreak of the Second World War, the city was also characterised by a unique microclimate and an abundance of greenery surrounding the buildings. The enormity of the destruction resulting from the war effort in 1945 and the subsequent reconstruction led to a significant transformation of the urban structure on an otherwise clear functional and spatial basis. Progressive urbanisation since the end of the 20th century has led to negative phenomena in the urban space that represent a major problem in both climatic and planning terms. The resolution to adopt a smart city strategy, introduced in September 2021 [2], seems to respond to the problems of overdevelopment and spatial imbalance in the city. However, the smart idea alone may not be sufficient for historic cities. Linking it to the idea of sustainable development and basing it on the historically shaped spatial and functional structure may be the key to developing an optimal solution. Its implementation must be preceded by an analysis of processes taking into account its past, present and future (Sobol, 2017). This multifaceted approach to the city is considered not only in ecological terms but also in terms of heritage conservation. The research carried out therefore focuses on the analysis of the historical aspects of Kolobrzeg's spatial structure, its transformation and development plans in the context of the newly introduced smart city idea. An attempt has been made to correlate the discussed themes with the assumptions of sustainable development in ecological, spatial as well and cultural terms, trying to find optimal solutions that take into account the unique character of the city and its needs.

[2] Decree No. 97/21 of the Mayor of Kolobrzeg of 15 September 2021 on the adoption for implementation of the Smart City Strategy of the City of Kolobrzeg and the appointment of a team for the implementation, monitoring, communication and evaluation of the Smart City Strategy of the City of Kolobrzeg.

2. Sustainability and the smart city concept

One of the determining factors in halting climate change is the introduction of transformational urban design and its adaptation to modern needs. A sustainable and green economy is a direction for development and economic transformation, through which quality of life and well-being can be increased. One of its objectives is also to ensure social justice and equity while reducing environmental risks, by halting the consumption of natural resources and developing renewable sources. Sustainable development is a doctrine that assumes a quality of life that is at the level of current civilisational development. It is an answer to the emerging problems of the modern world. Together with the concept of smart cities, which stems from the principles of sustainable development, it is an answer to increasing urbanisation or other negative spatial phenomena occurring in cities (Sobol, 2017).

2.1 Principles of sustainable development

The concept and outline of the principles of sustainable development were captured at the First United Nations (UN) Conference on "Environment and Development" in Stockholm in 1972 (Piechota, 2016). At that time, the focus was on the negative effects of rapid urbanisation associated with increased environmental pollution and attention was drawn to the need to reduce it. The general formulations, recognising the superiority of ecological aspects over economic and social ones, developed at the conference did not provide a universal solution for countries with different levels of development. The next stage in the process of shaping the definition of sustainable development was the work of the UN, which defined the concept of sustainable development, as economic development that does not violate the environmental, economic and cultural balance (Piechota, 2016) A milestone in defining sustainable development was the 1992 Rio Earth Summit conference in Rio De Janeiro, which created one of the most important documents constituting a set of principles and guidelines for developing strategies of action for development at international, national and local levels. An extension of the principles introduced was the World Summit on Sustainable Development in Johannesburg.

The follow-up to the development policy was the report *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication* issued by the UN in 2011 (Piechota, 2016). At that time, the concept of a green economy was defined as actions aimed at improving the quality of human life and well-being by increasing social equity while reducing harmful activities that lead to climate change and dynamic exploitation of natural resources. *The Future We Want* document summed up what has been achieved so far regarding introducing sustainable development policies. It is therefore assumed that the concept of sustainable development is considered in a multifaceted way, encompassing economic, social and environmental dimensions. The economic dimension is concerned primarily with GDP growth, determining the development of the country in terms of goods and services, The social dimension is concerned with meeting basic social needs, improving the quality of life and reducing unemployment. The ecological approach is concerned with improving the quality of the environment, protecting biodiversity and halting climate change.

Among the instruments supporting the introduction of sustainable development principles, apart from the above-mentioned doctrinal documents, one can also point to political and legal instruments, instruments of indirect action as well as environmental protection instruments (Midor, 2012). They perform a variety of functions integrally related to the functioning of man on earth from the basics of existence to production and technological development. They therefore represent an intrinsic value in the transformation of sustainable development and influence the economic and socio-cultural dimensions (Rogall, 2010).

2.2 Smart City

The smart city, is an urban planning concept that is based on the use of advanced information and communication technologies to improve the quality of life of citizens, and the efficiency of public service delivery. The concept is thus a component of a complex process of sustainable urban development. It focuses on improving the efficiency and quality of life in a city by applying innovative solutions at various levels of city management. In order to achieve this, it requires the cooperation of various industries and actors, as well as infrastructural links with a high level of technology (Florida, 2005). Its premise is also to ensure the centrality of citizens in a sustainable environment. [3] The concept has evolved over the years into version 2.0 and even 3.0, but its basic assumptions are based on cooperation between many aspects of city development. The smart city manifests itself in several operational areas including sustainable development understood as achieving a balance between improving the quality of life, environmental protection and economic growth, informa-

[3] International Organization for Standardization, 2019, Ciudades y Comunidades Sostenibles—Indicadores Para Ciudades Inteligentes; ISO 37122; International Organization for Standardization: Geneva.

tion and communication technologies for better analysis and management, and smart infrastructure and citizen participation in the urban management process.

Despite the differences between smart cities and sustainable development, the two concepts are interlinked. The smart city can contribute to achieving sustainable development goals by managing resources efficiently, reducing energy and raw material consumption, improving the quality of public services and promoting civil society and citizen participation. The spheres of influence of the smart city concept and sustainable development have common features, relating not only to socio-economic, but also to planning and urban planning issues (Broniewicz, 2017). The technologies introduced are used to design more efficient and functional cities. Among the available solutions addressing the aspect of architecture in the city, noteworthy ones are intelligent space management with the support of information and communication technology, enabling the monitoring of urban space (Stawasz 2005), The use of various types of electronic technologies in both communities and urban spaces is mutually beneficial (Hollands, 2008). One of the most important solutions is the planning of sustainable transport and user-friendly space for different forms of transport. Smart cities in the energy sector provide energy efficiency and energy management through the use of smart grids or green consumption through the adaptation of existing buildings and metering analysis (Rudewicz 2019). An important aspect is also the use and analysis of the data collected, which can be translated into planning decisions. This involves public participation in the urban planning process to take into account local and regional needs. The last is the transition to a green economy in smart cities, resulting in the development of innovation areas centred around integrated green urban infrastructure solutions. The introduction of the smart city concept in urban planning and urban transformation of a city can contribute to improving the quality of life of citizens, increasing the efficiency of urban services and reducing the city's environmental impact (German, 2020).

3. Sustainable development and smart cities in Poland

The transition to a green economy is one of the most important challenges facing countries around the world. The transition is not universal and requires unique solutions tailored to unique conditions. In Poland, changes in the approach to sustainable development can be seen. This is linked to

UN and EU membership, which regulate the need for the legal system to be subordinate to its implementation. Furthermore, the provision in Article 5 of the Constitution, in addition to the freedoms and rights of the human beings and the citizens, Poland also safeguards the national heritage and ensures environmental protection in accordance with the principle of sustainable development.[4]

According to the Central Statistical Office (CSO), out of 195 UN member states, Poland is ranked 15th in terms of the implementation of Agenda 2030.[5] In addition, as part of the new approach to the socio-economic situation, four additional indicators representing the state of development of the green economy were developed together with GDP. These are natural capital, environmental efficiency of production, environmental quality of life of people, and economic policy (Zakrzewska, 2019). In addition, legal acts, e.g. the Environmental Protection Law, have established the principles of its protection and the conditions for the use of natural resources.[6] The development of the economy to date has been based on unlimited consumption of natural resources. This has consequently led to irreversible climate change and the generation of further environmental threats. These changes have a direct impact on the life and functioning of societies and therefore economists point to a change in the economic model (Zakrzewska, 2019).

The Polish economy is based on non-renewable energy sources, primarily coal. In order to adapt to the requirements resulting from the signing of the three declarations[7], steps have been taken to increase the country's development in terms of sustainable policy and green energy.

Work on greening the economy has been linked to a number of programmes and strategic documents.

The transition to a green economy is one of the most important challenges facing countries around the world. The transition is not universal and requires unique solutions tailored to unique

4 Constitution of the Republic of Poland of 2 April 1997, Journal of Laws of 1997, No. 78, item 483, as amended.

5 https://2021.dashboards.sdgindex.org/rankings, accessed 12.04.2023.

6 Sustainable development indicators for Poland

7 Rio Declaration, Agenda 21 Action Programme, Declaration of Principles for the Sustainable Management of Forests, two global agreements: Convention on Climate Change and Convention on Biological Diversity

National Environmental Policy	2009-2012	Ensuring environmental security and laying the foundations for sustainable socio-economic development	
Poland's Climate Policy	By 2020	Safeguarding measures against sustainable climate change	Based on the United Nations Framework Convention on Climate Change
Poland's energy policy	By 2030	increasing the country's energy security in a sustainable manner	
A strategy for changing production and consumption patterns to favour the principles of sustainable, balanced development		decoupling economic growth from the increase in consumption of natural resources and environmental impact, and improving quality of life	
National transport policy	2006-2025	improving the quality of the transport system and extending it in a sustainable manner	

Table 1 - Development strategies based on CSO data [8]

The adopted strategies take into account the principles of sustainable development. The alignment of many activities and plans with EU requirements and initiatives has significantly improved Poland's environmental policy towards energy development, energy efficiency and environmental protection. Projects were implemented to improve river and coastal water quality and air quality. The strategies adopted also indirectly concerned urban spatial development. The successive introduction of emission-reducing measures linked to the popularisation of renewable energy or the top-down, statutory improvement of the energy efficiency of buildings and the development of sustainable modes of transport are transforming the urban fabric. However, this is a long-

[8] https://stat.gov.pl/cps/rde/xbcr/gus/oz_wskazniki_zrownowazonego_rozwoju_Polski_us_kat.pdf , accessed 12.04.2023.

term and rather difficult process. Studies monitoring the implementation of the sustainable development policy, taking into account social, economic, environmental and institutional-political aspects, show that Poland is in a strong group of countries that perform less well in relation to the requirements set by the EU (Rozmus, 2019). Taking into account the Europe 2020 Strategy, the results show that Poland has met the social targets at a quite good level, due to the achievement of EU values in 2 out of 4 indicators (Kryk, 2017). Studies show that the life expectancy rate has increased, which may indicate an improvement in the conditions of public health services. The level of employment and people with higher education have also increased. Nevertheless, analysing the reports of the Central Statistical Office, the achievement of the 17 Agenda 30 targets is on an upward trend.

The adoption of the smart city concept by cities can contribute significantly to environmental goals. It can be one of the answers to emerging contemporary urban problems and address global aspects in local and urban planning terms. Rapid development and consumerism combined with poor management have led to negative phenomena in the process of space shaping. Suburbanisation, or the takeover of suburban areas showing significant biodiversity, leads to a gradual degradation of the local ecosystem (Lopez, 2021). A high urbanisation rate requires innovative solutions to deal with complex problems in an efficient way (Yigitcanlar, 2015). The escalation of phenomena not only leads to irreversible changes in the environment but also has a direct and negative impact on human existence - existence and quality of life. Statistical surveys show that in Poland more than 60% of the population lives in towns and cities[9], thus consuming 50-80% of energy resources (Albino, Berardi, Dangelico, 2015).

Polish cities are therefore increasingly turning to the smart city strategy. One of the first to decide to implement it was Białystok. Tasks were focused on improving the quality of public transport and road infrastructure. In the case of Gdansk, a smart city refers to improving the quality of construction. Activities resulted in the construction of an energy-efficient multi-family municipal building in Dolne Młyny Street. Gdynia, on the other hand, bases its activities on the participation of inhabitants in the process of transforming the urban fabric. Created by the Institute for Urban Development, the Urban Lab creates a platform for the exchange of experience between experts and the local community focused on contemporary urban management. The smart city idea is also being implemented by other large cities in Poland, such as

[9] CSO (Central Statistical Office): Population. State and structure in territorial section.

Poznań, Warsaw, Wrocław and Krakow. However, it is increasingly reaching smaller local government centres.

4. Kołobrzeg – case study

One of the cities in Poland that are in the process of introducing the smart city strategy is Kolobrzeg. This seaside resort town can serve as an example of efforts to successively introduce the principles of sustainable development into the process of shaping historical space. It is a medium-sized city located in north-western Poland on the shores of the Baltic Sea, and its urban structure is based on mutually balancing centuries-old layers.

From the time of its foundation in 1255 until the beginning of the 19th century, the functional and spatial structure was defined by two points - the militarised harbour with its salinas, and the fortified city-fortress which was the administrative and residential area. The military development of Kołobrzeg blocked the expansion of the town into the forbidden building development area and the floodplain until 1873. Nevertheless, from the 1840s onwards, together with the interest in balneology, a new district began to emerge in the vicinity of the harbour - a resort of increasing economic importance (Heider. Kierzek, Laber, Kotuła, 2019). It was located directly on the coastal strip, initially without direct links to the rest of the city. The distinctiveness of the individual districts was emphasised by the forests and parks, forming a kind of buffer area between the spa, the harbour and the city.

Figure 1 - Map showing tripartite spatial and functional system (red)

A historical analysis of Kołobrzeg's urban structure has revealed a transformation of the urban space and a clear outline of a tripartite spatial and functional structure. The creation and development of the spa changed the relationship between the two hitherto urban centres and enriched the spatial structure of Kołobrzeg with an additional element. All this led to urban transformations that are an interesting example of functional structure transformation, its integration while maintaining the separateness of the main components in the city's spatial development process. The tripartite structure responded to the growing needs of residents and visitors by creating not only a spatial but also a functional balance. The spatial activities taking place at the time, based on the foundation of the former fortifications, enriched the urban fabric not only with hygienic streets and building quarters but also with green squares and plazas. In addition, a clear traffic system connected the different parts of the city in a way that was based on the centuries-old needs of the inhabitants, confirming the spatial balance. In the 1840s, the construction of seaside promenades was initiated and numerous walking avenues were laid out in the forest park. The creation of parks and walking avenues concentrated in the coastal areas had not only an aesthetic value but also served to strengthen the waterfront, protecting it from wind and water erosion. The dynamic growth of the city was based on a balance between new buildings and their functions and a buffer of greenery ventilating the historic centre. The balanced growth of the various parts of Kolobrzeg met the needs of the inhabitants and visitors. The city's development was abruptly halted by the Second World War. Kołobrzeg became a war lazaret at the time and in March 1945, after fierce battles, was almost 90% destroyed. In the post-war period, economic, political and conservation factors played a key role in the rebuilding of the city. The successive stages of reconstruction have influenced the shaping of the city's contemporary spatial and functional structure. The reactivation of the spa, which began in the 1960s, and the extension of the city's functions to include a holiday resort led to the dynamic development of the district.

Figure 2 - Map Views of the old town of modern Kolobrzeg (red)

Today, Kolobrzeg's development is based on service and production functions with a strong emphasis on tourism. The city's location and natural assets make Kolobrzeg one of the most popular holiday and spa destinations in and out of season. According to the Central Statistical Office (CSO) data from 2022, there were 16 hotels and 4 guesthouses in Kołobrzeg. Compared to 2008, the number of accommodation facilities increased by 10 facilities. In addition to these, there are other accommodation facilities in Kolobrzeg including spa facilities (22), holiday centres (14), guest rooms (62) and others (16).[10] Currently, the functioning of the town is subordinated to tourism, which also has negative consequences. Its intensity and significant growth in recent years have led to a process of intensive urban development. Holiday flat blocks are being built, aimed at short-term rentals. The city's largest and most profitable district has become a resort city (Ziegler, 2004), the old town has become a tourist attraction in a retrograde trend, retaining its administrative functions (Przybyszewska-Gudelis, Grabiszewski, 1986). The local labour market is dominated by offers related to tourism and spa activities. The consequence is not only an excessive growth of one function, disrupting the

[10] https://bdl.stat.gov.pl/bdl/dane/teryt/jednostka/3752, accesed 01.10.2023

historical spatial-functional structure, but also a mono-functional pointiness of individual functions.

Figure 3 - Map showing overdevelopment of the tourist function in the coastal area (dark blue) and new housing developments - suburbanisation (red)

Kołobrzeg's residents have thus been pushed into less attractive areas further away from the sea, thus exacerbating the phenomenon of urban sprawl (Mordwa, 2017). The data collected shows that every year there is an increasing outflow of Kołobrzeg's inhabitants to suburban areas encompassed by the neighbouring municipalities. The outflow of inhabitants has negative consequences in the spatial context. Suburbanisation may result in a communication infrastructure that is inadequate and not adapted to rapid urbanisation changes, together with an underdeveloped service area comprising shops, and educational, medical and cultural facilities. In addition, residents occupy valuable natural areas, which have a direct impact on the biodiversity and spa qualities of the resort. At the same time as the outflow of residents, the number of flats in Kolobrzeg is increasing. Their number has risen sharply since 2014. According to CSO data, the number of flats in 2022 was as high as 27,996, an increase of 25%. The data also shows that 97% of the newly built flats are for rent or sale. This shows the real scale of tourist facilities with flats for short-term rental.

The year	2014	2015	2016	2017	2018
Inflow of residents from villages in the voivodeship to Kolobrzeg	205	237	222	216	267
Outflow of residents to villages in the province	290	237	267	236	325
Number of flats	22226	22521	23025	23577	24530

Table 2 - Outflow and inflow of residents based on CSO data

The system transformation in Poland led to the dynamic development of tourism and consequently to the uncontrolled growth of the coastal belt and suburban wetlands. It has led to a functional monoculture subordinated to tourism. This translates into poorly diversified job opportunities and consequently inadequate living wages. This is compounded by the migration of young people and an ageing population. Development challenges overlap with ongoing redevelopment and revitalisation activities - in addition, these transformations are taking place in the face of new problems mainly related to climate change.

The intensive development of the city in terms of tourism that began in the 1960s, due to political decisions by the central authorities of the People's Republic of Poland, led to negative planning consequences. This is not an isolated case. Research indicates that urban sprawl processes are a problem affecting cities of all sizes. According to the Urban Policy Observatory, in the vast majority of urban regions, the suburban zone is characterised by a higher level of housing construction activity than the core centre. Past forms of governance have not protected Kołobrzeg from the negative phenomena faced by modern cities. It does, however, have enormous potential to implement the principles of smart cities and sustainable development. This is influenced not only by the historical urban structure which gives the city its identity but also by the associated greenery system. The preserved and protected system - the waterfront strip and numerous parks - provides a natural and historic separation between the individual districts. Preserving the historic structure together with taking into account the current needs of tourists and year-round visitors and residents provides an opportunity to restore the principles of sustainable development.

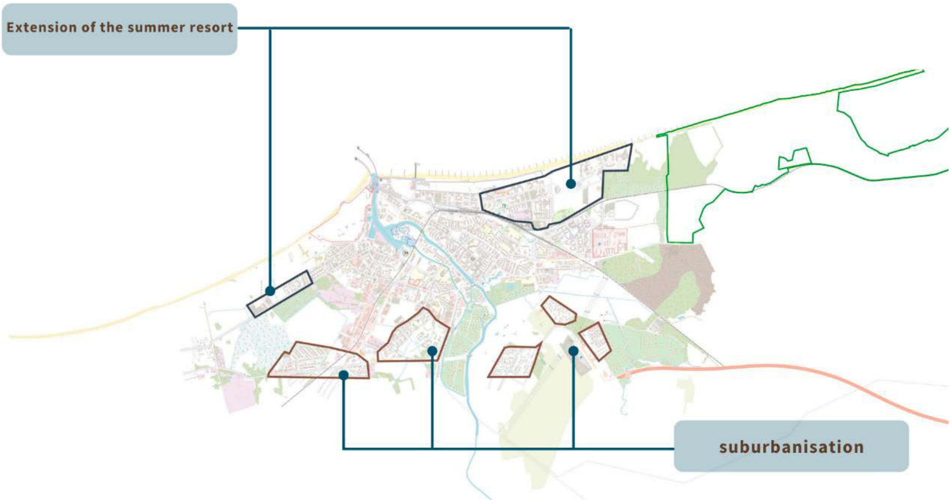

Figure 4 - the growth of Kolobrzeg in the last 30 years (red)

4.1 Smart city

In 2021, an ordinance was passed to adopt the smart city strategy for implementation. [11] It can provide a response to the negative spatial transformations taking place in the city. The strategy's assumptions try to respond to the most important smart city assumptions mentioned above, which include spatial management, sustainable transport, green energy solutions, social participation and green economy. Kolobrzeg's identified development challenges focused on the natural-economic-spatial aspect. The strategy acknowledges the already mentioned economic monoculture resulting from the dynamic development of tourism, as well as the problems of reconciling the conflicting interests of the city's various users - tourists, visitors, residents and investors. An imbalance between tourism, the environment and the local community area, as well as the city's transport problems, were pointed out. All these aspects are linked to the challenges of making life in Kołobrzeg attractive and the need for residents to participate in the city management process. The assumptions on which the challenges are based point to the aim of making better use of the resources at one's disposal, including locational and natural

[11] Order No. 97/21 of the Mayor of Kołobrzeg of September 15, 2021 on the adoption of the Smart City Strategy of the City of Kołobrzeg for implementation and the establishment of a team for the implementation, monitoring, communication and evaluation of the Smart City Strategy of the City of Kołobrzeg

resources, and building a network of economic links to increase competitiveness. An extremely important part of the city is its rich green areas. Implementation of the adopted strategy therefore includes more efficient use and conservation of natural resources as well as the preservation and increase of biologically active areas. In order to improve the well-being of residents, it was decided to develop and strengthen the city's residential function with access to public services.

