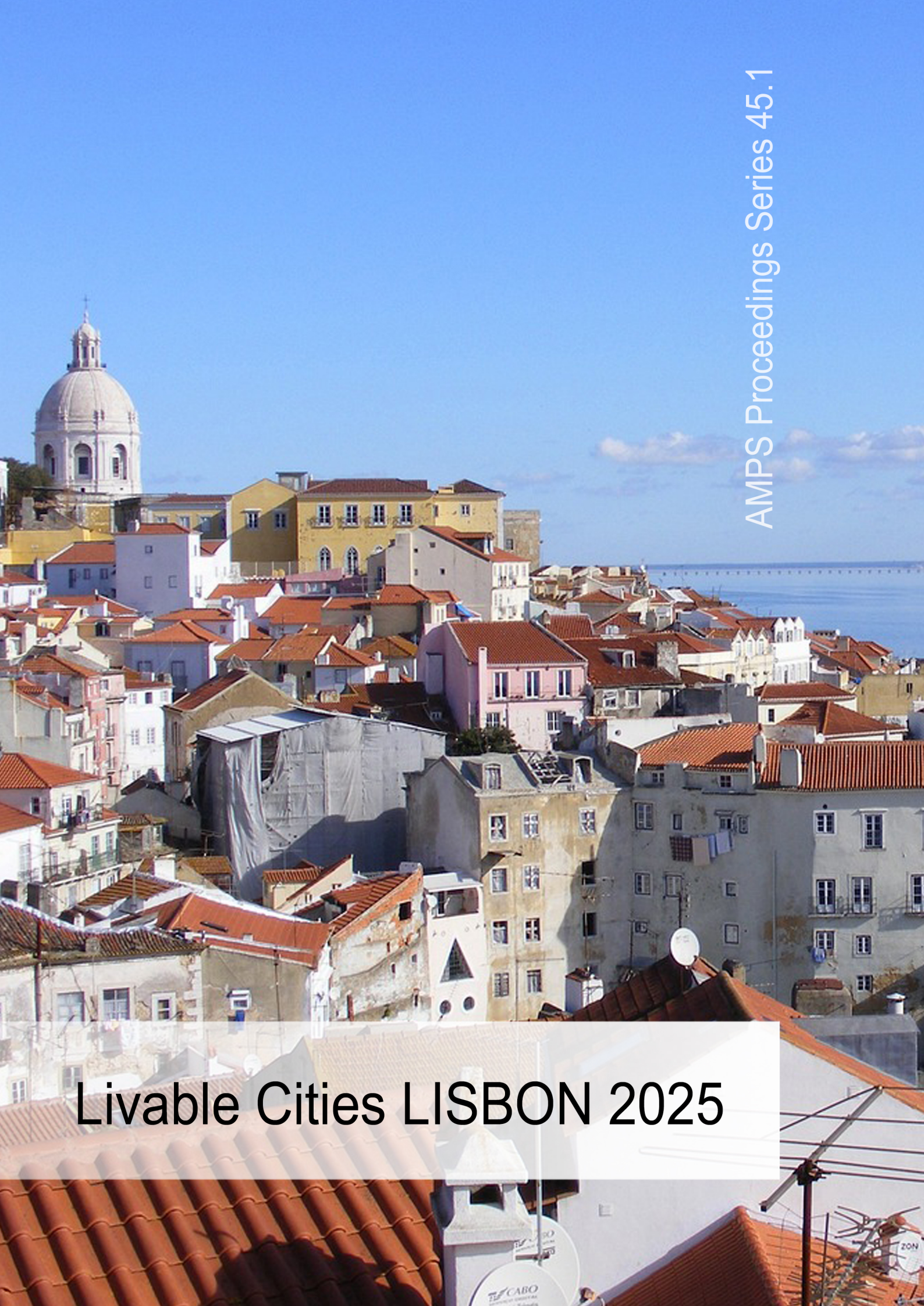

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Lisbon. Livable Cities

Cities, Culture, People & Place

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INTRODUCTION

Lisbon. Livable Cities

Cities, Culture, People & Place

Lisbon, the capital of Portugal has increasingly become a ‘mecca’ for European expats wishing to relocate. Attracted by sun, beaches, food, culture and a low cost of living, it has been ranked as the world’s third most livable city for foreigners. Inevitably, the results of this have been varied. Seen as a boost to the local economy, it also adds to property prices. It places strain on public services like health and transport, and is criticized repeatedly from a social sustainability standpoint.