Among the assumptions, an important aspect is the city's natural resources which determine not only the quality of life of the inhabitants but also the tourist space. According to Kolobrzeg's strategy, environmental protection projects are being implemented in the city. The percentage of selectively collected waste is increasing, [12] the proportion of parks and green areas is growing [13]and more areas are being developed in local spatial development plans. [14]

Figure 5 - Comparison of the proportion of greenery in the urban fabric in 1929 (darker shade of green) and 2020 (lighter)

12 33.9% of total waste

13 5.3% in 2012 to 9% in 2018

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The percentage share of tree area based on mapadrzew.com is only 4.20% for Kołobrzeg. Compared to other cities in the so-called Recovered Territories with a comparable scale of destruction, this proportion is relatively low (Koszalin 34.0%, Szczecin 16.9%,) but this is due to certain administrative conditions - the inclusion of forests in the urban area. Nevertheless, a quantitative analysis of the trees shows that there are far fewer trees in the old town area than in other areas of Kolobrzeg.

Kołobrzeg is gradually introducing a sustainable development policy, taking into account the resulting ecological, social and economic aspects.

The Smart City strategy, which has been adopted for implementation, seems to provide the necessary support for realising the potential of the place, and introducing economic diversity while maintaining the principles of sustainable development. The strategy, together with the adopted objectives based on creating the best conditions for living and recreation, cooperation between inhabitants and authorities, and an innovative economy, will create an opportunity not only for development but also for the preservation and adaptation of urban heritage objects in the face of the city's green transformation. Kołobrzeg therefore has great potential for multidisciplinary activities adapting the historic space to contemporary smart city solutions. In doing so, it will be necessary to utilise and appropriately develop the spatial system based on functional division, which has been in place for centuries. It provides a balance and guarantees sustainable development based on providing attractive conditions for both residents and tourists/ visitors.

4.2 Links to the historical urban fabric

Shaped in the course of its development from the Middle Ages to World War II, Kolobrzeg's urban structure developed a balance between three functionally different but also complementary districts: the downtown, the harbour and the spa. The effect of the balanced urban development was also an economic and social balance. In the context of the cited problems of the city of Kołobrzeg, a response to the needs of residents and tourists may be to strive to restore the spatial balance resulting from the historical layout. Due to the enormity of the destruction, it constitutes a great value of the rebuilt city. Of the actions listed in the public consultation and the Smart City Strategy for Kołobrzeg, some can be linked to the assumptions of the discussed functional and spatial structure. [15]

[15] Summary of diagnosis and research findings The strategy is developed within the project "KOŁOBRZEG. HUMAN, PART and SPACE".

Smart city objectives	idea	Reference to the historical spatial and functional structure
Creation of a Municipal Functional Area of the City of Kolobrzeg	the city's economic and spa function	Restoring networking and division of functions, moving away from a functional monoculture to a balance
Appointment of an urban gardener at the town hall	greenery management	In the 19th century. The function of City Gardener was performed by H. Marten, who established most of the parks in the inner city area
Access to green spaces, and recreational areas in the immediate area of residence should be increased	Integration of the local community	19th century. Supplementing the urban fabric with parks and squares on the sites of former fortifications
Use of the port	places for the development of entrepreneurship and the orientation of Kolobrzeg's economy beyond tourism and spa activities is also classified as a possible innovative measure	19th century. Redevelopment of the harbour and adaptation to new purposes - sailing basins, fishing, etc.
changes in the city's transport sphere.	Better green transport, use of rail, bicycles, etc.	Creation of new arteries after demolition of fortifications

Table 3 - Correlation of ideas related to the Smart City strategy with historical spatial and functional solutions

4.3 Possibilities

The indicated examples of Smart City objectives show that it is possible to restore, in correlation with the historical urban structure, the historical functional and spatial balance. Despite the enormity of the destruction, the original layout of the city is still legible. This will make it possible to implement the goals and objectives of the smart city strategy. It will, however, be necessary to link them to the achievement of social and ecological balance. A good solution seems to be, included in Kołobrzeg's strategy, relieving the spa zone in favour of other, equally attractive areas of the city. [16] This will allow for the dispersal of tourists and the activation of other areas, as well as taking care of the local environment and the comfort of residents and visitors. A good direction related to spatial planning will also be the successive completion of local spatial development plans for areas most threatened by the process of uncontrolled urbanisation combined with the participation of residents.

5. Conclusion

The presented analysis shows that the Smart City Strategy adopted for implementation in Kołobrzeg seems to provide the necessary support for using the potential of the place, and introducing economic diversity while maintaining the principles of sustainable development. The strategy, together with the adopted goals based on creating the best conditions for living and recreation, cooperation between residents and authorities and an innovative economy, will provide an opportunity not only for development but also for the preservation and adaptation of urban heritage objects in the face of the city's green transformation. Kołobrzeg therefore has huge potential for multidisciplinary activities adapting historical space to contemporary smart city solutions. Despite the small number of monuments and processed urban tissue, Kołobrzeg has a chance, with the appropriate application of the smart city idea and further historical analyses, to recreate the functional and spatial situation from before World War II in a modern and sustainable form. The analysis shows the correlation of the planned activities with the historical and spatial experience of the city, showing the flexibility, universality and possibility of implementing the existing, logically created urban structure. Also, the use of modern technologies that make the historic city smarter can make it even more improved.

[16] Smart City Kołobrzeg Strategy

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Smart City Strategy of the City of Kołobrzeg

Summary of diagnosis and research findings The strategy is developed within the project "KOŁOBRZEG. HUMAN, PART and SPACE".

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8. From Tradition to Resilience: The Value of Balinese Adaptive Culture in Climate Change Adaptation and Heritage Management

Diana Farisah Rahman[1]

Abstract

The Subak Landscape of Bali Province was inscribed as a World Heritage Site in 2012 for its exceptional irrigation system that links to the *Tri Hita Karana* philosophy, which emphasizes the importance of maintaining a harmonious relationship between humans, the spiritual realm, nature, and fellow human beings. Farmers and local communities have faced a growing challenge in safeguarding their livelihood and ensuring the productivity of rice fields. Although tourism has long been a key aspect of Balinese society, it is important to recognize that challenges in the agricultural sector have led many people to abandon farming in favor of jobs in the tourism industry. The disruption of this agricultural society by the global climate crisis is frequently overlooked.

Extreme drought, heavy rainfall, and flooding have significantly affected rice production and the social and economic sustainability of farmers and urban landscapes.

These changes in livelihood and agricultural practices, driven by the climate crisis as much as by tourism, have transformed Balinese villages and communities. Such transformations have brought about both negative and positive impacts on the Balinese built heritage. The Balinese's perception of heritage value and change have contributed to the adaptive characteristic of Balinese cultural heritage, leading them to normalize physical transformations. While there are consequences associated with this approach, it has been demonstrated that the shift in livelihoods and land use, which potentially jeopardize the World Heritage Status, is linked to the preservation of the Balinese culture and society that face destruction due to environmental changes. This serves as a compelling illustration of how climate resilience and heritage preservation are interconnected.

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Scholars and intergovernmental organizations consistently emphasize the pivotal role of local, indigenous, and traditional knowledge in climate change adaptation, disaster risk reduction, and biodiversity protection (Hulbert *et al.,* 2019; Raygorodetsky, 2011). This paper aims to explore the role of the Balinese culture in climate change adaptation as well as examine the impact of the climate crisis on the Balinese cultural heritage, including traditional knowledge, livelihoods, and urban landscape. It is important to acknowledge that varying interpretations of heritage preservation exist between international and local communities, often resulting in the marginalization of local and indigenous knowledge in heritage management (Rakic & Chambers, 2008; Taylor, 2009; Staiff & Bushell, 2013; Suntikul & Jachna, 2013; Cocks *et al.,* 2018). Using the subak landscape as a case study, this paper also seeks to explore the potential of local and indigenous knowledge as a bridge for integrating climate actions and heritage preservation.

Keywords

Adaptive culture, agriculture, climate change adaptation, resilience, subak landscape

1. Introduction

Indigenous communities are among the most vulnerable groups that are most affected by the climate crisis (Laduzinsky, 2019; ILO, 2017). Many indigenous communities also live in geographically high-risk areas and are threatened by extreme weather and its impacts, including floods, droughts, and the rise of seawater levels (UN Department of Economic and Social Affairs, 2019). Some scholars noted that indigenous people have various coping strategies to overcome the impacts of climate change which help mitigate their vulnerability (Garai *et al.,* 2022; Wardekker *et al.,* 2023). However, indigenous communities are yet adequately involved in climate actions due to the lack of engagement instruments and adequate policies (McDowell *et al.,* 2016; Pearce *et al.,* 2009; David-Chavez & Gavin, 2018; UNDRR, 2023).

The impacts of the climate crisis on heritage sites are also notable. Extensive evidence of the threats posed by the climate crisis to cultural and natural heritage sites are recorded all over the world (e.g. by Fatorić & Seekamp

2017; Sesana *et al.,* 2018; Dastgerdi *et al.,* 2019). UNESCO records that at least 83 of 252 natural World Heritage Sites are threatened by climate change, including the Great Barrier Reef in Australia and the Cape Floral Region in South Africa (UNESCO, 2020). Mansourian *et al.,* (2009) and Scheuren *et al.,* (2007) also raised their concerns that climate change has destroyed protected areas which are among the most effective tools to protect the earth's biodiversity, maintain natural ecosystems, and contribute to physical protection against natural hazards and disasters.

More research now demonstrates the benefits of integrating heritage preservation and climate adaptation on heritage sites and their communities (e.g. Tengo *et al.,* 2014; Berkes & Armitage, 2010; Berkes *et al.,* 2006; Wardekker *et al.,* 2023; Chapagain, 2023). There is also a growing recognition that cultural and heritage studies have more to offer for understanding climate action than is currently acknowledged (Simpson *et al.,* 2022; Kohler & Rockman, 2020; Chapagain, 2023). For instance, indigenous knowledge provides a further understanding of the actual impacts of the climate crisis and possible ways to adapt (Savo *et al.,* 2016). In Bolivian Andes, indigenous knowledge helps the community to understand climate variability and changes that affect their crops (Boillat, 2013).

Despite all that, efforts to integrate indigenous knowledge into heritage preservation or climate actions have been insufficient. Sectoral gaps, lack of stakeholder coordination, lack of inclusivity, and marginalization of indigenous knowledge are among the most common obstacles to local engagement in climate actions (Ford *et al.,* 2016). The lack of policy integration and multi-sectoral coordination are also mentioned as threats to heritage sites, their values, and the integrity facing the climate crisis (UNDRR, 2023).

Therefore, this chapter aims to explore the contribution of indigenous knowledge and cultural heritage to climate adaptation and resilience. It uses the example of the traditional irrigation system of subak and its community that shows how an adaptive culture helps to manage cultural heritage and reduce their vulnerability to climate change. This chapter also investigates the impacts of the climate crisis on the preservation of the subak landscape, explaining the interlinkages between heritage preservation and climate actions. The Balinese traditional knowledge has helped the subak community in sustaining rice production despite the changing landscape. Nevertheless, some challenges exist as locals attempt to align their adaptive culture with the World Heritage Site management standard. Inadequate government support is recorded as one of many obstacles in reducing the community's vulnerability to climate-related disasters.

Ethnography emerged as the chosen research methodology, strategically selected to navigate the challenges posed by the local community's reluctance to engage openly with formal research and governmental activities. As highlighted by Creswell (2013), ethnography proves effective in delving into the beliefs, meanings, behaviours, and critical issues such as power dynamics within a cultural group. Spanning the years 2017 to 2019, around 50 respondents were engaged in a mix of semi-structured and unstructured interviews across diverse settings.

To enrich the study, a systematic review of secondary data from sources like the World Heritage Site nomination dossiers, State of Conservation reports, and national heritage and climate policies was conducted. This broader perspective aimed to deepen the understanding of the subak system, the subak community, and the World Heritage Site framework. Both the primary and secondary data were analysed using a qualitative content analysis.

2. The subak system and its current challenges

The subak landscape was inscribed as a World Heritage Site in 2012 under the name of 'the Cultural Landscape of Bali Province'. These six clusters of rice fields include lakes, forests, temples, customary villages, and irrigation systems. The subak landscape is considered an Outstanding Universal Value for demonstrating a complex farming system and being a manifestation of the Balinese traditional philosophy of *Tri Hita Karana*. This philosophy, translated in English as three good causes, calls upon the community to maintain a harmonious relationship with nature, the spiritual world, and other human beings.

The subak landscape is classified as an evolving cultural landscape that has both tangible and intangible elements. It represents a holistic farming system that incorporates social, religious, and agricultural components. The sustainability of shared water management, the rituals conducted at water temples, and the cooperative spirit among farmers are integral to the landscape. The subak landscape is the only rice terrace in the region that extends beyond traditional cultivation, embodying the cultural and religious values unique to the island.

Some of the main components of the subak landscape are rice terraces, water temples, the subak organization, and subak regulations (*awig-awig*). The resilience of the subak system is evident through the pivotal roles played by these components. The intricate design of the rice terraces, for example, enables efficient water distribution and cultivation, supported by the water temples that are not only important as a place of worship but also central to the management of water resources.

Within the subak landscape, farmers convene under the umbrella of the subak organization, an important entity responsible for coordinating irrigation schedules and mediating conflicts among farmers. The regulatory framework of a*wig-awig* outlines guidelines pertaining to farming and irrigation. It serves the essential purposes of ensuring an equitable water distribution, averting the over-exploitation of nature, and fostering adaptability to environmental changes. The seamless interconnection and effective functioning of these components are paramount in ensuring a resilient subak system.

Figure 1. The subak landscape.
Source: Diana Rahman, 2018

As in the case of many World Heritage Sites, there are some discrepancies among different stakeholders of World Heritage Sites in interpreting the value of sites. In the subak landscape, this occurs due to cultural and knowledge gaps, lack of local community engagement, and different perceptions towards the landscape (Rahman, 2021). Currently, the subak landscape holds significant value for the local community residing in and around the site, serving as both a source of income and a link between the rice fields' owners and their ancestors. The local community views the subak system as a seamless integration of social elements, agricultural techniques, and religious rituals, perceiving the site through the lens of these components and interpreting its significance based on the interplay and relationship among them (Rahman & Fouseki, 2022). Currently, various interpretations of the subak landscape result in different understandings among stakeholders regarding the characteristics and attributes of the landscape. Consequently, it also results in different interpretations of the most suitable management approach.

The State of Conservation (SOC) report for a World Heritage Site is a collaborative effort between the UNESCO World Heritage Centre and the national government of the host country. This comprehensive report provides a detailed overview of site management, identifies present challenges, and provides recommendations from the World Heritage Committee for safeguarding the site's Outstanding Universal Value. The latest SOC report of the subak landscape highlighted significant changes that pose a threat to its values, primarily stemming from a lack of awareness and understanding within the local community regarding World Heritage Site preservation. This is a misconception that is not unique to the subak landscape but is a widespread issue in many World Heritage Sites, where local communities are often unfairly deemed less knowledgeable based on their different perspectives and approaches (Maikhuri *et al.,* 2001; Maruyama *et al.,* 2016; Al-Harithy, 2005). The report further emphasized that the local community's valuation of the subak landscape has changed over time. However, one could argue that other stakeholders may have had different conceptualizations of the landscape, leading to inaccurate interpretations of how the local community values the site.

Currently, the subak community has faced not only challenges related to landscape and heritage management but also challenges related to rice production. The climate crisis brought negative impacts on agricultural activities and natural resources in Bali. For instance, water scarcity is a pressing concern among the subak farmers. Erratic monsoons and unpredictable rainfall patterns have disrupted the plantation schedule and harvest plans, and in some cases, led to the complete destruction of rice fields. Farmers have also reported prolonged drought seasons that have significantly degraded soil fertility and rice yields.

Socio-economic and cultural changes, including shifting demographics, education, and economic opportunities have affected the subak system, especially as many young generations choose alternative livelihoods, leading to a decline in the number of subak farmers. Bali's popularity as a tourist destination has also caused rapid urbanization and rapid growth of tourism-related infrastructure, which triggered land use change and disrupted water resources. Modernization and technology adoption may also disrupt the subak system by affecting community-based decision-making processes and the community's relationships with each other.

However, Rahman's (2021) observations noted that the transformations of the subak landscape - including its farming system - are primarily the local community's responses to environmental changes. For example, the change in the selection of local rice varieties is a direct response to the evolving climate and environmental conditions, which has led farmers to opt for more robust rice varieties that can endure increasingly severe climates. Similarly, the adoption of modern farming tools instead of traditional ones aims to reduce labour time, enabling farmers to seek additional employment opportunities to cope with the escalating costs associated with rice cultivation.

These adaptive measures can bring both advantages and disadvantages for the sustainability of the subak system and the local community. However, these practices must be carefully considered and included in the development of a management strategy for the World Heritage Site as this links to the local community's approach to coping with challenges posed by climate change.

3. Transformation and adaptation through the Balinese perspective

In addition to the transformations in farming tools, rice varieties, and intangible elements, the subak landscape has also undergone physical transformations. Many rice terraces have been converted into residential buildings, homestays, restaurants, or abandoned due to various factors. Often, renovations of subak temples also incorporate new materials, designs, and functionalities. The facades and structures of houses, villages, and communal areas have also undergone many transformations, often driven by the local community's need to accommodate the expanding number of family members and facilitate tourism-related activities.

Physical changes are evident throughout Bali and the subak landscape. These modifications - both the process and the outcome - are regarded as integral to Balinese traditional culture. The adaptability of Balinese culture has long been recognized through various studies (Eiseman Jr, 1990; Vickers, 2012). The Balinese community itself is renowned for its ability to assimilate other cultures, embracing change as an inherent part of their traditional practices, and not at all accustomed to static conditions (Hobart, 2016; Picard, 1996). Balinese society views innovation as a means to conserve both their cultural heritage and the natural environment. For example, the introduction of innovative religious offerings has allowed the community to conduct ceremonies without overexploiting natural resources. Similarly, many modifications implemented in the subak landscape are intended to enable farmers to safeguard rice production and their livelihoods.

The Balinese culture plays a fundamental role in the operation of the subak landscape, providing guidance on religious ceremonies and fostering cooperation among farmers, which form the essence of the subak system. An essential principle within this culture is *Rwa Bhineda,* which embodies the Balinese belief in maintaining harmony and equilibrium between opposing elements, dismissing the notion of a strict positive-negative or good-bad dichotomy. (Eiseman Jr, 1990). The principle of *Desakalapatra* also underscores the significance of change, urging the Balinese to adjust their actions and interpretations according to varying places, times, and circumstances. These principles have contributed to the Balinese's resilience against various changes, including political, economic, and environmental changes. In terms of heritage preservation, these philosophies influence the values of numerous heritage sites in Bali, accentuating the intangible aspects over their physical dimensions.

The adaptability of the subak system and the Balinese community plays a crucial role in enhancing their resilience to climate change. Scholars have recognized resilience as the system's ability to absorb disturbances (Gunderson & Holling, 2002) a quality that arguably prevents the Balinese from succumbing to a negative state. From an indigenous standpoint, Todd (2015) and Lin, *et al.,* (2020) view resilience as an ongoing, dynamic process of cultural and ecological adaptation and transformation in the face of global climate change. They emphasize that resilience is not merely about survival, but also about thriving and flourishing for both human and non-human species. Berkes & Ross (2013) also argue that a community's adaptive capacity relies not only on their existing adaptation skills but also on their ability to synthesize knowledge from various sources—an attribute that can be observed within the Balinese community.

According to Berkes *et al.,* (1994), traditional knowledge also represents years of ecological adaptation of a community to their environments, playing a vital role in bolstering their resilience. However, traditional knowledge is not always aligned with many 'scientific approaches' to heritage preservation or climate adaptation. Research has shown that many dynamic communities and cultures often clash with the conservation principles outlined in the World Heritage Convention, resulting in tensions among heritage stakeholders (Al-Harithy, 2005; Cocks, *et al.,* 2018; Meskell, 2002; Winter, 2014). For instance, the adaptive nature of the Balinese community is in contrast with the concept of authenticity, posing challenges in managing the World Heritage Site.

The pictures below show the condition of the main road in a customary village that leads to one of the main water temples of subak (top left picture). As tourists started visiting the area, local shops emerged, providing the local community with an extra source of income alongside their poorly compensated farming jobs. Contrasting with the main street, the neighbouring street (bottom left) still maintains the traditional appearance of a Balinese compound. Note, however, that changes in terms of materials and function have occurred inside the house compound, including the establishment of small homestays (bottom right). A parking lot was built several years ago to manage parking and prevent traffic congestion, although it no longer adequately accommodates the growing number of tourists. Once the temple admission closes at 5 p.m., the parking lot reverts to being a communal space for local activities (top right).

Figure 2. Condition of one of the customary villages.
Source: Diana Rahman, 2018

The rice terraces themselves have undergone additional changes. The below images show a cemented irrigation canal constructed to address water leakage issues and mitigate water scarcity problems faced by farmers (top left). The paths traversing through the rice terraces have also been renovated using more durable materials to provide easier access for farmers to their fields (bottom left). These paved paths also serve the purpose of safeguarding the rice fields against damage caused by visitors and tourists. More buildings have been built in rice terraces as farmers seek to have cooler and weather-resistant spaces to rest or store their tools (bottom right). Within the subak temple, a small meeting hut has been replaced with a permanent multi-functional space to accommodate various activities that have emerged since the subak's designation as a World Heritage Site (top right).

Figure 3. Change in the subak landscape.
Source: Diana Rahman, 2018

This research suggests that the transformation of the subak landscape and customary villages should be viewed through the lens of both heritage management and climate action. The Balinese culture facilitates innovation as a means of fostering local resilience and a mechanism to temper excessive change, striking a balance between progress and preservation. It is worth noting that these innovative measures may not fully align with certain international conservation standards. Nonetheless, their consideration is crucial for ensuring the sustainability of the local community's way of life, knowledge, and practices, thus should be given due attention in future planning endeavours.

4. Discussion

Climate change contributes directly and indirectly to the transformation of the subak landscape and its customary villages, an important fact that is often overshadowed by the rapid growth of tourism within the community. The direct influence of climate change on the subak system, and by extension, the Balinese culture, is manifested in the transformation of the subak landscape and the farming practices. These changes hold intrinsic value, representing the adaptive nature of Balinese culture and the community's interpretation of the interconnectedness between culture and nature. The indirect impact of climate change is predominantly observed within customary villages, where the growth of the tourism industry coincides with the decline in rice crops and the uncertainty of weather patterns hindering rice production.

These transformations demonstrate the utilization of indigenous knowledge to revitalize traditional practices and underscore its role in fostering a resilient community. As highlighted by Lee & Chen (2021), indigenous knowledge plays a crucial role in enabling community members to cope with environmental hazards. By incorporating indigenous knowledge into heritage preservation efforts, we can gain an understanding of how to establish a climate-resilient heritage. Instead of imposing international conservation standards, empowering local communities to employ their own approaches can significantly contribute to enhancing their resilience to climate change. On the contrary, neglecting indigenous practices only increases the vulnerability of heritage sites and society to the impacts of climate change. Additionally, Yeh *et al.,* (2021) demonstrate that cultural and heritage conservation is a dynamic and diverse process that is and always embedded in social and cultural contexts. This understanding provides a justification for adopting a locally led conservation approach.

The subak organization itself serves as an exemplary co-creation space, facilitating negotiations between farmers and traditions. It plays a vital role in establishing boundaries to manage potential cultural and physical transformations in the landscape while simultaneously incorporating innovative knowledge to address evolving environmental conditions. As such, the sustainability of this organization holds significance not only for sustaining rice production and safeguarding the subak system as a cultural heritage but also for developing effective climate adaptation strategies. Unfortunately, tensions among farmers or between farmers and their leaders have become prevalent in many areas within the subak landscape. These tensions have the potential to disrupt the harmonious functioning of the subak organization.

That being said, it becomes crucial to rethink our interpretation of the tensions and dynamics between global and local approaches in heritage management. One prevalent notion is the perceived lack of knowledge or awareness among locals when it comes to preserving heritage sites. There are two issues associated with this notion. Firstly, assessments are often conducted by "experts" who are unfamiliar with the site's conditions or lack a comprehensive understanding of the community's culture. Their interactions typically consist of limited encounters or superficial "in-depth" interviews with the community. Secondly, these "experts" tend to interpret the actions of the local community in isolation or from a singular sector's perspective. It is important to recognize that local knowledge and practices are not shaped by a single-sector approach but rather by a multi-sectoral approach.

According to Gonzales (2013), we cannot ignore indigenous autonomy in conservation as indigenous conservation strategies are inherently holistic and rooted in culture and profound connection to the land, territory, spirituality, language, and worldview. Despite the study, there has been limited community involvement in determining conservation strategies, including inadequate consultation during the World Heritage nomination process of the subak landscape. As a result, the management of the site has proven to be ineffective, leading to tensions between the local community and the government.This situation has raised important questions about the purpose of conservation efforts and who will benefit, as voiced by many farmers and residents who feel disadvantaged by the World Heritage Site framework.

Similarly, Chen (2020) argued that the resilience of indigenous groups is embedded in the geographical, historical, cultural and political context, which implies that resilience strategies are not universally applicable. It is essential to integrate this understanding into the development of mitigation and adaptation strategies for World Heritage Sites, particularly due to their diversity. In this case it is important to view the interlinkages between heritage preservation and climate adaptation because they reflect the dynamic relationship between Balinese culture and the environment. By valuing and integrating Balinese innovative practices, we can utilize the unique characteristics of the culture in the preservation efforts while effectively addressing the challenges posed by climate change.

Strengthening the resilience of the subak system is contingent upon providing comprehensive support to the local community and their livelihoods. This entails not only enhancing the capabilities of local farmers in domains such as climate change, sustainable tourism, and modern agricultural technology but also actively involving the community in decision-making processes. Tailored climate-resilient strategies specific to the subak system must be formulated. Additionally, extending financial support to farmers, facilitating market access, and creating robust regulations, monitoring, and evaluation systems are also imperative for the resilience and preservation of the subak landscape.

Therefore, while the subak community and the Balinese people possess skills to adapt to environmental change, this does not diminish the importance of government support. Many subak farmers have expressed disappointment in the lack of government support despite its existence, indicating a need for more targeted and effective governance. The involvement of local communities in governance is crucial to ensure the integration of their voices and indigenous knowledge into heritage management practices. Furthermore, an adaptive governance approach is necessary to effectively incorporate indigenous knowledge into climate change adaptation policies (Berkes *et al.,* 2021). Given the current top-down management approach of the subak landscape and the limited authority of the local community, without government support and involvement, the integration of heritage preservation and climate adaptation would remain unattainable.

5. Conclusion

The subak landscape undergoes various transformations that affect its tangible and intangible aspects, bringing benefits and disadvantages to the subak system and the local community. However, change itself, encompassing the process and outcome is considered an inherent part of Balinese traditional culture. The Balinese community is renowned for its adaptability and assimilation of other cultures, and this adaptability is reflected in the transformation of the subak system.

Climate change triggers the transformation of the subak system, impacting not only the rice fields themselves but also the society and customary villages where the local community resides. The traditional knowledge and practices of the Balinese people play a crucial role in managing potential changes in the landscape, while also incorporating innovative approaches to address evolving environmental conditions. This adaptive characteristic is instrumental in enhancing the local community's resilience to climate change.

Given that heritage management and resilience strategies cannot be universally applied, it becomes imperative to integrate indigenous and local knowledge in understanding heritage values and dynamic relationships between culture and nature within a community. This knowledge should serve as a crucial foundation for developing heritage management strategies and climate mitigation and adaptation plans, particularly for World Heritage Sites.

Drawing upon the subak organization as an example, this paper underscores the paramount importance of co-creation in formulating effective heritage management and climate adaptation strategies. Co-creation allows for an effective utilization of indigenous knowledge, providing a holistic understanding of landscapes within their socio-cultural contexts. It also enables the incorporation of multi-sectoral perspectives into heritage management strategies. The establishment of inclusive and adaptive governance is equally crucial to fostering seamless integration between heritage management and climate adaptation. Without such integration, there is a tangible risk of marginalizing local and indigenous knowledge, particularly in the face of prevalent scientific and international approaches, which pose a threat to the resilience of local communities and can lead to the degradation of their cultural heritage.

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9. The impact of the photovoltaic system on Florence's roofs. Collaboration and balance between innovation, Authenticity and Integrity.

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Abstract

Considering the Historic Centre of Florence World Heritage site as a case study, the paper aims to provide a reflection about the need to reconcile the protection of the site's Outstanding Universal Value with the increasing urgency to implement adaptation strategies to climate change in urban heritage environments. The municipal regulations are the result of an attempt to reconcile these needs, and are part of a national and regional regulatory framework that has recently undertaken an evolution oriented towards the need to provide a rapid response to the contingent energy crisis.

The Florence experience serves as example of how studies and researches on the territory, additional levels of safeguard and international conventions and recommendations can be transposed in local legislation but also come into conflict with it. Therefore, climate change turns out to be an ambivalent threat: for itself and for those measures that risk contradicting the objective of maintaining the Integrity and Authenticity of the site.

In this context, the vision adopted by the Florence World Heritage and Relations with UNESCO Office of the Municipality of Florence aims to consolidate the presence of culture and heritage in urban policies - in accordance with UNESCO's Recommendation on the Historic Urban Landscape - with the ambition of focusing on the city's historical, cultural, environmental and social identity in a dynamic, value-based context, and not only prescriptive and of mere preservation, enhancing its uniqueness and at the same time its universality.

Keywords

Historic centres, UNESCO World Heritage sites, Authenticity & Integrity, Historic Urban Landscape, photovoltaic system, Florence.

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1. Premises and objectives of the paper

Climate change is having a profound impact on conservation and protection practices worldwide, especially in sites protected under the UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage. It has been 50 years since the adoption of this important international heritage protection instrument, and climate change is one of the most significant threats affecting the Outstanding Universal Value of the sites inscribed. State Parties are working to address this issue, although, conflict between local and supranational norms often appears. The extensive global debate on ecological and energy transition has resulted in the development of a comprehensive regulatory framework that inevitably intersects with the preservation of cultural heritage and landscape. The aim of the research is therefore to understand if and how these components can coexist.

The inscription of Florence's Historic Centre on the UNESCO World Heritage List in 1982 went relatively unnoticed for over twenty years at both the local and national levels. However, it gained renewed significance after the establishment of the Florence World Heritage and Relations with UNESCO Office within the municipal administration in 2005. This office is dedicated to the enhancement and management of the site. Over time, interest in the preservation of the World Heritage Site grew, especially following the approval of the first Management Plan[3] in 2006 and the preparation of essential documents[4] such as the Periodic Report and the Retrospective Statement of Outstanding Universal Value in 2014.[5] This gradual yet significant process of recognizing the value of the World Heritage Site provided a vital opportunity to reconsider the management policies and programmatic instruments within the municipal administration (Francini C., Montacchini A., Scuto L. R., Tanturli C., Vannucci G., 2022).

The experience of Florence's Historic Centre, as discussed in the present paper, serves as an example of how studies and research on the territory, ad-

[3] Following the 2016 update and the 2018 Monitoring, the third update of the Management Plan of the Historic Centre of Florence site was released in 2022 (approved by the City Council on 30 December 2021, deliberation No. 670). Florence World Heritage Office and Relations with UNESCO, curated by Francini C., 2022, The Management Plan for the Historic Centre of Florence - UNESCO World Heritage Site, Firenze

[4] All public documents relating to the Historic Centre of Florence World Heritage site can be found at the following links: https://www.firenzepatrimoniomondiale.it/archivio-documenti/ and https://whc.unesco.org/en/list/174/documents/

[5] UNESCO, Adoption of Retrospective Statements of Outstanding Universal Value, Draft Decision 38 COM 8E, Doha 2014, 92-94 Link: https://whc.unesco.org/archive/2014/whc14-38com-8E-eNo.pdf

ditional protective measures (e.g. the identification of the Buffer Zone of the World Heritage Site), and international conventions and recommendations can be incorporated and implemented within the existing municipal regulations. The objective is not to introduce further constraints on initiatives aimed at energy transition, but rather to facilitate them, achieving mutual benefits in the process.

Using the UNESCO Historic Centre of Florence World Heritage Site as a case study,[6] this paper aims to demonstrate how a balanced and coherent approach to energy transition, aligned with the conservation of the site's Outstanding Universal Value, is crucial not only to ensure the Integrity and Authenticity of the site but also to rethink urban planning.

Figure 1: View of Florence Core and Buffer Zones from Belvedere Fortress.

[6] The Variant also affected the Core Zone and Buffer Zone of the World Heritage site Medici Villas and Gardens in Tuscany (inscribed in 2013), a serial site whose villas of Castello, Careggi, Petraia and Poggio Imperiale, as well as the Boboli Gardens, are included in the Municipality of Florence. No additional level of protection has been provided for these areas as they are already subject to landscape constraints.

Following the definition of the current regulatory framework, the levels of protection in the territory and the relationship between these elements and the UNESCO conventions and recommendations, the paper will deal with the experience between the Florence World Heritage and Relations with UNESCO Office and the Urban Planning Department concerning the variant to the urban planning instruments that would have regulated the installation of photovoltaic panels in the Florentine territory, and the reflections that ensued.

2. Energy efficiency regulations in historic city centers: international, Italian, and local developments

Although guided by the principles of hierarchy and subsidiarity, European directives, national legislation, and local regulations on energy transition often come in conflict. In the context of World Heritage sites, these inconsistencies not only trigger conflicts among different levels of government but may also lead to contradiction with the guidelines set forth by the World Heritage Centre, potentially compromising the sites' Outstanding Universal Value.

To tackle the negative impacts of climate change, European policymakers have adopted programmatic documents outlining strategic objectives and specific targets for reducing greenhouse gas emissions and promoting renewable energy infrastructure.

In line with European energy objectives, Italy has enacted legislative measures[7] that combine systematic choices for energy transition with two ad-hoc guidelines, formulated during the pandemic emergency and in response to the recent energy crisis resulting from the conflict in Ukraine, which posed significant challenges to energy supply worldwide.

Within the complex and evolving scenery of national regulation,[8] one law

[7] The Italian government set its own energy and climate objectives by presenting, in the year 2020, the Integrated National Energy and Climate Plan 2021-2030 (PNIEC) and subsequently, in the year 2021, the National Recovery and Resilience Plan (PNRR). Specifically, with D.lgs. 199/2021 on the Implementation of Directive 2018/2001/EU, better known as the Renewable Energy Directive II (RED II), Italy also created the basis for an adjustment of the respective regulatory framework, aimed at accelerating a sustainable growth path.

[8] With D.L. 50/2022 (consolidated with Conversion Law 91 of 15 July 2022), all areas not protected under D.L. 42/2004 (Cultural and Landscape Heritage) and external to the buffer zone of the same assets (7 km for wind power systems and 1 km for photovoltaic systems) were deemed suitable for the installation of energy supply systems. Moreover, on 24 February 2023, D.L. 13/2023 was published, containing urgent provisions for the implementation of the PNRR and the National Plan for Complementary Investments (PNC). Arti-

that regards the enhancement of energy performance in cultural heritage has a particular relevance for the purposes of the present study. The so-called Energy Decree No. 17/2022, converted into Law 34/2022, introduces simplified procedures for installing solar and photovoltaic panels on buildings,[9] with a particular focus on their implementation within Zone A, i.e., historic centers. Within these areas, the installation of solar panels is exempt from permit requirements, except in regions designated as landscape-protected.

Nevertheless, the Decree specifies that even within protected historic centers, the installation will qualify for the simplified model for rooftop installations if *'the panels are integrated into non-visible roof structures that do not interfere with the urban landscape as seen from the panoramic viewpoints',* with the simplified procedure not applying to panels installed on rooftops made of *'traditional local materials'.*[10]

3. The case study of Florence: a complex definition of protection and safeguard levels

The primary objective behind the variant to the two urban management tools - the Structural Plan and Urban Regulation of the Municipality of Florence - was to address the limitations that hindered the installation of photovoltaic systems in a significant portion of the city. In summer 2022, the need to quickly draft the amendment, thus bypassing the administrative process of obtaining prior permits for installation, led to the establishment of distinct regulations for each of the 'macro areas' that define the administrative division of the Florentine territory. These macro areas, identified in the municipal urban planning instruments as zones and sub-systems, are subject to several

cle No. 47 of the Decree announces the reduction of the same buffer zone mentioned above: the new distances to be exceeded are currently 3 km for wind power systems and 500 m for photovoltaic systems.

9 According to Law 34/2022, the properties for which landscape authorisation is required for the installation of energy systems are those:
- subject to a landscape constraint by special Decree pursuant to Article No. 136, paragraph 1, letter b) of D.L. 42/2004 (villas, gardens, parks, etc.)
- located in areas on which a landscape constraint has been imposed pursuant to Article No. 136, paragraph 1, letter c) of D.L. 42/2004, which also includes historical centres;
- subject to cultural constraints, for which the authorisation of the Superintendence must be acquired pursuant to Article No. 21 of D.L. 42/2004.

10 Law 34/2022, Annex Amendments made upon conversion of D.L. 17 of 1 March 2022, Article No. 9

levels of protection, with the historic center receiving the highest level of priority in this hierarchy. In this respect, areas subject to landscape protection constitute an exception, as in accordance with the provisions of the Territorial Address Plan (PIT) - an urban planning tool that takes on the function of a Landscape Plan - the installation of photovoltaic systems remains subject to the binding opinion of the Superintendence, as required by the Code of Cultural Heritage and Landscape.

3.1 What is meant by 'historic centre'?

In Chapter II of the Code of the Cultural Heritage and Landscape, titled 'Identification of Landscape Assets', Article No. 136 'Buildings and Areas of Notable Public Interest'[11] lists among the protected landscape assets *'complexes of immovable things which constitute a characteristic aspect having aesthetic and traditional value, including historic centers'*. Rather than focusing on individual architectural structures, the conservation measures related to such assets thus extend on the entire ensemble. This approach echoes a fundamental principle in the field of urban conservation, initially laid out in the Venice Charter of 1964.[12]

However, recognizing an area of notable public interest under these terms can lead to inconsistency between different regulations. The concept of the historic center proposed by the Code, subject to protection and therefore constrained, lacks objective criteria for determining what constitutes the 'historic center'. As a result, this definition remains subject to individual interpretation and is unlikely to align with the precise technical definition emerging from municipal urban planning regulations.

Similarly, the ministerial definition of the 'historic center', referred to as the homogeneous territorial Zone A, also fails to provide a definitive solution. It is described as *'parts of the territory affected by urban agglomerations with historical, artistic, or exceptional environmental value, or portions thereof, including the surrounding areas, that can be considered integral parts, due to these characteristics, of the agglomerations themselves*[13] - a definition obtained from the document provided by the Technical Rules of Implementation

11 Paragraph as modified by D.L. 63/2008, Article No. 2

12 The Venice Charter 1964, Article No. 1: The concept of a historic monument embraces not only the single architectural work but also the urban or rural setting in which is found the evidence of a particular civilization, a significant development or a historic event. This applies not only to great works of art but also to more modest works of the past which have acquired cultural significance with the passing of time.

13 D.M. 1444 of 2 April 1968, Article No. 2 Homogeneous Territorial Zones

(NTA) of the General Regulatory Plan of the Municipality of Florence.[14] Due to the lack of precise criteria, defining the exact boundaries of the historic center remains a subjective matter, leading to potential discrepancies between different interpretations and municipal plans.

3.2 Florence levels of protection and safeguard

In the case of Florence, there are several levels of protection and safeguard to consider: the Historic Centre or Zone A1, the Core Zone and Buffer Zone of the World Heritage Site, the area subordinate to landscaped constraints.