Livable for many then, Lisbon is also a city of challenges for others. Like a multitude of other places across Europe, it has experienced epochs of deindustrialization, periods of population growth and decline, and varied phases of investment and disinvestment. It has had architectural and urban ‘golden ages’, as well as times of abandonment and degeneration. It has seen attempts at city boosterism, concerns about resilience and public health, efforts to improve its sustainability, and attempts to preserve its heritage. It has been a site of innovations in housing, and a place of social unrest.

In all this it is prototypical – a city that has documented the social and urban changes of recent times – whether they be Daniel Bell’s post-industrial society, Jane Jacob’s life and death of cities, or David Harvey’s city and social justice. It has echoed Richard Florida’s cultural city and reflects the traits of the smart city. It is the home of UNESCO world heritage sites and a place where public transport can be, and is, complicated and slow. It is a city and, as such, is contested.

Interested in examining the city as a site of livability across times and places, the papers collected in this volume offer here were responses to the above context from the perspective of sustainability, architecture and urbanism, broadly defined.

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DENSE MATTER: IN SEARCH OF THE ANTI-HEROIC

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INTRODUCTION

Dense Matter: In Search of the Anti-Heroic explores the concept of material culture as it manifests in urban and lived environments, particularly in areas that have undergone denaturalization or dehumanization. These spaces are often characterized by impervious surfaces and are commonly found in underprivileged communities. This article argues for a departure from the linear and singular narrative of the techno-heroic, advocating instead for a paradigm shift that encourages the development of equitable humanistic environments. This shift entails embracing complexity, fostering a renewed sense of humility, and cultivating a culture that values a sense of place.

Using a theoretical framework, this essay challenges traditional narratives and explores mundane, conflictual, yet significant aspects of everyday life. The text contrasts techno-heroic landscapes, like urban spaces dominated by three-dimensional hard surfaces, with anti-heroic spaces exemplified by the All People's Fresh Market in Columbus, Ohio. The Fresh Market, despite its hard surfaces, serves as a model of human engagement and community interaction. Therefore, Dense Matter: In Search of the Anti-Heroic calls for a rethinking of urban landscapes to include nature, community integration, and equitable access to green spaces. Ultimately, it emphasizes the need for a paradigm shift in the design of urban spaces to address social and environmental fairness, promoting a more diverse and humanistic urban environment.

Context

In the early 2000s in my design research as a landscape architect and academic, I perceived the asphalt universe as a source of untapped creative potential, a wonderland brimming with dormant possibilities[1] (fig.1). This notion stemmed from the realization that hard environments offer convenience, enabling us to seamlessly reach our destinations, meanwhile holding nature and water at bay, being cost-effective and infinitely expandable. In the United States, the acceptance and perpetuation of such hard environments have become normalized within urban existences and city development. Asphalt and concrete landscapes exhibit resistance to change, raising questions about their cultural and spatial longevity. However, should these landscapes be normalized? Like other hard spaces, asphalt serves as a pragmatic and highly technical superstar, epitomizing the Techno-Heroic paradigm. Nevertheless, the application of technology in particular machine learning, has also unveiled the inequitable nature of our urban landscapes. In these environments, the presence of green spaces and trees is associated with privilege and affluence, while the prevalence of hard surfaces intensifies heat and compromises the health of underserved communities.[2] Impervious surfaces persist; they exhibit cultural permanence and are distributed unequally. Yet, despite their omnipresence, they often go unnoticed, strangely invisible.

My initial enthusiasm and idealistic optimism for this asphalt wonderland have quickly evolved into a work ethic focused on transforming the hard and non-green spaces prevalent in our communities. These impervious surfaces, given their environmental and social impact and their political context, necessitate more ambitious ideologies that establish strategies pertaining the urban landscape: a firm integration with local communities, capitalizing on local qualities, stronger connections between the spaces above and below the urban surface, and the inclusion of nature everywhere. Through this strategy, impervious surfaces become holey, or porous, making room for widespread engagement with nature. Achieving this cultural and physical transformation is a gradual and challenging process, requiring social buy-ins, political changes, conflict resolutions, a reorientation of urban priorities, collaboration, and unwavering determination.