The Urban Regulation (now converted into the Operative Plan) of the Municipality of Florence defines the 'Historic Center' (or Zone A1) as the urban fabric within the boundaries of the last city wall. Until 2021, it coincided with the Core Zone of the Historic Centre of Florence World Heritage site. During the 44th extended session of the World Heritage Committee in Fuzhou, China, from July 16 to 31, 2021,[15] the minor boundary modification of the Core Zone was approved under decision 44 COM 8B.56. The modification aimed to rectify a formal representation error in the site mapping, error that previously excluded the San Miniato al Monte complex from the delineated perimeter, despite its explicit mention in the 1982 Declaration of Outstanding Universal Value.[16]

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14 Municipality of Florence Urban Planning Department, Technical Rules of Implementation of the General Regulatory Plan. Regional Approval: Regional Council resolution No. 385 of 2 December 1997. Municipal Council acknowledgement: Resolution No. 141 of 9 February 1998. Link: https://ediliziaurbanistica.comune.fi.it/export/sites/ediliziaurbanistica/materiali/SUE/NTA_PRG1998_agg_marzo2014.pdf

15 Office of Florence World Heritage and Relations with UNESCO, 2020, Proposal for a Minor Boundary Modification to the boundaries of the World Heritage Property 'Historic Centre of Florence' Link: https://whc.unesco.org/document/181268

16 Link: https://whc.unesco.org/en/list/174/

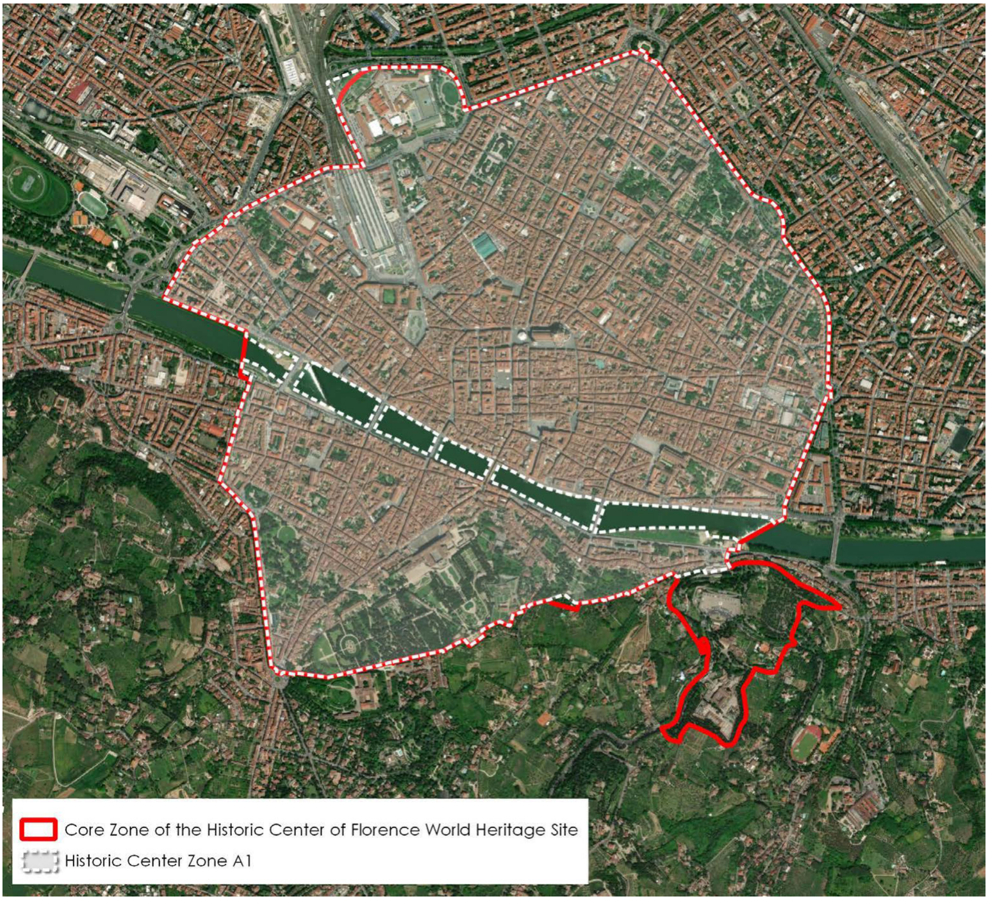

Figure 2: Discrepancies between the Core Zone of the Historic Centre of Florence World Heritage site and the 'Historic Centre' or Zone A1.

This process provided an opportunity to include not only the previously missing attribute but also an area characterized by natural elements such as gardens, avenues, and ramp systems, which collectively form an urban park designed to embrace greenery and offer panoramic views of the city, while also serving as a link between the historic center and the hilly ecosystem (Francini C., Montacchini A., Scuto L. R., Tanturli C., Vannucci G., 2022).

Thanks to its strategic position between the Arno River and the hilly landscape, Florence has preserved over the centuries its naturalistic features, where the traditional landscape, characterized by farmhouses, historic villas, and religious buildings, can still be discerned (Agnoletti M., 2010). The nature of the hillside system and its visual relationship with the built environment of the historic center are among the foundational elements of Authenticity and

Integrity that led to the inclusion of the Historic Centre of Florence in the UNESCO World Heritage List in 1982.

In the Municipality of Florence, the area subordinate to landscaped constraints consists of the overlapping of 12 areas[17] deemed of public interest due to specific characteristics. These include *'areas with particular orographic properties'; 'areas with a diverse combination of wooded and cultivated spaces - some of which constitute ancient rural landscapes'; 'areas where human works are inseparably fused with nature'; 'areas with historically and architecturally significant installations, including numerous villas, ancient buildings, and churches immersed in olive plantations, which not only form a natural landscape of uncommon natural beauty but also constitute a characteristic ensemble with aesthetic and traditional value' and 'areas that offer accessible viewpoints from where to enjoy the spectacle of beauty and renowned monuments'.*[18] The individual areas follow linear systems such as main roads and rivers or define zones with specific characteristics as mentioned earlier. However, they collectively form an incomplete and fragmented framework, lacking a broader perspective.

[17] The areas registered and mapped are those protected under the former Law 1497 of 29 June 1939 Protection of Natural Beauties (although in some cases it was also possible to recover measures issued under the former Law 778 of 11 June 1922 Protection of Natural Beauties and Properties of Special Historical Interest), later repealed and replaced first by D.L. 490 of 29 October 1999 Unified text of legislative provisions on cultural and natural heritage, then by D.L. 42 of 22 January 2004 Code of the Cultural Heritage and Landscape. Following the revision actions carried out jointly by the Region of Tuscany, the Ministry of Cultural Heritage and Activities (through the involvement of the Regional Directorate for Cultural and Landscape Heritage of Tuscany and the Territorial Superintendencies) and the LAMMA Consortium, the perimeter of the landscape constraints were validated.

[18] Landscape Constraint, Territorial Coordination Plan of the Province of Florence, Knowledge Framework, List of Properties and Areas of Significant Public Interest, approved by resolution of the Provincial Council No. 1 of 10 January 2013. Link: https://www.cittametropolitana.fi.it/wp-content/uploads/Vincolo_PAE.pdf

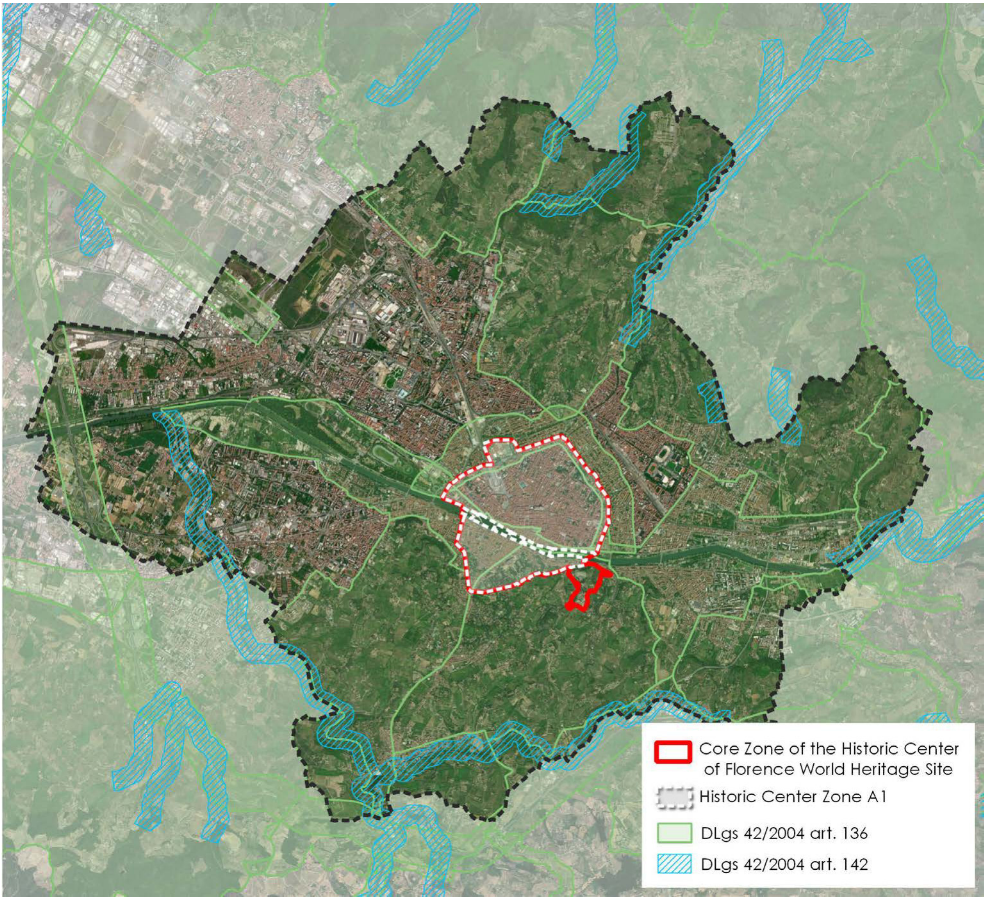

Figure 3: Areas subordinate to landscape constraints: these, together with Zone A1 and the Core Zone, constitute the mosaic of protection levels relevant to the variant.

It is essential to highlight that the concept of the historic center basic to the different levels of protection described so far in this paragraph, with the exception of the Core Zone, does not consider the UNESCO Recommendation on the Historic Urban Landscape (HUL)[19] of 2011 although this is dealt with in the Historic Centre of Florence Management Plan as well as a prerequisite to the very formulation of the guidelines of the entire document. The HUL is defined not as a heritage category but as a methodology used to govern the territory in an integrated and holistic manner. HUL applies to an urban area resulting from a historical layering of cultural and natural values that go beyond the notion of a 'historic center'. It encompasses a broader context that includes various factors, taking into account the quality of the

[19] UNESCO, 2011, Recommendation on the Historic Urban Landscape, Parigi

human environment and the productive and sustainable use of urban spaces in a balanced relationship (Francini C., 2020). This methodology promotes a vision that aims to *'consolidate the role of culture and heritage in urban policies, placing the city's historical, cultural, environmental, and social identity at the core in a dynamic and value-based context, rather than being purely prescriptive and focused on conservation, highlighting both its uniqueness and universality'* (Francini C., 2017).

Another level of safeguard, coherent with the principles of HUL, stems from the recognition of the Buffer Zone of the World Heritage Site, which, in the case of Florence's Historic Centre, occurred in 2015 through the identification of an area resulting from the overlay of different levels of protection (Bini M., Capitanio C., Francini C., 2015) and more than 50 panoramic viewpoints on the urban landscape. The Buffer Zone provides an additional layer of safeguard to sites by ensuring the preservation of the historic city's background, main vistas, and other structural and functional characteristics. In 2020, the Municipality of Florence incorporated the Buffer Zone[20] and eighteen viewpoints (out of over 50 identified), along with their visual axes,[21] into local urban planning instruments. Due to the extensive expanse of the Buffer Zone, spanning 10,453 hectares and including parts of neighboring municipalities, it was not deemed feasible, in the case subsequently discussed, to define specific guidelines for the installation of photovoltaic systems that would apply to the entire area.

[20] Second mid-term variant to the Structural Plan and Urban Regulations, approved in April 2020 by the City Council with DCC 2020/C/00007.

[21] Table 3 - Protections of the variant of the Structural Plan, approved by the Municipality of Florence on 31 December 2014.

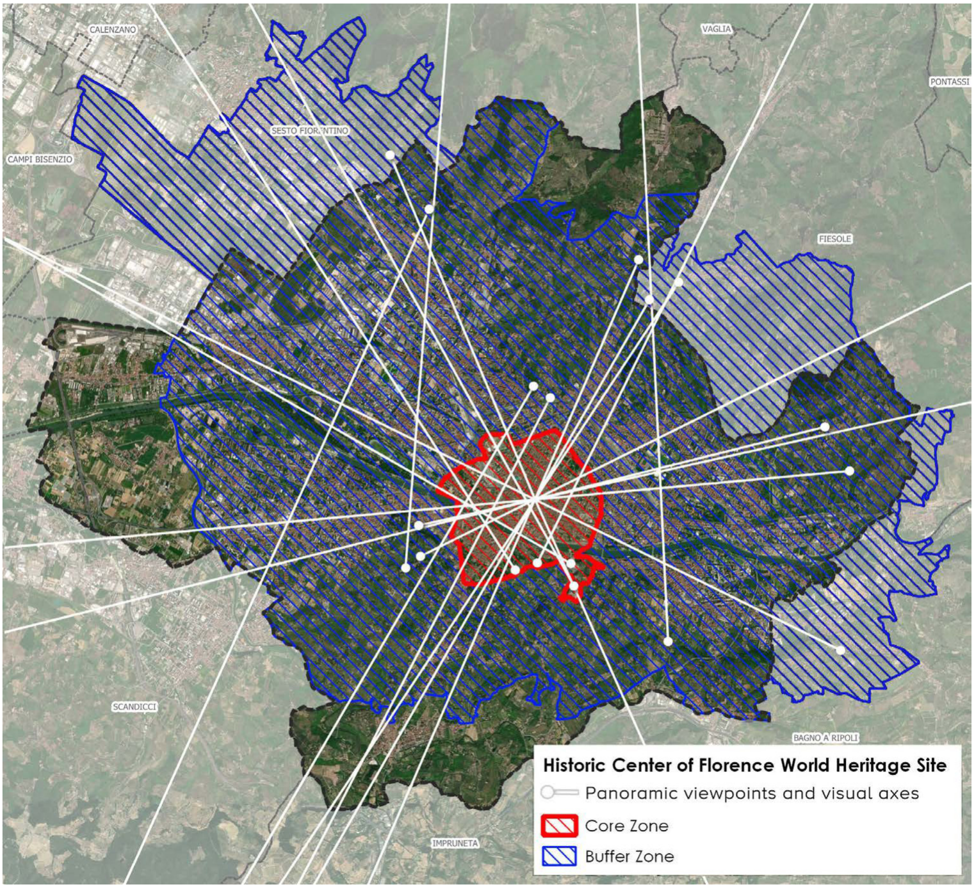

Figure 4: Core Zone and Buffer Zone of the Historic Centre of Florence World Heritage site with the eighteen panoramic viewpoint.

4. The process of amendment to the 'Variant to the Technical Rules of Implementation of the Structural Plan and Urban Regulation regarding the installation of photovoltaic and solar thermal systems'

In recent years, the municipal administration of Florence has been working on the development of new urban planning instruments - the Operative Plan (PO), formerly known as the Urban Regulation, and the Structural Plan (PS) - to align the municipal planning with the existing regional legislation, Regional Law 65/2014. In 2022, changes in national regulations and the growing attention within the European debate made it essential to prepare a variant to the urban planning instruments that would anticipate the update of the Operative Plan, scheduled for 2023. The aim was to quickly align the local normative provisions with the changing national and European framework.

4.1 What the variant proposal involves

The variant related to photovoltaic and solar thermal systems began its urban and environmental evaluation process in the summer of 2022, in compliance with the provisions of the superordinate planning instruments: the Territorial Address Plan (PIT),[22] a tool of the Tuscany region with landscape planning value, and the Regional Environmental and Energy Plan (PAER).

The Structural Plan sets out broad principles that urban planning elaborates in detail, and therefore, the variant also involved this instrument. Specifically, through Article No. 11 of the NTA,[23] the Structural Plan indicates that the Operative Plan must ensure that neither photovoltaic nor solar systems are installed within the Historic Centre (Zone A1) or the UNESCO Core Zone.[24] It should also *'comply with what is indicated by the PIT in areas subordinate to landscaped constraints'*. Referring to Section 4 of the PIT, it states: *'The installation of energy production systems using photovoltaic and solar panels must be designed in relation to the characteristics of the building and the intercepted views, and should not involve mere placement of elements on the roof, in favor of appropriate integration, employing suitable technological solutions...'*. While the indications from the PIT are mostly consistent with the previously mentioned Law 34/2022, they lack the important specification that exempts *'roofs made of traditional local materials'* from the obligation of integration.[25]

[22] Adopted by the Regional Council Resolution No. 58 of 02 July 2014, the Territorial Address Plan (PIT), with the same value as the Regional Landscape Plan, represents the instrument by which Tuscany pursues landscape protection, valorisation and promotion objectives (in line with the European Convention), in an integrated manner with the other territorial government instruments. The PIT serves an important function, as a reference framework for planning instruments at local level, and as a landscape regulation tool through the indication of protection measures aimed at safeguarding and enhancing the most important areas.

[23] Municipality of Florence Urban Planning Department, 2023, Technical Rules of Implementation of the Structural Plan Link: https://accessoconcertificato.comune.fi.it/trasparenza-atti-allegati/123766/PS_All_B_NTA_rev2023_signed_signed.pdf

[24] The extension of the Core Zone (approved by decision 44 COM 8B.56 during the 44th Extended Session of the World Heritage Committee in Fuzhou, China on 16 - 31 July 2021) was not succeeded by a modification of Zone A1 within the Urban Regulation of the Municipality of Florence, therefore the area subject to the minor boundary modification is not affected by the same protections present on the rest of the Core Zone since it does not coincide with the Zone A1 area. For this reason it is essential that Article No. 11 of the Structural Plan specifies that the constraint affects the area of the Core Zone, thus including the hilly area around the basilica of San Miniato al Monte.

[25] Law 34/2022, Annex Amendments made upon conversion of D.L. 17 of 1 March 2022, Article No. 9 Link: https://www.gazzettaufficiale.it/eli/id/2022/04/28/22A02680/sg

A photovoltaic system is considered integrated when it does not overlap the pre-existing roof surface but the panels fully replace a portion of the traditional roofing elements on which they are installed.

4.2 Considerations regarding the safeguarding of Autenticity and Integrity

As mentioned earlier, the nature of the hilly terrain surrounding Florence and its visual relationship with the built elements of the historic center are fundamental factors contributing to the Authenticity and Integrity that led to the inclusion of Florence's Historic Center in the UNESCO World Heritage List in 1982. In particular, in the 2014 Retrospective Statement of Outstanding Universal Value, in the section concerning the site's Authenticity,[26] it is described as follows: *'The setting in which Florence is situated, surrounded by Tuscan hills and crossed by the Arno River, has remained unchanged over the centuries. The Florentines, aware of their architectural heritage, have been able to preserve the original construction techniques that involve the use of traditional building materials such as 'pietra forte,' 'pietra serena,' plaster, and frescoes [...]'*[27].

[26] Historic Centre of Florence UNESCO World Heritage site, Autenticity full text: The setting of Florence, surrounded by the Tuscan hills and bisected by the Arno River, has remained unchanged throughout the centuries. Florentines, aware of their own architectural past, have been able to preserve original building techniques with traditional building materials such as 'pietra forte', 'pietra serena', plasterwork, and frescoes. The Historic Centre of Florence has safeguarded its distinguishing characteristics, both in terms of building volume and decorations. The city has respected its medieval roots such as its urban form with narrow alleyways, and its Renaissance identity, exemplified by Palazzo Pitti's imposing structure. These values are still appreciable within the historic centre, notwithstanding the 19th-century transformations undertaken during the period in which Florence served as the capital of Italy. Unique Florentine handicraft and traditional shops in the historic centre are a concrete testimonial to the local past. Thus, they guarantee continuity for an outstanding tradition perpetuating the historical image of the city.

[27] UNESCO, Adoption of Retrospective Statements of Outstanding Universal Value, Draft Decision 38 COM 8E, Doha 2014, 92-94Link: https://whc.unesco.org/archive/2014/whc14-38com-8E-eNo.pdf

Figure 5: Balance between green areas and terracotta roofs in the Florence Municipality area.

The safeguarding of the Authenticity of a cultural property, among other things, involves the preservation of its traditional building materials. In Florence, among these, we recognize the terracotta elements - particularly the ‘coppi’ and ‘embrici’ tiles - that traditionally compose the roofs of the historic center, large parts of the surrounding areas, and the hilly regions.[28]

[28] In the specific case discussed in this paper, the focus was on the brick elements used for roofing, but the same considerations could apply to other traditional materials and a plurality of interventions on the historic building. Indeed, the preservation of a site’s Authenticity concerns form and design, use and function, traditions and techniques, materials and substance in their broadest sense. Remaining in an area related to the present research, among the World Heritage historical centres that owe the preservation of Authenticity to the construction material of their roofs we can mention the Historic Villages of Shirakawa-go and Gokayamai (Japan, inscribed in 1995) and the Trulli of Alberobello (Italy, inscribed in 1996).

4.3 Office of Florence World Heritage and Relations with UNESCO observations on the variant proposal

Following this consideration, in July 2022, the Office of Florence World Heritage and Relations with UNESCO, part of the Municipality of Florence, raised its observations to the Urban Planning Department regarding the 'Variant to the Technical Implementation Rules of the Structural Plan and Urban Regulation concerning the installation of photovoltaic and solar thermal systems'.[29] The Office emphasized how the request for integration of photovoltaic panels into the roof's slope - proposed by the PIT for all areas subordinate to landscaped constraints - could lead to the loss of traditional building materials and potentially, in the near future, their replacement with incongruent elements. This would result in the loss of roof uniformity, the harmony of the urban context, and consequently, affect the perception of Florence's Historic Center from the viewpoints, compromising the site's Integrity.[30]

The disincentive towards the practice of integration did not aim to completely prevent the installation of photovoltaic panels but rather to allow their mere placement on the terracotta roof to preserve the traditional elements and facilitate a more straightforward and cost-effective installation. In any case, since these installations would occur in areas subordinate to landscaped constraints, the project for installing the photovoltaic system would be subject to the binding opinion of the Superintendence under the Code of Cultural Heritage and Landscape. The Superintendence would assess that the simplification of the technological project does not result in excessive visual impact.

29 Variant to the Technical Rules of Implementation of the Structural Plan and Urban Regulation concerning the installation of photovoltaic and solar thermal systems | Verification of submissibility to Strategic Environmental Assessment and screening of impact assessment (Regional Law 10/2010 Articles No. 22, 23 and 73ter).

30 Historic Centre of Florence UNESCO World Heritage site, Integrity full text: The Historic Centre of Florence comprises all the elements necessary to express its Outstanding Universal Value. Surrounded by Arnolfian walls that date to the 14th century, the city includes the 'quadrilatero romano,' which is made up of the present Piazza della Repubblica, the narrow, cobblestone streets of the medieval city, and the Renaissance city. The urban environment of the historic centre remains almost untouched and the surrounding hills provide a perfect harmonious backdrop. This landscape maintains its Tuscan features, adding to its value. Many of the threats to the historic centre relate to the impact of mass tourism, such as urban traffic air pollution, and of the decreasing number of residents. Natural disasters, specifically the risk of floods, have been identified as a threat to the cultural heritage and landscape. The 2006 Management Plan addresses this concern by defining emergency measures to be taken in the case of flooding.

Figure 6: Solution required by the PIT and in the variant: integrated solar panels involving the dismantling of a traditional roof portion.

Figure 7: Alternative solution: solar panels overlapping the existing roof, allowing the integrity of the roof and its traditional materials to be preserved with a very modest elevation of the whole.

An additional recommendation suggested by the Office to the Urban Planning Department to support this process and the drafting of the variant was to consider implementing the Heritage Impact Assessment (HIA) within the evaluation processes, applying the Preliminary Assessment Model developed by the joint Heritage and Research laboratory[31] specifically for Florence's

[31] The Heritage and Research laboratory, HeRe_Lab, is the joint laboratory, set up in 2015, between the Florence World Heritage and UNESCO Relations Office of the City of Florence and the departments of the University of Florence: DIDA (Department of Architecture), DAGRI (Department of Agricultural, Food, Environmental and Forestry Science and Technology) and DISIA (Department of Statistics, Informatics and Applications), and the involvement of individual members of SAGAS (Department of History, Archaeology, Geography, Art and Performing Arts) and DISEI (Department of Science for Economics and Enterprise). The laboratory, coordinated by Giuseppe de Luca and Carlo Francini, is composed of a multidisciplinary team and carries out research activities with the aim of defining plans and projects dedicated to the safeguard, conservation and valorisation of the Outstanding Universal Value of World Heritage Sites by identifying shared solutions for the conscious and sustainable management of tangible and intangible cultural, natural and landscape heritage Link: https://www.firenzepatrimoniomondiale.it/here_lab-heritage-research/ HeRe_Lab is recognised as good practice at national and international level: in particular, in 2017 it received the appreciation of the UNESCO/ICOMOS Advisory Mission in Florence, while in 2021 it was included in the PANORAMA - Solutions for a Healthy Planet platform (jointly coordinated by ICCROM, ICOMOS and IUCN) as an emblematic example of governance of a World Heritage site.Link: https://panorama.solutions/en/solution/herelab-joint-heritage-research-lab-management-world-heritage-property-florence-italy

Historic Centre.[32] The HIA methodology, another tool for implementing the HUL approach, is based on the *Guidance on Heritage Impact Assessments for Cultural World Heritage Properties* developed by ICOMOS International in 2011 and can be used as a method for assessing the potential impacts of development actions or transformation projects with the aim of proposing mitigation measures to reduce the possible negative effects on the OUV of a World Heritage site. The HIA is akin to the existing Environmental Impact Assessment (VIA) and Strategic Environmental Assessment (VAS): procedures used to ensure environmental sustainability concerning changes to projects, policies, and urban plans - however, unlike these methodologies, HIA is not legally binding (Francini C., Montacchini A., Scuto L. R., Tanturli C., Vannucci G., 2022). In the Florentine context, the *Preliminary Assessment Model* has recently been incorporated into the Municipal Operative Plan (PO), adopted on March 13, 2023.[33] This model should be utilized both at a political and procedural-technical level, particularly for guiding interventions involving the transformation of the city's skyline based on the viewpoints identified.[34]

32 HeRe_Lab, curated by Francini C., 2019, Appunti per un modello di Valutazione di Impatto sul Patrimonio (HIA), Firenze Link: https://www.firenzepatrimoniomondiale.it/progetti/heritage-impact-assessment-hia/ The model designed by HeRe_Lab is currently being used for the Heritage Impact Assessment of Pier Luigi Nervi's Artemio Franchi Stadium renovation project (the competition was won by Arup studio, with David Hirsch as chief architect) on the Historic Centre of Florence site.

33 Adoption of the Structural Plan and Operational Plan by the City Council on 13 March 2023, by DC/2023/00006.

34 Specifically, this Model was used experimentally by the Florence World Heritage and Relations with UNESCO Office, in accordance with the Municipality of Florence, during the past years to monitor the refunctionalising interventions of large complexes and abandoned areas within both the World Heritage site and its Buffer Zone. For example, since 2021, an HIA process has been underway for the redevelopment of the Artemio Franchi Stadium, originally designed by Pierluigi Nervi. Some guidelines recommended by the Florence World Heritage and Relations with UNESCO Office have been included in the competition notice promoted by the Municipality of Florence. Currently, the comparison between the winning team of the competition and the same Office is ongoing in order to facilitate the definition of the project in compliance with the OUV of the World Heritage site.

4.4 Counterclaims of the Urban Planning Department

In response[35] to the observations made by the Florence World Heritage Office, the Urban Planning Department argued that the existing methods are sufficient to mitigate the potential impact of the variant, so as not to require the specific use of the HIA in their opinion. Regarding the installation methods of the panels, the Urban Planning Department deemed it necessary to fully adhere to the provisions of the PIT as the superior instrument, thereby maintaining the obligation to integrate the panels and consequently dismantle portions of the traditional roofs in areas subject to landscape protection. This decision was made despite acknowledging the concern that significant roof portions will need to be removed and recognizing that the rapid advancement of panel technology will likely render the PIT requirement outdated in the near future.

The variant to the technical rules for the implementation of the Structural Plan and Urban Regulations concerning the installation of photovoltaic and solar thermal systems was adopted in November 2022 and took effect on May 3, 2023.[36]

5. Conclusions

As a result of the drafting of the variant under consideration, the operative approach towards local urban transformations has revealed a 'deficiency' in the provisions of a supra-local tool, the PIT, which lacked a comprehensive reception of the national regulations and an ad hoc regulation for the protection of historic centres that is mindful of the recommendations on the Historic Urban Landscape.

The experience of the Historic Centre of Florence can be considered a positive example of how studies and research on the territory, additional levels of safeguard (such as the identification of the Buffer Zone of the World Heritage Site) and international conventions and recommendations can be incorporated and implemented within the existing municipal regulations - the

[35] Observations and counter-deductions can be found in the following document: Town Planning Department of the Municipality of Florence, variant to the Technical Rules of Implementation of the Structural Plan and Urban Regulation concerning the installation of photovoltaic and solar thermal systems, Technical Reports, Annex A, pp. 72-73
Link: https://accessoconcertificato.comune.fi.it/trasparenza-atti-allegati/143233/All_A_RelaUrbaRappAmb_VarFTV_Approv_2023sg100807_signed_signed_signed.pdf

[36] In accordance with Article No. 32 Regional Law 65/2014, following publication of notice in Burt No. 18.

effective integration of HIA into the territorial governance tools is a unique exemplum in the Italian panorama. Despite this, there remain objective difficulties in the application of the UNESCO World Heritage Centre recommendations and in the correct and effective use of the HIA, which proves to be a pragmatic approach with non-systematic utilization to date. Therefore, in the immediate future it will be necessary to evaluate within the site's governance the opportunities related to a concrete and effective application of the HIA, as well as a proper dissemination of the values related to the recommendations on HUL. Additionally, there should be a consideration of how the Management Plan should harmoniously interact with the local urban planning instruments, aiming for an integrated management of the entire World Heritage site: an urban planning capable of interpreting, integrating and pursuing the Outstanding Universal Value.

With their typical value-based approach to heritage, the UNESCO conventions and recommendations offer the opportunity to better understand the relationships between heritage, city, territory, environment and community, putting to the background a merely constraining approach that, by itself, cannot guarantee the safeguarding and preservation of a World Heritage site.

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List of acronyms

D.C.C. - Municipal Council Resolution
D.L. - Decree-Law
D.Lgs - Legislative Decree
HIA - Heritage Impact Assessment
HUL - Historic Urban Landscape
L.R. - Regional Law
NTA - Technical Rules of Implementation
PAER - Regional Environmental and Energy Plan
PIT - Territorial Address Plan

PNC - National Plan for Complementary Investments
PNRR - National Recovery and Resilience Plan
PO - Operative Plan
PS - Structural Plan
VAS - Strategic Environmental Assessment
VIA - Environmental Impact Assessment

With regard to technical terminology, please refer to the Italian system.

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10. How does Cultural Heritage Foster Climate Action? Examples of Histo-Culture-based Urban Resilience from Around the World

Marika Fior[1], Rosa Romano[2], Maria Paz Abad Gonzalez[3], Jui Ambani[4]

Abstract

Climate variability and change have been ongoing. Urban areas with historical and cultural significance are vulnerable to the increasing effects of climate change, both physically (such as building materials durability) and socially (such as loss of inhabitants, internal displacement, tourism, and worsening economic conditions for disadvantaged populations). However, people and cities have proven to be resilient over time, even in the face of global challenges.

Combatting climate change impacts on heritage and people requires consideration of social, cultural, environmental, and economic factors. This chapter focuses on the unique challenges posed by the presence of Cultural Heritage in an urban setting and explores design actions that balance preservation with innovation. By examining the physical and structural features of historical cities, their public spaces, and sociocultural connotations, the chapter aims to highlight how communities on the frontlines of the climate crisis use them as an expression of intrinsic resilience.

Through case studies from different climatic zones, the chapter explores the rediscovery and re-evaluation of 'histo-cultural forms' of climate change adaptation. It outlines techniques and solutions -from traditional and Indigenous knowledge to tangible structural features- that are being used to cope with heat islands, storms, floods, etc. and are congenial to heritage sites, in sustaining local culture and knowledge and know-how while demonstrating renewal and adaptability.

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Keywords

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1. State of the Art

1.1 Cultural Heritage and Community are co-evolutionary elements for the adaptation

The scientific community recognises that integrated urban systems are a key-factor in the regeneration of cities, now chosen by the world population as their place of living (UN, 2019). At the same time, reports by the International Panel for Climate Change (IPCC) have systematically demonstrated that human activities are the primary cause of the intensifying in global warming, the melting of glaciers, rising sea level, and the increase in the frequency and intensity of extreme weather events exacerbating the exposure of cities and settled communities (Musco & Magni, 2014).

For the first time in 2013, Cultural Heritage was recognised as a key-factor in addressing global risks, placing culture at the heart of sustainable development policies (UNESCO, 2013). In 2015, the *Sendai Framework* emphasised that Cultural Heritage -as the most symbolic expression of a cultural system- must be considered in any disaster risk reduction programmes and thus strengthen the communities' resilience (UNDRR, 2015). Form another perspective, Cultural Heritage could support "the building of a community able to prevent, cope with and recover from disturbances" (Fabbricatti, Boissenin & Citoni, 2020, talk about "Heritage Community Resilience").

In this chapter, Cultural Heritage is understood as the set of material signs stratified on the territory over time (Corboz, 1983; Secchi, 2005). It is strictly linked to a community because it is the empirical evidence of the adaptive/transformative/evolutionary capacity of civilisations to face existential challenges. Different eras have marked the progress of civilisations; and the Cultural Heritage is the result of these transitions, not always peaceful, but expressive of the societies that created and preserved it. Therefore, Cultural Heritage is not static (reaching an ideal *status*) and immutable, but changes according to different social and environmental conditions. In other words, it is a "gene-culture-environment coevolution": the way through which a group of people figure out 'how we live here'. "It is in this way that cultural evolution generates insights about what is and is not adaptive; and such insights are directly applicable to issues of climate-change adaptation in the world today" (Brewer & Riede, 2018). The evolutionary capacity of Cultural Heritage, in adherence to the community, is the element that determines its conservation or abandonment, and above all, it shows the replicable Histo-Culture-based urban-building solutions. After all, none historic city could live without a community. Indeed, the article 1 of the *UNESCO Convention* (1972) emphasised that Cultural Heritage is created and animated by the society; while, the article 6 of the *Faro Convention* (2005) included the definition of "Heritage Community" and set off the inseparability between the two dimensions. Nevertheless, the process of adapting the historic city to the society's needs -that inherits the heritage- is crucial and it can only take place together with citizenship's evolution. The latter must re-actualises its environmental, social, economic and cultural values for developing of a more sustainable and inclusive city (Redaelli, 2019).

To make cities climate-proof, it is strategic to study the urban-building solutions that communities have employed over time to cope with negative micro-climatic conditions and reducing social costs (building and building back better). With this perspective, one must learn from the past to write the present and prepare for the future. Moreover, the fact that historical cities have survived until today represents the first real lesson in urban resilience, as it derives precisely from their ability to adapt and evolve (Holtorf, 2018). The climate change impacts on tangible heritage and has both direct effects on buildings, public spaces and infrastructures, as well as indirect effects on people and habitats, leading to climatic migrations (or displacement of cultural bearers) and abandonment of their place of living (Shirvani Dastgerdi *et al.*, 2020).

However, climate change is also an opportunity for 'transformative development', activating opportunities for cities to generate urban quality, security/healthy and innovation from Cultural Heritage. According to Wolfram (2016), transformative capacity focuses on understanding how urban systems can reshape themselves and transition to a more sustainable form and function that is better than the conditions they had before the shock/stress experienced. Such knowledge can be acquired through Traditional Ecological Knowledge, an evolving body of knowledge acquired by local populations over hundreds of years through direct links with nature (Nelson & Shilling, 2018). Observing Cultural Heritage as not only a fragility factor but also as a resource stimulates the principle of sustainable urban development, based on the deep link between culture and territory.

1.2 From architecture to vernacular urbanism increasing resilience

Heritage features are closely linked to climate: urban and rural landscapes are linked to the plant species that thrive in different climatic regimes. They are designed with the local climate in mind, taking on the vernacular dimension that Oliver (2006) calls "domestic". The history of cities offers several examples of how civilisations have dealt with climatic hazards by creating site-specific adaptation solutions, sometimes still practised by some Indigenous societies and preserved in the urban structure of places.

Today, these systems based on empirical actions related to everyday life, rooted in Indigenous societies -constituting vernacular production-, are considered key elements for the sustainable development of built environments. The term *vernaculum* was used by the Latins to distinguish everything that was produced on the side from what was acquired from commercial exchanges. In literature, "vernacular architecture"[5] refers to buildings built by non-academic and anonymous labour that incorporates traditional construction systems and responds sustainably to a geographical environment (Peralta González, 2017). There is a growing interest in this topic in discussions related to building history highlighting a relationship between building function, climate and traditional construction techniques with historical context (Moholy-Nagy, 1976). The definition of 'vernacular urban planning' is less obvious but can be traced back to what Françoise Choay (1996) calls the "city idea" or Alberto Magnaghi (2000) the "statute of places".

On the contrary, globalisation and the trend towards cultural homogenisation show little attention to Cultural Heritage and site-specific characteristics of places (Dipasquale & Mecca, 2016). In architecture, this translates into the use of standardised design solutions to the detriment of local craft creativity, which in many cases involves high consumption of natural and energy resources because it is based on the linear fossil principle.

Vernacular architecture, by its nature, is a practical knowledge of continuous evolution and contamination. A valid example of it is the evolution of the Spanish covered streets, from which street roof-protection became an architectural feature, defining porticoed areas that in turn evolved from building character to urban morphology -a structure capable of con-

[5] The debate on what vernacular architecture is, has been raging since the creation in 1976 of the International Committee on Vernacular Architecture (CIAV) of International Council on Monuments and Sites (ICOMOS), whose central concern was to prevent the disappearance of this type of construction, which is vulnerable to the rapid growth and changes of modern life (Charter on the Built Vernacular Heritage ratified by the ICOMOS 12th General Assembly, in Mexico, October 1999).

figuring entire cities- as the *Portici* of Bologna (arcades) demonstrate (Rudofsky, 1970).

Therefore, tradition and innovation are allied for urban sustainable development, concretely implementing the idea of "transformative resilience" (Manca *et al.*, 2017) that underlies a process in which the society learns from the past for dealing with the future cities and facing new challenges.

2. Goals and Methodology

Throughout human history, vernacular architecture and urbanism have represented adaptive solutions to environmental, climatic, socio-economic, and societal constraints (Correia *et al.*, 2014). These traditional multi-scalar actions range from technological elements to architectural and urban solutions. They reflect a practical response to the local community's identity and know-how, in other words, its culture.

The chapter highlights how -along the human history- adaptive solutions to climate change can be found at various scales. From ancient times to the closest urban history, solutions -from the building detail to the definition of a new district- represent a set of local-based actions/techniques showing a community's identity and its know-how, in other words its culture.

The idea behind the article is that urban resilience to climate change should not be created from scratch through a top-down approach. Resilience must be found in the existing settlement fabrics and strengthened (Fabbro, 2020). In fact, it is peculiar to artefacts that have variety, multi-functionality and redundancy, i.e. the typical characteristics of resilient complex systems such as historic cities and, in general, the Cultural Heritage handed down from/to the generations.

To support this idea, this chapter presents four urban contexts from Ecuador, India, Spain, and Italy, each with different histories, cultures, traditions, geographies, and climates. Their diversity shows how local knowledge and culture have always allowed civilizations to adapt to environmental and climatic challenges. The chapter discusses concepts and techniques that can be replicated in our current situation.

The case study is a recent research methodology mainly used in the humanities to analyse unique or complex situations. Cities are "evolving complex systems" determined by their own (unpredictable) capacity for self-regulation, i.e. by the changes that occur over time in both physical and social structures (Bertuglia & Vaio, 2019). Hence, this contribution presents a non-systematic review of four cities from around the world (Azuay-Cañar provinces in Ecuador, Udaipur in India, Madrid in Spain, and Rome in Italy). The review aims to analyse these cities and identify their adaptive solutions to climatic and meteorological hazards from the past, handed down from the past as good solutions to meteorological and climatic hazards. The methodology used in this research is a QUALITATIVE literature review for each city, focusing on identifying traditional climate adaptation forms. This method is based on a second-level study through a hermeneutical review of the scientific literature. Unlike a systematic review, typically used in medical settings, the hermeneutical review focuses on qualitative reflection and interpretation of phenomena. The review aims to generate ideas and hypotheses rather than on the completeness of the literature selection. (Greenhalgh, 1997; Greenhalgh *et al.*, 2018).

The four case studies represent preliminary qualitative research on traditional forms of adaptation to the climate with the aim of collecting 'data' (observations and comments) to generate ideas and hypotheses through the so-called inductive approach whose strength is the proximity to the 'truth of the reality that happened'.

After a brief summary of the state of the art (ph. 1) on Cultural Heritage in relation to climate change and communities, and the illustration of the working methodology (ph. 2), a specific paragraph describes each city's historical, environmental, and social characteristics. This includes highlighting the architectural and urban planning solutions used to cope with urban heat islands and heavy rainfall[6].

The paragraph 3 collects the discussion of Azuay-Cañar provinces in Ecuador (ph. 3.1), Udaipur in India (ph. 3.2), Madrid in Spain (ph. 3.3), Rome in Italy (ph. 3.4). The first case study in the Azuay-Cañar provinces in Ecuador tries to understand low-impact mitigation practices, where the earth is the predominant material for vernacular architecture (a technique used by 30% of the global population for building their home). It also highlights the social practice of *minga,* which is used to organise private, semi-public, and public spaces, reducing realisation costs and ecological footprint. The second case study is about Udaipur, India, where traditional materials such as marble and lime are used to mitigate the impacts of severe heat, and the region's five lakes and underground systems (*Paar, Talabs, Bawri* and *Kundi*) are used to store rainwater. The third case study focuses on another low-impact and sustain-

[6] As highlighted in the Sixth Assessment Report during the IPCC's 58th Session held in Switzerland (2023, March 13-19), urban heat islands and extreme rainfall are the most disruptive and transversal effects on all cities in the world. The increase in global temperature due to greenhouse gases determines the increase of heat waves and accelerates the water cycle, causing more floods and droughts (Hoegh-Guldberg et al., 2018).

able solution in Madrid, Spain, where the ancient groundwater capture and management system, the *qanat* technique, is used to sustain water resources. The fourth case study is about Rome, Italy, where the role of post-unification districts, "new Piedmontese," is highlighted based on the orthogonal grid of streets rotated towards the west (equisolar axis) are used to favour wind cooling.

The final paragraph (ph. 4) offers some concluding reflections on the lessons that the case studies offer. It highlights that Cultural Heritage is both an object of adaptation actions (site-specific) and a solution for adaptation actions (place-based). Architectural and urban planning techniques/solutions -that have spanned continents and history (from antiquity to modernity)- demonstrate how historic cities have always been resilient organisms providing adaptive solutions consistent with local culture. They are Cultural Heritage, on the one hand, to be preserved and, on the other hand, to be re-actualised in order to defend cities and people from climate hazard.

The collection of four case studies demonstrates that the adaptation of historic cities needs implementing useful actions and methods to face global challenges, starting from the re-signification of the Cultural Heritage. The latter already offers valuable solutions to the negative climate effects (heat waves and heavy rains especially). Local practices and traditions represent a fundamental *trade d'union* for the development in continuity of urban history, to simultaneously protect and adapt cities. This approach can only be implemented on a case-by-case basis. However, common elements among different contexts that can be taken as inspiration for new Histo-Culture-based solutions. In order to increase urban resilience, among climate change adaptation actions, it is strategic to recover traditional building techniques and urban planning solutions by integrating them with innovative technologies (Garcìa Hermida, 2019; Bonazza, De Nuntiis & Sardella, 2021).