The term "dense matter"[3] symbolizes the substantial material presence of hard surfaces in the lived environment and its societal significance. It aligns with material culture and implies the urgency for change. On the other hand, "holey matter" serves as a critique of dense matter, describing a condition in which the city's surface consistently reconnects the spaces above and below. In this condition, air, moisture, flora, and fauna establish physical connections with soil, hydrology, and organic life, providing space for nature and ultimately positively impacting human well-being[4]. Dense matter can easily be associated with the techno-heroic paradigm.

Figure 1. Asphalt Garden, Metis International Garden Festival 2003

Techno-Heroic Paradigm

Ursula K. Le Guin, a speculative fiction author, proposed an alternative perspective on human origins. As a thought experimenter,[5] she envisioned a world where the tools used to hunt mammoths and harm people were replaced by a simple carrier bag. This container served the purpose of carrying things, such as oats, shifting the focus from heroic tales of adventure and near-death experiences to the ordinary aspects of everyday life. Le Guin referred to this concept as the "carrier bag theory of fiction."[6] This alternative viewpoint relieves the pressure of adhering to a single ideology of the Techno-Heroic narrative in favor of a humane proposition. It sheds light on the diverse range of human experiences and the quality of life when designing our lived environments. Consequently, the carrier bag theory of fiction opens alternative avenues of thought. Although originating in the mid-80s, it remains highly

relevant in this era of reevaluating our relationship with the built and natural environments, nearly 40 years later.

Le Guin's carrier bag theory of fiction encompasses two core ideas. Firstly, it challenges the traditional notions of narrative and storytelling. Secondly, it suggests replacing the significance of hard and pointy objects with a receptacle, or a thing that carries things. These concepts draw a parallel with the material aspects of our world and the narratives they generate. This essay combines these two concepts, breaking away from heroic and linear narratives and embracing multiple interpretations that can be at times mundane and conflictual. These interpretations are held together by a conceptual container, symbolized by the impervious environment. In this context, the carrier bag represents a vessel that holds these ideas. This essay delves into the search for the anti-heroic, exploring its various forms and the significance of this process. Additionally, it examines different interpretations and conceptions of impervious surfaces—those hard elements comprising our urban and lived environments.

Like oats, asphalt and concrete surfaces are mundane and often overlooked aspects of our surrounding landscape. They lack aesthetic appreciation and humanistic comfort, serving as means to an end—an uninterrupted and expansive facilitation of movement. They do not evoke imagination for an embracing mediating space between our homes and the spaces where we engage daily.

Heroic vs Anti-Heroic

So, what defines a heroic or techno-heroic landscape, and how can we begin to contemplate deviating from it? While Le Guin, a science fiction writer, operates within fictional realms, landscape architecture engages with immediate and tangible environments that often resist idealized imaginations. Alex McClean's aerial photographs, including those showcasing parking lots, depict what a techno-heroic landscape might resemble (fig.2): a perfectly constructed flat ground plane accommodates an immense number of cars, serving a singular purpose while presenting a coherent narrative. It is an awe-inspiring landscape, possessing a sublime quality within its non-human, motorized environment—flat, seamless, and seemingly infinite. It resembles a two-dimensional representation of an Agnes Martin painting, with repetitious lines and flawless execution,[7] or akin to a wood block print in Lygia Pape's Tecelares Series,[8] showcasing planes of black ink with thin lines revealing the paper beneath. McClean's portrayal of this landscape is both an artwork and a photograph, capturing the subject matter’s invisible technology and the artist’s expertise. The execution of this parking plane, this new urban skin, is magnificent. However, the complete eradication of anything natural or pre-existing within it is perplexing, highlighting the incredible human ability to mold existing elements into a unique form of perfectness, uniformity, and simplicity, rendering this a Techno-Heroic landscape.

In our everyday lives, we encounter various instances of techno-heroic impervious landscapes. Retail landscapes and regional malls, high school parking lots, as well as the channelized concrete Los Angeles River, exemplify this notion. Additionally, car and access spaces within office complexes fall into this category. Many of these environments adhere together and accrue in size. These landscapes are shaped by linear and singular narratives, devoid of programmatic elements and green spaces, and often neglect the human experience. As cities grow, the accumulation of hard mobility spaces in urban areas contributes to the expansion of increasingly vast impervious landscapes, further magnifying the techno-heroic presence.