3. Case Studies Discussion

3.1 Azuay-Cañar provinces, Ecuador

The provinces of Azuay and Cañar have an average multiannual temperature between 15-17° C. The historical zone of the city of Cuenca is located at approximately -2.8974° latitude, -79.0045° longitude, and at an altitude of around 2,543 meters above sea level.

To understand the vernacular architecture in the provinces of Azuay and Cañar, it is necessary to refer briefly to the Cañari and Inca people (the first settlers) and the influence of Spanish colonisation on this type of architecture. The mountainous landscape has greatly influenced the vernacular architecture of these provinces. Before the Spanish occupation, settlements were typically located in high settlements and even steep sites, as this allowed them to ensure a strategic position over their enemies, as well as good ventilation and sanitary conditions. According to González Suárez (2017), the shape of the houses in these provinces varied from almost round to quadrangular, with elliptical houses having two doors among the Cañaris. Their construction systems were strongly linked to ways of life that have since been lost. To fully understand the vernacular architecture of these provinces, it is necessary to establish a relationship between technological solutions, cultural values of the property and users' comfort requirements.

According to Houben and Guillaud (1994) and ASTM E2393/E2392M-10 (2016), earth has been a construction material for a long time, and adobe is one of the oldest systems, with records dating back to 8000 b.C. It is also the most widespread with examples in almost all the warm-dry and temperate climates of the world (Achig *et al.*, 2013). It is observed that about 30% of the total population lives in earthen constructions, not only adobe, with approximately 50% concentrated in developing countries in Latin America, Africa, India, Asia, the Middle East and Southern Europe, with a predominance in rural areas (Houben & Guillaud, 1994; Blondet, Villa García & Brzev, 2003; Fratini *et al.*, 2011). On the other hand, according to the inventory of World Heritage architecture on earth (CRAterre, 2012), 150 properties are constituted by this materiality, with a majority presence in the region defined as Asia-Pacific regions, followed by Latin America.

The main constant in this type of architecture is using earth as the predominant material (Eljuri, 2010). The structures are predominantly made of adobe or bahareque. In some cases, a combination of both materials (bahareque and rammed earth) is used, especially if the building has more than two stories (García *et al.*, 2017). Each location's variations in form and function result in unique characteristics that respond to the specific urban or rural context. The use of wood in ornamental elements and the play of planes create semi-public spaces that enhance the functionality of the building (Pesantes, 2011). Using local materials not only enhances the identity of the place, but also reduces transportation costs and pollution. Traditional materials such as hemp, lime or straw absorb CO_2 making them an eco-friendly option (Godwin, 2011).

Adobe has thermal inertia, which allows it to store heat and transmit it from the outside to the inside, depending on the wall thickness and orientation (Wrigth, 1981). Structures with this system have a low environmental impact since less energy is needed to produce them, and they are 100% recyclable and reusable. Only 1% of the energy needed to manufacture reinforced concrete is required to prepare, transport and work the mud on site (Minke, 1994). Research on buildings in the Netherlands shows that using wood in the construction of buildings could reduce CO_2 emissions by 50% compared to traditional materials (Pérez Gálvez *et al.*, 2012). Additionally, manufacturing processes with this material have the potential to reduce the production of about 100 tons of CO_2 emissions each year. Using this material in construction represents an important contribution to the eco-efficiency of the construction industry and, therefore, to a more sustainable development (Pacheco-Torgal & Jalali, 2012). Adobe mainly consists of mud, which also absorbs pollutants and regulates environmental humidity and indoor climate (Carangui, 2010).

The space in these structures is mainly semi-public, denoting a sense of community and trust. The social practice of community or voluntary collective work, called *minga*, is used for agriculture, canal and bridge construction, and other infrastructure works in the American Andes. The result entails the satisfaction of participation for the common good and retribution, expressed in the direct benefit of those who have helped. The *minga* is used to build and manage human, economic and natural resources, which are born from social organisations, cooperatives and communities, to achieve goals that contribute to the common good. The *minga* becomes efficient and modern, with roots in past cultural moments of regional and local communities. From the procurement of materials to the construction, the *minga* begins in the family nucleus, which the community joins. Everyone participates, including children, elders and women accompanied by ritual elements that guarantee the well-being of the occupants. Community work is the platform for transmitting knowledge to the next generations. (Vázquez *et al.*, 2018).

3.2 Udaipur, India

Rajasthan, a western desert state of India, is known for its harsh climatic conditions, including extreme heat, hailstorms, frost, cold waves, locust attacks, cyclones, cloudbursts, and sandstorms. The region is also grappling with the intensifying impact of global warming, leading to unprecedented heat waves (Hess *et al.*, 2018).

Rapid urbanization and infrastructure development further expose the state, including its Cultural Heritage and people, to the adverse effects of climate change. This case study focuses on Udaipur, often called the 'City of Lakes' and 'White City', to explore how traditional water systems are pivotal in mitigating climate change impacts.

Udaipur has a rich history of traditional and ancestral knowledge-bearing communities whose practices predate the modern infrastructure. The city's iconic architecture and urban fabric have earned it the White City. This is attributed to the use of white marble and lime wash in the construction of houses, which not only adds to the city's aesthetics but also helps mitigate the impacts of severe heat (capaCITIES, year n.a.).

Udaipur is also known as a 'City of Lakes' due to its sophisticated system of five man-made lakes: Fateh Sagar Lake, Lake Pichola, Swaroop Sagar Lake, Rangsagar and Doodh Talai Lake. Over 300 years ago, the Maharanas (rulers) of Mewar built this interconnected lake system in Udaipur which supports and sustains groundwater recharge, ensuring the availability of water for the purpose of consumption, industries, agriculture and tourism (MMHPTN, 2020).

The traditional water systems -*Paar* (Table Water), *Talabs* (Lakes), *Bawri* (Stepwells), and *Kundi*- are still used and relied upon by the city to store rainwater through its network of catchments in man-made lakes, ponds, and step wells, as well as porous agriculture techniques. Apart from being the most efficient way for water harvesting and management, these systems also serve religious, cultural, traditional, and sociological purposes (CSE, 2020).

Paar system is a common water harvesting practice in Udaipur, where rainwater flows from catchment areas and percolates into the sandy soil. To control water wastage and create a *Paar* system, 6-10 deep holes, known as *Kuis* or *Beris*, are constructed near water-leaking tanks.

Udaipur boasts a variety of stepwells with different typologies. *Kua* is usually a well owned by an individual, while *Bawri* or stepwells are deep trenches lined with stone blocks. These stepwells serve as venues for social and religious gatherings. They help maintain water levels with rainfall, keep the water cool even in summer, and act as natural water purifiers.

Tankas, also known as small tanks, can be found in the courtyards of traditional homes. They are constructed with lime plaster and thatched bushes to divert surface water runoff. This concept can also be applied on a large scale, serving clean water to an entire neighbourhood.

Talabs are lakes or large reservoirs constructed in natural depressions or valleys. These are community-based constructions with lime masonry walls and soil filling. Smaller reservoirs are called *Talai*, medium-sized lakes are *Bandhi* or *Talab*, and larger ones are sagar or samand. These lakes are crucial in sustaining water availability for consumption, industries, agriculture, and tourism (Murugesan & Amirthalingam, 2014). When the water in these reservoirs dries up just a few days after the monsoon, the pond beds are cultivated with rice (CSE, 2020).

Udaipur faces water-related challenges due to its need for perennial rivers. The region relies on deep wells and rainwater harvesting systems. However, rapid urbanization, increased demand for agricultural land, and deforestation have led to impermeable concrete surfaces, making natural water storage difficult. The escalating heat waves have intensified droughts and further reduced water availability. Groundwater levels have plummeted significantly (Udaipur Urja, 2022).

At the same time, Udaipur's traditional water systems offer valuable lessons in climate resilience. These systems not only serve as efficient water harvesting and management methods but also safeguard Cultural Heritage and provide a sustainable solution to the water scarcity exacerbated by climate change. As other regions grapple with similar challenges, the experience of Udaipur serves as a beacon of hope and a model for incorporating traditional knowledge into modern climate adaptation strategies.

Water Conservation: traditional water systems have been instrumental in conserving and storing water. Stepwells, *Tankas*, and *Talabs* help capture rainwater and replenish groundwater, providing a sustainable water source for various needs.

Cultural and Social Significance: these traditional systems serve not only as water reservoirs but also hold immense cultural, religious, and sociological value. They are gathering places for the community and contribute to preserving heritage.

Resilience to Climate Change: the interconnected lake system in Udaipur has proven to be resilient against the challenges of climate change. It supports groundwater recharge, ensuring a consistent water supply, even during periods of drought (MMHPTN, 2020).

3.3 Madrid, Spain

Madrid was established by the Muslims (around 860 a.D.) as a fortress to control the Manzanares River valley. The Moors, skilled 'hydraulic engineers', introduced irrigation systems and water management techniques, such as the *qanat*. This is an ancient system for capturing and managing groundwater, which involves long underground tunnels known by different names including *karez*, *aflaji*, *ingruttati*, *khottara* and *foggara*. These tunnels transport water to the surface using the gravity, providing a low-impact and sustainable exploitation system even by today's standards.[7]

The foundation of Madrid itself is closely linked to its hydraulic infrastructures, which naturally developed due to the morphology of the land. Some scholars suggest that the name Madrid is derived from the Arabic word *mayra*, which means 'water conduit', combined with the Ibero-Roman suffix *-it*, which means 'place of'. The outcome is *Mayrit*, the word from which Madrid is derived (Martınez-Santos & Martınez-Alfaro, 2012).

The *qanats* of Madrid are often called the '*viajes de agua*' (water trips), derived from the Latin phrase *Via Aquae*. Other local traditions still connect Madrid to groundwater. For example, Madrid's oldest coat of arms bears the inscription: "*Fui sobre agua edificada mis muros de fuego son esta es mi insignia y blasón*" (I have been on the water and built my walls of fire, this is my badge and my coat of arms). Legends about Saint Isidro the Worker, a native of the region and Patron Saint of the city, depict him as a renowned water seeker, i.e. diviner. In total, 124 km of *qanats* run beneath the Spanish capital; 70 km of which are used to catch water and 54 km to transport it to the city, supplying water to 750 water sources, which over time became fountains.

The *qanats* vary in size and shape; some are unlined, while others are brick-lined with arched ceilings to improve stability and prevent contamination; most are high enough for a person to walk inside and about 60-80 cm wide (Martınez-Santos & Martınez-Alfaro, 2012).

Madrid became the capital of Spain in 1561, and as the population grew, so did the demand for water. Historical documents indicate that several new tunnels were opened during this period, with the last branch being inaugurated in 1855. The *qanats*, the capital's only water source until then, were replaced by water from the Lozoya River, channelled through the Canal de Isabel II in 1858. (Gerrard & Gutiérrez, 2018). This change marked a cultural transition that led first to the decommissioning and then to the disappearance of these systems. The disposal of *qanats* implies the loss of history, tradition, memory and local identity, inextricably linked to the contamination of civil-

7 The construction technique of the *qanats* involves digging a mother well in order to assess the depth of the water table. Based on the depth, the lower outlet point of the tunnel is calculated, which is then excavated to join the two points. Vertical shafts are excavated along the tunnel route to facilitate access and removal of excavated material, as well as to ensure ventilation and evaporation. When the tunnel intersects the water table, the groundwater infiltrates and is transported by gravity towards the outlet: the water is then conveyed into the city in distribution reservoirs or irrigation fields.

isations that in the past, as today, represents the main vector of innovation and socio-cultural evolution. The *qanat* technique, along with vernacular architecture in general, underlies that connection between the artificial and the natural systems, between technological and ecological principles, favouring those ecosystem services essential for planetary equilibrium based on a system of mutual exchange between human activity and the cycle of nature.

The *qanat* technique originated in the Middle East and spread to Europe and America over time. The ancient *qanat* system still supports agricultural and permanent settlements in Iran's arid regions, and the traditional community management system allows for fair and sustainable water sharing and distribution (De Cesaris, 2023). In 2016, Iran's *qanats* were declared a World Heritage Site. Similarly, in 2002, UNESCO recommended the protection of Madrid's *qanats* as a World Heritage Site to preserve an important part of the city's heritage. However, well-preserved *qanats* are rare, and only a few of them have survived today. Occasionally, a tunnel is discovered during excavation, as is the case with the *Viaje de Agua de Amaniel* built between 1614 and 1616. Also known as the Palace waterway, because it was created during the reign of Felipe III to supply the Alcázar. Today, it can be seen in the galleries near Juan XXIII Street facing the Amaniel Aqueduct. In the same way, some of its *capirotes* (well caps) have stood the test of time and survived as elements of the urban landscape (Madrid, 2009).

The valorisation, management and utilisation of this Cultural Heritage -compatible with its original function as the city's water supply- represents an unmissable opportunity to address the phenomena of heavy rains and heat islands in Madrid (and perhaps also in other parts of the world). Starting from these ancient underground infrastructures, an integral regenerative process can be triggered in line with the recent *Nature Restoration Law* (approved by European Parliament in 2023, July 12).

3.4 Rome, Italy

Rome *Caput Mundi*. The city's history is rich and spans millennia of civilisation. This discussion will focus on modern Rome, specifically the city development between the 19th and 20th centuries, aiming to assess the resilience of its settlement's fabrics to climate change. During this period, the concept of vernacular/traditional architecture and the focus on the environmental comfort of settlement fabrics gave way to the real estate market, which became increasingly independent of the hydro-geo-morphology of the territory and the historical landscape (Funiciello & Testa, 2008). Is this really the case?

Historically, Rome was built on seven hills (no higher than 40-50 m), which guaranteed defence from enemies and healthiness from the plain of the River Tiber. The land was anthropised through drainage networks with the burial of watercourses and works such as the *Cloaca Maxima* (Pica & Del Monte, 2018). The progressive anthropisation of the soils and the continuous levelling of the minimum altitude differences have certainly influenced the climatic comfort of the city. The reduction of the steepness and the inefficiency of the underground drainage systems cause evident problems throughout the urban area (Funiciello & Cologgi, 2008), and the impacts of the floods of the Tiber extend especially in the historic centre (Lanzini *et al.*, 2008). Furthermore, the ancient Romans had devised solutions for the thermal comfort of both private spaces -through the use of white and porous lime mortar (which allowed air permeability and the reduction of humidity inside buildings)- and public spaces -through the creation of the *Viae Tectae*, i.e. the covered streets to protect passers-by from solar radiation- addressing the issue of urban heat islands *ante litteram*.

Over the centuries, the city has undergone a slow and fluid stratification process, adopting settlement rules linked to the knowledge and canons of the time and favoured by a mild climate. It was during the establishment of the great European capitals after the Second Industrial Revolution that Rome began to redesign its urban spaces (Cassetti, 2005). On an experimental basis, we believe that these solutions have supported the process of continuous adaptation of the city to environmental, meteorological and climatic factors by creating climate-proof settlement fabrics. The objective, through the study of the post-unification districts of Rome, is to recognize not the features of vernacular architecture, but of a 'vernacular/traditional urban planning' which has been deposited in Rome, in other European capitals as well, a model of a resilient city and today recognized for its quality and historical value.

Briefly reviewing the modern history of Rome, the city started to draw its first city plan after the unification of Italy (1870). The Viviani's Plan, was not definitively approved, and instead, the city followed a model of expandion similar to what was happening in Paris by Baron Haussmann and in Barcelona by Ildefonso Cerdà[8]. The far-sighted experience of Barcelona proves the

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[8] The Spanish case is emblematic for briefly summarizing the inspiring principles of a new, modern settlement model which aimed to combine efficiency and aesthetic quality. The Cerdà's Plan (*Proyecto de Reforma y Ensanche de Barcelona*, 1859) is well-known for having used the cuadrícula, the orthogonal grid of streets, to facilitate mobility and create urban blocks that satisfy conditions of density, ventilation and sunlight. Another interesting aspect is the attention that Cerdà retained, to a collector avenue to protect the Eixample from torrential rains in 1855 (Magrinyá & Marzà 2009).

extreme confidence on technological innovation based on a hard engineering approach. Seems that the approach progressively interrupted the traditional relationship between humans and nature.

Rome waited until 1887 the official plan, again by Viviani engineer. Nevertheless, in those ten years, the urban area grew through the development of the “new Piedmontese districts”. They were so called because they housed the new ministerial management class that arrived from Turin (in Piedmont region), but also because they repurposed, with the necessary adjustments, the Turin settlement model. It consisted of straight streets, with four/five-storey rental houses (already present in Baroque Rome) plastered with yellow ocher, the cheapest colour, and built around the public squares. “Here and there, timidly, the ‘Piedmontese’ tried to transplant the *portico* (arcades): but on the one hand the weather of Rome did not require them and tradition did not know them, on the other hand, they stole area from speculation” (Insolera, 2011). The *portico* was an architectural element that would not have brought great climatic benefits to Rome at that time, given the constant relationship with the surrounding countryside – the *Agro romano* Which transferred the fundamental ‘ecosystem services’ for free and vegetated soil to the urban districts (ventilation, cooling, rainwater absorption).

In these circumstances, the expansion of the popular peripheries in the capital gave rise through the development of two important neighbourhoods: San Lorenzo and Santa Croce. San Lorenzo in particular, was build as a quarter for the rail workers, covering almost 40 hectares and featuring an orthogonal grid of streets, with five-storey ochre-plastered houses flush with the street and a closed inner courtyard for ventilation and lighting.

The orientation of the grid is rotated towards the west by 30-40 DEGREES, allowing the winds to enter, especially in the summer, when they come from the east and west, channelling themselves into the neighbourhood’s road network. The orientation follows the equisolar axis defined by Gaetano Vinaccia in 1940, a pioneer in solar engineering (Chiri & Giovagnorio, 2015). This axis ensure the correct thermal exposure on four sides of the buildings instead of just two, making it better than the heliothermic one (Vinaccia, 1952). The road network is not particularly wide (about 12-14 metres), but manuals from the beginning of the century stated that unlike cold countries, in warm ones, narrow streets defend inhabitants from the sun and dust, reconciling shading and ventilation.

4. Final Remarks

What is the lesson offered by the FOUR WORLDWIDE case studies? Heritage is not just historical elements and practices. It is the urban, the new, the old, the ignored, the forgotten, and the valued. It serves as a story-telling machine and a cascading research tool, providing insights to mitigate modern-day challenges such as climate change through its lived experiences.

In the case of Ecuador, vernacular architecture has economic value because it uses resources efficiently, both spatial and material. The vernacular architecture uses what is necessary -no less, no more- making it highly energy efficient. Heritage buildings highlight aspects such as the walls thickness, which helps in gaining heat during the day and expelling it during the night to the building's interior. Using recyclable materials is a relatively new concept that aims to reduce energy expenditure and maintain a long-term energy balance in the building (Pérez Gálvez *et al.*, 2012). This approach maximises and prioritises the use of materials from the immediate environment, favouring *in-situ* construction, which reduces the ecological footprint and optimises transportation costs and facilitates its constant maintenance. The *minga* has also been used as a tool for heritage conservation that implies cost reduction, greater feasibility of execution, and optimisation of human resources. This type of non-wage labour significantly reduces the cost of labour and entrepreneurship (Vázquez *et al.*, 2018).

Culture, is the full range of human experiences: from the ones living through knowledge and practices of indigenous and local communities to tangible remains of earlier societies, who also faced environmental shocks along with historical trajectories that have created the places and climatic situations within which we live now (ICCROM-FAR, 2022).

The study conducted on Udaipur sheds light on the importance of cultural knowledge in supplementing scientific data for effective climate change management. Traditional methods of rainwater and natural water harvesting can serve as examples of water conservation in India to combat the impending water crisis. The research emphasizes that city-wide measures, involving citizens in enhancing preparedness and utilizing traditional knowledge, have a sustainable and long-lasting impact. Culture and heritage play a crucial role in developing fair and inclusive pathways for climate action and decarbonizing. Combining indigenous and local knowledge, ecosystem-based and community-based adaptations can generate transformative sustainable changes. Governance measures that transparently incorporate scientific and indigenous knowledge can act as enablers of such co-production (ICCROM-FAR, 2022).

The case of Madrid offered a clear example of the evolutionary capacity of vernacular architecture through the use of Islamic hydraulic technology. The architecture adapts to the changing temporal needs of society, while maintaining a harmonious link with natural and urban context. Horizontal wells, as opposed to drilled wells, respect natural balances and hydrogeological balances, utilizing free water tables and following only seasonal recharge rhythms. These durable and sustainable systems transport of water to the surface without the use of mechanical energy, relying on gravity dependent on orographic altitude. The aquifer's potential as a complementary water source offers an alternative resource to running water to cope with droughts and water shortages linked to climate change. However, Madrid's *qanats* have mostly disappeared, tombed or closed for security reasons, and to avoid indiscriminate use as landfills. Most of the isolated segments that have survived are integrated into the wastewater network. Identifying still existing tunnels may represent a unique opportunity for the recovery of rainwater in ongoing growth. The restoration and adaptation of tunnels and connected cisterns offer a high potential for adaptation to extreme climatic phenomena in a historical context difficult to modify and transform using modern technologies. Instead, the successive stratification of such systems has shaped and consolidated the context.

In the case of Rome, the reported chronicle of urban development at the end of the 19th century emphasises how the town planning of the time was not indifferent to climatic issues; indeed, in line with European town planning of the period, it started from considerations closely linked to the geography and hygiene of places. The review of the San Lorenzo district in Rome shows that it is a real piece of the 'historical city' as defined by Rome's land use plan (PRG 2008). The local plan clearly indicates that regeneration actions for these fabrics must consolidate the characteristics of the layout, enhancing the process of street hierarchisation and rethinking the morphological characters of the streets, i.e. downgrading some road axes in order to favour pedestrian use.

The general idea that derives from these considerations is that exploiting the 'co-evolutionary capacity' of Cultural Heritage (expressive of local know-how and its techniques) determines its proactive role in the planning of the city's future, thus abandoning its role as a constrained asset to be safeguarded (Della Torre, 2010). The aim is first of all to leverage the vernacular character of heritage, its ability to resist change and to update itself with respect to the needs of the times, maintaining a character of compatibility with the environment in which it interacts because it does not alter it but incorporates its specific features.

Today, talking about regeneration implies implementing development actions restoring meaning to the material and immaterial culture of places. Renewed tradition can be the basis for setting up the construction of the sustainable city because it supports urban development in continuity and with respect for its history. The specificity of local history translates into local forms of adaptation, i.e. ‘established forms of climate resilience’. By recovering traces, re-signifying and innovating them in terms of sustainability will contribute to transforming and enhancing urban resilience. The physical and structural components of Cultural Heritage, if re-enacted, can contribute to adaptation. They are transformed from fragility to opportunity. Furthermore, Cultural Heritage is a resource for the identity value and the sense of belonging it generates.

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Authorship

The authors decided and discussed the article’s topic and contents. Marika Fior defined the structure and wrote paragraphs 1.1, 2, and 3.4; Jui Ambani wrote paragraph 3.2; Maria Paz Abad Gonzalez wrote paragraph 3.1; Rosa Romano wrote paragraphs 1.2 and 3.3. The authors wrote the final remarks together.

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11. The medium technology of the building cultural heritage

Friedrich Idam[1], Günther Kain[2]

Abstract

This paper deals with the huge sustainability potential of our building heritage. On the basis of current research projects, it is shown how historical solutions for building conditioning can be recorded, evaluated and refined using the methods of applied building research. In the course of climatic changes, the requirements of building conditioning shifts increasingly from heating to cooling. From this point of view traditional building envelopes and cooling systems gain importance, also in the global north.

As an alternative to the currently favored high-tech innovation of "smart buildings" and their technological consequences, targeted ex-novation in the form of re-implementation of technologies proven in the past could prove to be more sustainable in the long term.

This does not mean a "back to the Stone Age," but rather the most comprehensive possible evaluation process of medium technologies and their long-term efficiency potential. Mid-range technologies, which have already proven their functionality over centuries, hold the potential for a climate-compatible technological turnaround that can be implemented worldwide on the basis of mankind's building heritage.

Keywords

Simple smart buildings, built cultural heritage, sustainable buildings, building innovations, medium technology

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1. Introduction

The ongoing worldwide climatic changes and the economic crisis require the development of simple, resilient, but above all cost-effective construction techniques, building types and building operating systems. This ambitious profile of requirements is already comprehensively represented by our building cultural heritage. In contrast to short-lived and expensive high-tech buildings, however, traditional building techniques are also accessible to the population of underdeveloped regions. The approach presented assumes the most open and broad view possible into other times and in other regions, learning from the building cultural heritage of mankind. This can provide the basis for a paradigm shift in construction.

2. Simple Smart Buildings

For example, one can learn from the proven strategies of those regions that have already had a climate like the one that seems to solidify in Europe for centuries, to construct resource-efficient cool buildings. The mainstream approach on the other hand, is the innovative development of building technology, which is considered a promising solution strategy. The development objective are fully automated "intelligent" buildings, so-called "smart buildings". However, the short life cycles of such systems are often overlooked due to rapid technological change. In addition, technical innovations often increase resource consumption. As early as in the second half of the 19th century, the economist William Stanley Jevons recognized that technical innovations reduce operating costs below tipping points and thus lead to a disproportionately higher consumption of these resources. (Jevons 1866) This paradox is also referred to in technical literature as rebound effect. As a counter model, the re-implementation and moderate further development of historically proven technologies is presented here. The combination of empirical knowledge and applied construction research can be the starting point for sustainable building strategies, whose long-term consequences are already available as real findings.

This approach is by no means intended as a "return to the Stone Age," but rather as a comprehensive evaluation process of intermediate technologies and their long-term efficiency potential. The concept of intermediate technology, which was already coined in the 1970s, offers the potential for a technology turnaround that can be implemented worldwide. (Schumacher 1973, Kohr 2007)

For the generations before us, it was obvious to create durable buildings by simple means and minimal energy input, whose architectural elements were adapted to the site climate. This ensured the constructive protection and long-term existence of a building. The preserved building fabric of the World Heritage Sites, which is still inhabited, represents a positive selection: These are the best houses, they are the ones that have survived a tough evolutionary process. These outstanding buildings have simply functioned long and well. They are simple and smart houses yet, referred to as "Simple Smart Buildings".

In the various World Heritage Sites, locally available building materials have been used to develop resilient building constructions and building types that have survived the centuries and for this very reason still offer a high quality of use. A promising approach to the development of simple and resilient building techniques, as well as long-lasting building types and building operating systems, lies in the concept of Simple Smart Buildings, which draws on the potential of our building cultural heritage.

3. Methodology and relevance

As part of the ICOMOS Austria research network, several research projects are currently being carried out with the support of the Cultural Section of the Austrian Federal Ministry for Arts, Culture, the Civil Service and Sport, taking into account the Simple Smart Buildings approach. Applied building research is used meaning scientifically measuring various phenomena in-situ in and on buildings. The approach enables the evaluation of hypotheses and fact-derived conclusions. In specific, this included the metrological evaluation of thermal transmittance in historic window constructions, the exploration of the potential use of peat moss (Sphagnum) as a sealing and insulation material, the reassessment of thermal qualities of solid masonry under changing climatic conditions, the minimally invasive installation of infrared shading screens in historic attics, and the cooling efficiency of historic air well systems.

These topics can be understood as examples how the "Simple Smart Building" approach could be used for practical applications. The strength of the concept is that it combines the efficient use of resources - both materialistic and energetic and a positive social dimension by empowering people to build and maintain their build environment by themselves. Additionally, simple smart buildings provide the means to develop the building stock in a more sustainable use. Finally, the integrative consideration leads to a more resilient society which has the means at its command to adapt to an ever-changing environment.

4. Window constructions

The aim of the window research project is to demonstrate the significance and competitiveness of existing and new wooden box-type windows compared to multi-pane insulating glass windows using a holistic life cycle-oriented approach. The preservation of valuable architectural substance should thus be secured and its replacement by industrially manufactured windows should be avoided due to a one-sided, only short-term energy-focused consideration.

Historic double windows are still in use, but since the 1970s they have been increasingly replaced by so-called thermal windows made of wood, metal or plastic. The primary argument for the window replacement, apart from the durability of the surface coating, is the high thermal transmittance of double windows. The heat transfer in a stationary state is described by the U-value, which quantifies the area-related energy flow through a building component at a defined temperature difference from the inside to the outside. For the historic double windows, however, it is not the measurement results on the actual building stock that are used, but rather fictitious substitute values (default values) defined in a standard, which are two to three times the laboratory values of the industrially manufactured thermal windows. As measurements on existing double windows showed, properly renovated box-type windows have lower U-values than 2.5 W/m^{2}K, defined in most standards and simulation programs. Another aspect is that the inert gas filling of thermal insulation glass begins to diffuse out after latest 30 years, and heat losses through the glass surfaces increase with the course of time (Kain and Idam 2023a). In order to be able to determine the actual thermal transmittance of windows in situ, the development of a measurement method has now been tackled, which can be used in situ on the real object (Kain et al. 2017). This procedure creates the basis for developing a validated, comparative life cycle assessment of different window systems "from cradle to grave" in terms of energy consumption for specific objects. The validation of this in-situ measurement method will be carried out in a research project launched in 2022 with extensive comparative measurements at the standard-compliant window test facility of the Municipal Department 39 in Vienna. On the one hand, the U-values are determined in a test stand by official experts in accordance with the standard, and on the other hand, a series of sensors are additionally attached to the test window in order to also be able to carry out the deductive U-value estimation as a comparison to the test result.

In total, three maintenance states have been mapped so far: the unrefurbished window in its original state, the window with adhesive seals on the inner sash, and the window with taped joints and inserted window cushion. The initial results of the evaluation show that the U-value of the unrefurbished window is close to the default value of 2.5 W/m²K, the installation of seals on the inner sash leads to a reduction to approximately 2.0 W/m²K, and the complete sealing of the joints causes only a slight improvement to approx. 1.9 W/m²K, but this results in classic problems of condensation on the outer sashes. In the next step, scheduled for 2023, the results of the in-situ method will be compared with the test rig results to assess its validity. It is expected that the effectiveness of potential remediation measures can be derived from the measurement data obtained.

In areas with distinct winter and summer climates, there are very different demands regarding the building envelope over the course of the year. Progressive global warming also requires effective shading systems for historic buildings and their historic window stock, which do not impair the values of the monument. Most of the time varying seasonal requirements are compensated by means of technical air-conditioning systems.

Figure 1: Historic double window (end 19th century) in the test stand of the of the Municipal Department 39, Vienna, window taken from the stock of the convent Mauerbach, photo Peter Hunger.

Alternatively, this compensation can also be achieved by seasonally changing adaptation of the building envelope. Until the middle of the 20th century, window constructions were equipped with an additional sash during the cool season to prevent energy loss, and with blinds during the warm season to prevent excessive solar radiation and improve ventilation. Transforming this approach for modern buildings offers an interesting field of research with future potential. Therefore, in the course of the 2022 window research project, the development of a variable external shading system, based on empirical knowledge, was also tackled (Kain and Idam 2023b). With the help of the validated in-situ measurement method, it should also be possible to determine the effect of different shading systems non-destructively.

5. Peat moss (Sphagnum)

The examination of historical building structures not only provides information about past working techniques, but also unveils materials that have stood the test of time. Sphagnum moss is found as a joint sealing material in objects as diverse as drift chalets, log buildings, and wooden boats. Knowledge about sealing the joints of historic wooden structures has current relevance, as there is demand for durable and ecologically compatible joint sealing solutions in the growing market segment of timber constructions.

In the past, sphagnum was simply extracted from local, near-natural bogs, whereas now the sustainable extraction of this raw material has been researched for several decades. Under natural conditions, sphagnum mosses grow primarily in acidic to sub-neutral, nutrient-poor environments, such as those found mainly in intact raised bogs. The water table is the main determinant of sphagnum moss growth; sphagnum mosses can therefore also grow in wet forests or wet meadows, but they are most commonly found in raised bogs (Krisai 1999). In wet, natural bogs, sphagnum peat mosses are the main contributor to the growth of a raised bog, which can grow about one millimeter (mm) per year (Krebs et al. 2015).

For several decades, research has been conducted into the cultivation of peat mosses in so-called paludicultures (“palus” - Latin for “swamp, morass”). This involves the rewetting of drained and degraded peatlands that have been used for agriculture or forestry. After rewetting, peat mosses can be applied to a former raised bog area and harvested after an average of four years (Sphagnum farming). After harvesting, these grow again and can be harvested every few years. Current studies in Germany show Sphagnum yields averaging 36 tons of dry matter per hectare and year. By rewetting and keeping the water table high, Sphagnum farming areas can store carbon again (Gaudig et al. 2018).

The use of moss can be documented in the Upper Austrian Salzkammergut from written sources as early as the middle of the 18th century (Vasold 1768). Before the dried moss was inserted into the joints to be sealed, it was spun into a plait, a kind of sealing cord. This is evidenced not only by the actual finding of a sealing cord in the joints of an 18th century log rooming, but also by oral tradition.

Figure 2: Beringstadel, Gosau, block carpentry 18th century. Sealing cord made of sphagnum. Condition 2017, photo: Stefanie Mandl.

The historic constructions all have wedge-shaped joints into which moss was pressed with a positive fit. On the narrower inner side of the joint, a narrow trapezoidal filler strip was first inserted to prevent the moss from being pressed through the joint. The next step was to insert the sphagnum, which was spun into a sealing braid and compacted with the help of a wider, also trapezoidal press bar, which was fixed with U-shaped clamps made of wrought iron. As soon as this construction comes into contact with water, all the construction elements absorb moisture and swell in the process. In this way, the geometry of the construction elements and the swelling behavior of the materials automatically regulate the degree of tightness of the joint.

Also, in the stone bases of the alpine huts, the joints of these dry-stone walls were stuffed with moss (Stadler 1984).

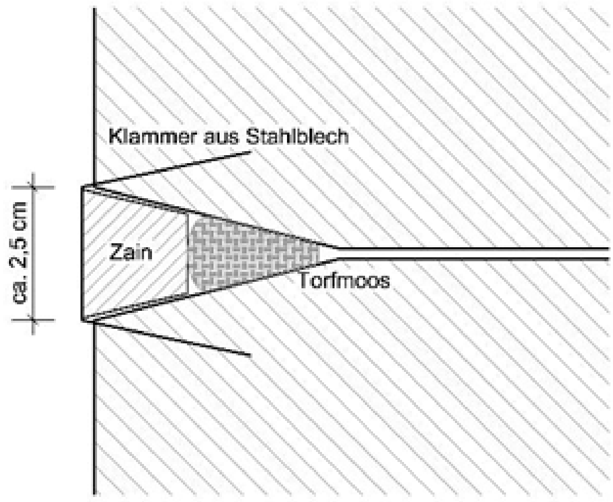

Figure 3: Detailed section through the sealing of the joints of block carpentry. Drawing Friedrich Idam.

The technical and physical properties of Sphagnum were investigated at the HTBLA in Hallstatt and the Salzburg University of Applied Sciences. It was found that Sphagnum has an equilibrium moisture content of 18.3 % (standard deviation 0.4 %) in a climate of 20 °C and 65 % humidity. This climate leads to an equilibrium moisture content of about 12 % for wood. The significantly higher equilibrium humidity is caused by the special structure of the hyaline cells of the moss, which enables the high-water storage capacity of the plants. In the experimental setup, gut-dry sphagnum moss was stored in water until maximum swelling. In this process, the moss is able to absorb an average of fourteen times its dry weight in water, with a simultaneous significant increase in volume. This behavior is very interesting for the sealing of joints on buildings in the alpine climate, since the high relative humidity that occurs more frequently in summer leads to an increase in the equilibrium moisture content of the moss and an associated swelling. Due to the languid moisture balance of natural wall materials (wood, clay, brick), this condition can persist well into the heating season. The highly hygroscopic moss could also buffer potentially occurring condensate in the joints during winter and accelerate drying to the outside due to its diffusivity (Kain et al. 2019).

Particularly relevant for use as a thermal joint sealant is the thermal conductivity of peat moss. This was determined for various raw densities as part of a research project at the Salzburg University of Applied Sciences. It was found that the thermal conductivity at a density of 50 kg/m³ is only 0.036 W/(m*K), which is comparable to that of mineral wool or polyurethane foam. Thus, the insulating capacity of moss is on a par with recent joint insulation materials and also offers itself as a renewable raw material for thermal insulation panels (Kain et al. 2021, Morandini et al. 2022).

6. Stone walls

Solid masonry made of stone has been the universal wall builder for thousands of years. It combines the advantages of using regionally available raw materials with those of thermal storage mass. With the traditional binder lime, durable walls can be built with a moderate ecological footprint. Unlike cement, lime permanently binds atmospheric CO_2 in its curing process.

Figure 4: Room extension and work stone extraction, photo Gottfried Buchegger.

Unrendered stone-faced walls characterize the image of the World Heritage cultural landscape Hallstatt-Dachstein/Salzkammergut. The necessity of a secure foundation makes the historic stone walls follow the natural course of the rock formations, whereby the retaining wall with its buckling edges and curvatures takes over the motif of the terrain. These historic stone retaining walls intuitively show the forces they are capable to absorb. Masonry that primarily absorbs vertically acting forces shows clearly legible horizontal bearing joints. Retaining walls, which must also withstand horizontal loads, slope against the earth pressure with a 10 to 20 % slope, the so-called run-up.

The bearing joints of the retaining walls run horizontally in long courses for several meters, then jumping against each other in height. The course heights change and tend to decrease towards the top. The largest stones are located at the base of the walls, and towards the top the stones become smaller, creating a perspective effect in conjunction with the slope of the walls, which makes the wall appear higher. Historic stone walls in the Salzkammergut are also characterized by the fact that the entire visible surface is executed with narrow joints and level. (Idam and Kain 2020)

Figure 5: Plinth masonry of the Schafferstadel Hallstatt. Photo Friedrich Idam.

The main physical disadvantage of dense, non-porous stone material for use in building construction is its good thermal conductivity. Studies of masonry stock show that masonry structures for residential buildings differ in stone size and joint design from purely engineered retaining walls. Smaller bricks, wider joints made of air-lime mortar and clay bricks mixed into the bond significantly increase the porosity of the wall structures. As a result, both their thermal conductivity and vapour diffusion resistance decreases. In wall inventories at the Hallstatt-Dachstein/Salzkammergut World Heritage Site, there is also evidence of organic mortar additives in the plaster, such as sawdust, which further reduce thermal conductivity. Whereas until a few years ago stone walls in residential buildings were nevertheless perceived as too cold in the winter months, they now offer a pleasantly cool indoor climate in the increasingly hot summers – entirely without energy-intensive cooling technology. This is because the thermal daytime peaks are shifted to the cool nighttime hours by the inertia of the thermal storage mass of the solid stone walls.

7. Infrared shading

Urban World Heritage sites, with their stock of important buildings, are often located in inner-city heat islands, where summer temperatures rise at an above-average rate year after year. For these buildings, alternative cooling systems must be developed that function in a self-regulating manner, preferably without the use of operating energy, and that leave the fabric of the monument as untouched as possible.

As initial tests in the attic of Vienna's Burgtheater in August 2020 have shown, quite effective cooling effects can be achieved with lightweight membranes applied in the roof space. In the specific case, the energy radiation of the heated roof cladding was "shaded" towards the inside (Kain et al. 2022). The term "shading" here refers to shielding the invisible infrared radiation of the solar-heated roof cladding. Therefore, infrared shading is effective even in unexposed roof spaces. In the first test, membranes in the form of fire-resistant fabric sheatings were used as shielding elements. Cooling effects on the shaded surfaces (compared to the existing roof cladding) of up to more than 15 K could be proven by measurement. It would therefore appear to be expedient to pursue the infrared shading of roof spaces further.

The physical mechanism of this finding can be explained by the "Stefan-Boltzmann relationship". According to this, the thermal radiation power of a body increases in proportion to the fourth power of its absolute temperature. However, if a cooler surface is placed in front of the hot roof cladding on the inside, the heat radiation to the inside can also be reduced exponentially.

In order to maintain or further increase this effect, the area in front of it should be kept permanently cool, which is quite possible given the low mass of ultralight under-roof elements. In two pilot projects based on these initial findings, the material of the canopy elements and economically and ecologically feasible cooling methods were evaluated. As a cooling medium, naturally pre-cooled air flows that originate from an air well or are guided into the building as a wind flow will be in the focus of further investigations.

The first step is the development of a test design for the valid evaluation of ultra-light sub-roof elements. Materials such as thin plywood or membranes in form of fire-resistant fabric sheets can be considered. It will be necessary to clarify the influence of different materials, their weight and the combination of different material layers. In any case, the ultra-light sub-roof elements must be fire-resistant, easy to install and, if necessary, easy to remove again without affecting the historic structure. With infrared shading, a simple, effective and economical improvement of the thermal quality of roof spaces of valuable historic buildings can be achieved without interfering with their substance, static structure and external appearance. Infrared shading could significantly reduce the daily cyclical temperature fluctuations of upper floor ceilings and their damaging effects on the equipment and architectural surfaces below (Kain et al. 2022).

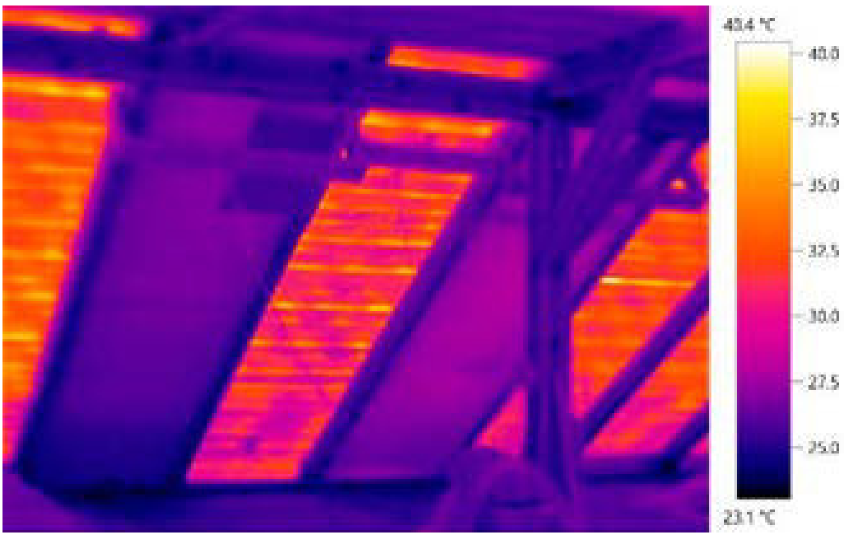

Figure 6:
Infrared shading Stadel Bad Goisern. Thermography Günther Kain.

8. Air fountain

Storing large amounts of energy over several months is one of the key challenges on whose sustainable solution the success of the energy transition of the 21st century will depend. The value of our building heritage is based not only on its external appearance, but also on the evidently resilient substance and the building technology experience accumulated over centuries. Historic storage and distribution systems for building conditioning are still in operation, enabling efficient and sustainable temperature and humidity balancing over time. In this context, the building services and the building fabric form a systemic unit whose elements are conceived holistically and interact with each other. The utilization cycles of these complex, largely self-regulating building service systems driven by air pressure differences span centuries. Such systems were already known in ancient times and spread from Persia through the Ottoman Empire and the Balkans to Western Europe.

As a transport medium, a large preconditioned air volume moves slowly through wide shafts, which are located in the interior walls and are connected to the rooms by optionally closable openings. Equilibrium states of temperature and humidity settle between the air and the masonry. In this way, the entire core of the building is preheated in winter and kept cool in summer, while maintaining a constant humidity level in the interior. These combinations of shaft systems with an upstream earth mass storage tank, which can be charged or discharged by means of the air flowing through it, are called air wells. Due to the considerable storage potential of the earth masses around and under the building, seasonal shifts of the extreme values from summer to winter or vice versa are possible.

In the diurnal cycle, the thermal daytime peak of the early afternoon is analogously shifted to the cool nighttime hours by the continuous air circulation, while condensate that has formed in the surface area of the shafts in the early morning hours evaporates during the day, releasing cooling energy and humidifying the dry air.

The extent to which masonry can store energy and moisture depends not only on its mass, but also on the choice of building materials. Traditional building materials such as brick, lime plaster, wood or clay are not only excellent at storing energy, but also have a moisture-regulating effect due to their porous structure. The specific surface area of porous materials, in contrast to dense materials, is many times greater. This accelerates the intensity of physical exchange processes, such as heat transfer or evaporation.

Since the humidity of the outside air is significantly higher in summer than in winter, it can be used in air wells for cooling. Capillary condensation plays an essential role in this process. In porous materials, similar physical laws apply as in capillaries. Different pressure conditions prevail in these fine structures than in the surrounding atmosphere. This causes water to rise upward in capillaries against gravity and water vapor to liquefy more easily. However, water also flows there, both in liquid and vaporous form, always from warm to cold. When cool night air passes through the air well, the surfaces in the wells become colder than the core of the masonry. Moisture stored in the masonry moves toward the cold surface and the water vapor condenses. From there, the water moves in liquid form to the surface, where it is absorbed by the air flow and the water evaporates in the process. The transition from the liquid to the vapor state, at atmospheric air pressure, extracts energy from the surroundings, so that both the air flowing through and the surfaces of the shafts are cooled additionally.

Important buildings on the Ringstraße in the historic center of Vienna, a World Heritage Site, such as the State Opera House, the Stock Exchange, the Parliament Building, the Burgtheater, the two Court Museums and finally the Corps de Logis - the imperial apartments in the new Hofburg, were equipped with a series of large air fountains unique in the world. The physician and air hygienist Carl Böhm planned these installations, some of which are still in operation today, from 1861 until the turn of the 20th century.

Figure 7: Air vent "Blasengel" on the Burgtheater, Vienna. Photo Friedrich Idam.

The air well system of the Burgtheater is best preserved from the examples mentioned. The air is led from the intake in the Volksgarten to the exhaust opening above the roof. The supply air sinks through a shaft six meters in diameter to the third basement level. From there, a one hundred meter long tunnel leads the supply air through the earth reservoir to the ventilation center, where it is now further specifically conditioned and distributed throughout the building via a highly complex system of corridors, shafts and chambers, and finally discharged via roof at the "bubble angel". This popular name derives from the wind vane, visible from afar, which is executed as a figural sheet-metal work. This outlet work represents both the artistically designed roof crown of the Vienna Burgtheater and a fascinating technical monument with future potential. For more than 130 years, wind energy has continuously turned the huge outlet opening of the exhaust air duct to the lee in a self-regulating and trouble-free manner, so that the exhaust air flows out freely (Idam et al. 2023).

9. Wind towers

When we think of wind energy, we probably first think of the large wind turbines that are currently being installed in the landscape. But wind energy can also be used in a simpler and perhaps more sustainable way shown by the control system of the "bubble angel". "" Another fascinating example are the "Badgirs", wind towers that have spread from Persia throughout the Middle East. In the badgir, several physical phenomena are combined cleverly. These are mainly the dynamic pressure of the wind, the Venturi effect, the storage capacity of solid masonry, evaporative cooling and the chimney effect.

During a summer day, buildings are cooler inside than the outside air. This means that a chimney located inside the building is also correspondingly cool. The cool air becomes heavier and sinks in the chimney. The cooled air flows out through openings at the lower end of the chimney. At the upper end of the chimney, on the other hand, the sinking of the cold air creates a slight negative pressure through which the outside air is drawn in. If this suction is not sufficient, the wind can be used to drive the badgir. If the wind hits a surface in its way, the air accumulates there and an overpressure is created - the dynamic pressure. On a surface that is at an angle to the wind direction, the dynamic pressure deflects the wind. To catch the wind, all you have to do is placing a surface at the top of the chimney that is slanted 45 degrees. The wind flows horizontally against this deflecting surface and is forced down the chimney.

In this way, cool outside air enters the building even when the chimney has warmed up during the day and the air in the chimney rises. In the process, the chimney cools down and continues to draw cool air into the building with the onset of the chimney effect, even if the wind is then no longer blowing. During night, when the inside air temperature is higher than outside the shaft of a badgir can be used powered by the chimney effect whereupon the warm air moves upwards because of its lower density.

In its simplest design, a badgir consists of a shaft facing upwind and a second shaft facing downwind. In the supply air shaft, the cool air is captured and led into the building, while in the exhaust air shaft, the used, heated air is blown back upwards and released to the outside. This basic construction method is sufficient when one wind direction prevails. Where the wind frequently changes direction, we find more sophisticated designs, which then consist of four or even eight shafts, which enable wind capturing from several directions. The wind tower systems are controlled by empirical knowledge that has been passed down through generations. In a few simple steps, depending on the weather conditions, the indoor climate can be regulated by opening or closing certain shafts. (Roshanak 2018)

Towards the end of the 18th century, the Italian physicist Giovanni Battista Venturi discovered that liquids and also gases flow faster when the flow channel narrows. What surprised him, however, was that the pressure at the constriction does not increase, but rather decreases. This has to do with the fact that the faster-moving molecules entrain the particles in their vicinity. This effect makes it easy to extract stale air from a room. Constrictions in the exhaust air shaft automatically create the necessary negative pressure, and the used air is extracted through openings in the shaft.

A wind tower is indeed a tower in its outer appearance and with its thick walls sometimes as large as a church steeple. Most wind towers in the Orient are built of clay and are impressive structures designed in many ways.

The storage capacity of the massive building structure of the badgir can compensate for the climatic differences between day and night. The same physical mechanisms as in the air wells of Vienna's Ringstrasse are used with porous structures of the clay in the badgir. This closes the chain of a transfer of medium technologies that goes back to the Baroque era and stands as a model for a sustainable problem-solving strategy.

10. Conclusion and outlook

Even in times of crisis, people build, but unlike in times of plenty, it is now necessary to use resources efficiently. The climatic changes underway around the world and the emerging economic crisis require the development of simple, resilient, but above all cost-effective construction techniques, building types and building operating systems. An interesting aspect of the "Simple Smart Buildings" approach is that it is a way to deal with phenomena of climate change and in the same time help to reduce the overall resource consumption of buildings.

From the experience gained from the examples discussed before, a limitation of the "Simple Smart Buildings" approach is that it requires an "out of the box" perspective in an early state of planning. In real life, very often in an early project phase decisions in favor of high-tech solutions are made which are likely to make a simple smart building impossible. Moreover, the realization of smart buildings requires skilled workers of which there is a lack off at the moment.

On the other hand, simple smart buildings can be realized with the people and materials available on site. This is a huge advantage making societies independent from global supply chains and giving local manpower its value. Also, the transferability of simple smart solutions is high. Therefore, best practice examples like presented before have the potential to inspire other projects on a global scale.

The idea has to be spread amongst experts and investors as it lacks huge lobbying efforts. This mainly because for tendency simple smart buildings are less dependent on building industry than modern high-tech buildings. As the use of simple smart technologies requires a multi-disciplinary planning approach, the most successful "marketing" activity for the idea probably is the training of engineers working in the field.

Our World Heritage represents the best and most durable intermediate technology, which not only holds the potential for a paradigm shift in industrial societies. Unlike short-lived and expensive high-tech systems, intermediate technologies are also accessible to broad segments of the world's population. And that is the basic idea of World Heritage: to bring about peace on the basis of the common heritage of all people.

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Marika Fior is an urban planner and PhD in Territorial Design at Politecnico di Milano (2013). Since 2021 she is Assistant Professor at Sapienza University of Rome and since 2015 she is Adjunct Professor in Urban Planning and Urban Design at Politecnico di Milano. Since 2007 she developed several research activities (Research Fellow) at the Department of Architecture and Urban Studies at Politecnico di Milano. She is freelance urban planner since 2009, she sets projects and consultancy on landscape planning, territorial planning, town planning and urban design in Italy and abroad. Since 2015 she is Member of the Regional Commission for the Lombardy Region Landscape and a Board Member of the National Association of Historic-Artistic Centers (ANCSA). For ANCSA, she developed several researches with particular attention to the contemporary condition of Italian historic centers.

Carlo Francini, art historian, is since 2005 the site manager of the UNESCO World Heritage site "Historic Center of Florence" and the responsible of the Florence World Heritage office of the Municipality of Florence. In his long-standing career in heritage management, Carlo has served crucial roles, acting as a key mediator between private local actors and international bodies such as the UNESCO. He is the Scientific Coordinator of the Italian World Heritage Association and co-director of the Heritage and Research Laboratory (HeRe Lab), the joint research laboratory in heritage-related topics between the Municipality of Florence and the University of Florence. Since

2022 he has been a member of the Italian delegation to the UNESCO World Heritage Committee.

Christer Gustafsson, Ph.D. is Full Professor in Conservation at Uppsala University, Sweden. Currently, he is engaged as a member of the UNESCO Culture 2030 Indicators Expert Facility, an international expert group working with indicators for the United Nations' Sustainability Goals (Agenda 2045), Secretary-General for ICOMOS International Scientific Committee on Economics of Conservation as well as Chairman for EIT Culture & Creativity strategic topic group for Innovative, entrepreneurial and circular adaptive reuse of cultural heritage.

Friedrich Idam is a permanent member of the Advisory Board for Monuments at the Austrian Federal Monuments Office, member of ICOMOS Austria and a court expert for historical building constructions. Freelance activity as a building researcher. Teaching activity in the field of monument preservation at the Danube University Krems. www.idam.at; idam@gmx.at

Günther Kain is a freelance building physicist, wood technician, master carpenter and court expert for carpentry. Lecturer at the HTBLA Hallstatt in the field of wood restoration technology. Material research in the field of "Natural Material Innovation" at the Salzburg University of Applied Sciences and member of ICOMOS Austria.

Xinghan Lou is a Ph.D. researcher affiliated with the Cultural Studies Research Group at Katholieke Universiteit Leuven (KU Leuven), Belgium. Her academic journey is marked by a diverse background spanning cultural studies, environmental design, and heritage conservation. With a passion to unraveling the complexities of sustainable cultural heritage preservation, Xinghan's scholarly pursuits have taken her across continents, from her foundational studies in Asia to her doctoral exploration in Europe. Currently, she delves into the nuanced interplay between heritage practices, makings, and contemporary issues such as digitization, commercialization, and the challenges posed by a changing climate.

Asma Mehan is an Assistant Professor and Director of Architectural Humanities and Urbanism Lab (AHULab) at Texas Tech University Huckabee College of Architecture. She is the author of the books "Tehran: from Sacred to Radical" (London: Routledge, 2022) and "Kuala Lumpur: Community, Infrastructure, and Urban Inclusivity" (London: Routledge, 2020). is a researcher, educator, and architect working at the intersection of architectural humanities and critical urban studies. She is the author of the books Tehran: From Sacred to Radical (Routledge, 2022) and Kuala Lumpur: Community, Infrastructure, and Urban Inclusivity (Routledge, 2020). She has authored over 80 articles and essays in scholarly books and professional journals in multiple languages, such as English, Persian, and Italian, on critical urban studies, architectural humanities, urban planning, housing, and heritage studies. ORCID ID: https://orcid.org/0000-0002-7381-6663

Aitziber Egusquiza Ortega is a senior researcher in Tecnalia Research and Innovation in Bilbao, Spain. Graduated as an architect with post degrees in Urban Management and Cultural Heritage and PhD on decision making process for improving sustainability and liveability of historic urban environments using multiscale information management. Experienced co-ordinator of several Large-Scale European Projects focusing on impactful change on resilience, cultural heritage, and climate change. Currently, is the co-ordinator of a Horizon European Project called RescueME. The project focuses on a landscape approach to resilience, aiming to protect cultural heritage and landscapes.

María Paz is a conservation architect from Cuenca, Ecuador, currently based in Rome, Italy. She possesses a master's degree (MSc) in Architectural Conservation from the Sapienza University of Rome. Throughout her professional journey, she has engaged in multidimensional projects including an interdisciplinary approach, spanning both Italy and Ecuador. Her projects have primarily concentrated on examining the intricate relationship between urban historical landscapes and natural as well as anthropic environmental systems, including the application of the Historic Urban Landscape approach. Post-graduation, she joined an architectural studio in Rome that specialized in the reconstruction of historic buildings affected by the Amatrice earthquake in 2016, there she contributed to post-disaster reconstruction and rehabilitation efforts. She collaborated with ARS Progetti Spa where she worked on various projects emphasizing on heritage conservation and urban mapping. In November 2023, she joined Hydea Spa, where she has been engaged in projects focused about heritage conservation and documentation.

Diana Farisah Rahman now works at the United Nations Office for Disaster Risk Reduction (UNDRR), advocating the integration of disaster risk reduction strategies into National Development Planning. Previously, she worked at the Institute for Sustainable Heritage at UCL for six years, where she conducted various research projects related to the management of World Heritage Sites, engagement of indigenous and local communities in heritage management, and local climate adaptation strategies. Her work emphasized the vital role of indigenous and local knowledge, fostering inclusive approaches to heritage management strategies within agricultural landscapes. Dr. Diana Farisah Rahman also worked for the Centre for Critical Heritage Studies, investigating the intricate relationship between culture and agroecology and its role in building a resilient and sustainable food system.

Bhagyasshree Ramakrishna is an urban designer, architect and academician. She holds a Master's degree in Urban Design (M.Arch.) from CEPT University and Bachelor's degree in Architecture (B.Arch.) from Mumbai University, India. She was a studio professor and thesis research advisor at CEPT University, examining social innovation in urban spaces. Her work is also an inquiry of inclusive and accessible gendered geographies in the Global South. She won a research grant analysing water tanks of a historical port town in Greater Mumbai. Her research is centered around the areas of the urban socio-spatial constructs, and community-led urban transformations. Her current practice focuses on retrofitting child-friendly urban spaces within low-income neighbourhoods through research-led social mapping.

Shruthi Ramesh is an architect, urban designer and researcher based in Kerala, India. She is the recipient of the 2023 Writing Urban India Fellowship, a mentorship program, where she developed her original research titled "The Production of the Malayali Dream: the emergence of single- family as the dominant spatial imaginary." based on the peculiar housing character in Kerala. She holds a Masters in Architecture specialising in Urban Design from CEPT University, and completed her undergraduate studies from GEC

Thrissur. Her research, vested in critical urban studies explorations in intersectional feminist and subaltern geographies, has been showcased in various international conferences and publications including the Harvard Urban Review, Cidades Journal and City Observer. She is currently running her architectural practice ‘Meander Design Studio’ in Kannur, Kerala.

Matthias Ripp, a senior heritage manager with a background of historical geography, is coordinating the “Old Town of Regensburg with Stadtamhof” site. He is active in numerous networks such as Heritage Europe and ICOMOS. He coordinated the EU HerO (Heritage as Opportunity) project and chairs the UNESCO world heritage working group on historic city centres of the German Association of Cities. Since November 2011 he has also been regional coordinator for the North West European and North-American region of the Organisation of World Heritage Heritage Cities (OWHC), is teaching at different Universities and works as a trainer, facilitator and consultant.

Rosa Romano, architect with School of Specialisation in Architectural Heritage and Landscape, currently a PhD student at the Department of Planning, Design and Technology of Architecture at Sapienza University of Rome. The research area of the doctorate is the historical-heritage city and possible strategies for adapting the historical fabric to climate change. The question is how to adapt the historical fabric without losing its identity but enhancing it.

She has worked both as a freelancer as a technical assistant at the Italian Ministry of Cultural Heritage. As a technician at the Ministry (2008-2018) assigned to the Capodimonte Museum in Naples, she collaborated on projects for the re-functionalisation of museum sites. In particular, she collaborated in the re-functionalisation processes of the Capodimonte Museum and Real Bosco di Capodimonte, also taking part in the setting up and care of the permanent and temporary collections.

Jessica Stuckemeyer is an architectural designer and author that will graduate Summa Cum Laude from Texas Tech University with a Bachelor of Science in Architecture and an Interior Design minor in December 2023. She takes interest in sustainability, adaptive reuse, historical preservation, and longevity of architecture and will join E4H Architecture in Dallas, Texas starting in 2024. She has experience in team management, project logistics, and urban planning and has contributed to a selection of book chapters and journals within the architectural discipline.

Jacque Teller is a professor of urban planning at the University of Liège, where he leads the Local Environment Management and Analysis (LEMA) research group. His research typically combines urban governance issues with the modelling of urbanisation dynamics. He develops an interest in emerging landscapes, either as new forms of landscapes or new means/tools to address these. He is working on a sustainability assessment of urban expansion/densification processes.

Atish N Vadher University teacher in science, leads the biology provision on the foundation programme at Loughborough University in the UK. Atish obtained a BSc Hons in Biological Sciences from Nottingham Trent University in 2012. Atish completed an MSc in Environmental Monitoring and Management in 2013. He obtained his PhD in Freshwater Biology in 2018 at Loughborough University. In 2017, he joined The University of Northampton as a Teaching Laboratory Manager. He joined Loughborough University in 2022 as a University Teacher in Science (Biology) and contributes to various avenues of research with colleagues across Europe.

Gaia Vannucci is an Architect and a Research Fellow at the Department of Architecture of the University of Florence, where she is specializing in conservation of architectural and landscape heritage. Her main research interests are related to conservation, management and enhancement of World Heritage sites, to UNESCO Conventions and Programs. Since 2019 she has been part of the Heritage and Research Laboratory (HeRe Lab), a joint laboratory established between the Municipality and the University of Florence. The Lab develops topics related to the management of the Historic Centre of Florence World Heritage site and research projects concerning the UNESCO World Heritage on the national territory.

Yijin Zhang, graduated from Bartlett School of Architecture, University College London, with a Master's degree in Architecture and Historic Urban Environments. Staff at Monitoring and Management Center of Hangzhou

West Lake World Cultural Heritage. She helps to heritage management of the West Lake by participating in the revision of "Planning for the Protection and Management of the Hangzhou West Lake Cultural Landscape (2021-2035)" and overseeing the Heritage Impact Assessment.

Starting with a systemic understanding of cultural heritage, climate-change related urban transformation processes are analyzed through a multi-disciplinary lens and methods that blend the arts, humanities, and sciences. Governance-specific topics range from relevant cultural markers and local policies to stimulate resilience, to a typology of heritage-related governance and the vulnerability of historic urban landscapes. A variety of contributions from the Americas, Asia, and Europe describe and analyze challenges and potential solutions for climate-change related urban transformation and the role of cultural heritage. Contributions focusing on innovation, adaptation, and reuse introduce the concept of urban acupuncture, adaptive reuse of industrial heritage, and how a historical spatial-functional network system can be related to a smart city approach. The potential role of cultural traditions for resilience is analyzed, as is the integration of sustainable energy production tools in a historic urban landscape. Examples of heritage-based urban resilience from around the world are introduced, as well as the path of medium-technology to address climate adaptation and prevention in historic buildings. The contributions emphasize the need for an updated narrative that cultural heritage can also contribute to climate adaptation and mitigation.

Matthias Ripp, a senior heritage manager with a background of historical geography, is coordinating the "Old Town of Regensburg with Stadtamhof" site. He is active in numerous networks such as Heritage Europe and ICOMOS. He coordinated the EU HerO (Heritage as Opportunity) project and chairs the UNESCO world heritage working group on historic city centres of the German Association of Cities. Since November 2011 he has also been regional coordinator for the North West European and North-American region of the Organisation of World Heritage Heritage Cities (OWHC), is teaching at different Universities and works as a trainer, facilitator and consultant.

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