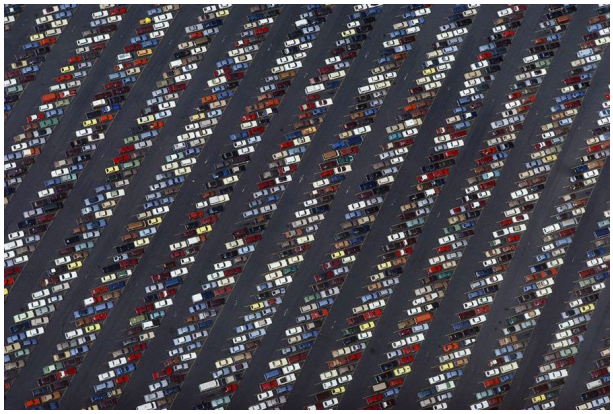

Figure 2. Parking lot photographed by Alex MacLean

Anti-Heroic: The All People's Fresh Market

The All People's Fresh Market in Columbus presents a different, non-heroic narrative. It chronicles a people-driven, mundane, complex, and multifaceted history. Though, in its lack of porosity and nature, its environment is equally hard and impervious (fig.3), it is not a simple or "linear" space; a space that is organized or used for a single purpose that of the efficient organization of automotive access. However, the Fresh Market serves as a model of human engagement with urban space, where complex human interactions take precedence, with the inside and outside spaces acting as a vessel to accommodate that. The market's mission is to provide free fresh fruits, vegetables, and dairy products to any household with earning less than 200% of the federal poverty guidelines and in 2025 the eligibility is $64,150 for a family of three, or $31,300 for one person. In 2021, it served customers from 190 different ZIP codes, with a daily average of 300 to 350 customers.[9] This number has gone up and the market currently serves between 320 and 400 customers between Tuesdays and Fridays.[10] Established in 2012 by the nonprofit United Methodist Community Development for All People, it is the largest food pantry in Ohio.

Social Context

Although rapidly gentrifying, the Southside neighbourhood, where the Fresh Market is located along Parsons Avenue, is characterized by high social vulnerability. The Centers for Disease Control and Prevention describes social vulnerability as the degree to which a community exhibits social conditions, that may affect its ability to prevent human suffering and financial loss in the event of disaster.[11] These social conditions include high poverty, low percentage of vehicle access, or crowded households. This vulnerability is expressed through the Social Vulnerability Index, and scores range from 0, lowest vulnerability, to 1, highest vulnerability. These scores are visualized through interactive maps providing increasingly detailed insights from county level to the census block; the smallest geographical unit for which the U.S. Census Bureau tabulates data. In 2023, in the Southside, geospatial analysis at the scale of census blocks showed that most blocks east and southwest of Parsons Ave are rated as high vulnerability with scores in the 0.85 range and one of 0.94. In comparison, Franklin County had an overall Social Vulnerability Index Score of 0.51. In my research on impervious surfaces, heat, and shade, this fine-grained spatial and demographic information has been helpful in pinpointing specific areas of need. Rather than developing blanket strategies for green infrastructures and trees, this detailed spatial indexing allows for precise targeting, which is helpful especially in communities with limited resources. The Social Vulnerability Index relates demographic data with space, which makes site specific interventions possible. However, since the change in presidency in 2025, the Trump

administration has limited access to the datasets, and the census block-based geo-spatial data is no longer available; only one county-wide data point is presented, setting back research and community action.[12]

Given the social context of the Southside, the United Methodist Church for All People and the United Methodist Community Development for All People (CD4AP) play a central role in the Southside community by improving the lives of its residents. Its main campus along Parson's Avenue is home to the church, the Fresh Market, a medical center, a clothing store, a bike store, and a community center. The South End Café, opened in 2023 and created by CD4AP, is a social enterprise to employ those impacted by incarcerations as a steppingstone toward greater employment. Furthermore, the Parsons Avenue Redevelopment Corporation supports the redevelopment of Parson Avenue as part of building a more inclusive community on the Southside.[13]

Building-Car Symbiosis

In the car-oriented society of the American Midwest and Columbus, the beer hall is the epitome of a building-car symbiosis other than a parking garage. Originally a drive-through beer hall, a common typology in Columbus and some are still in existence, the Fresh Market building is shaped like an upside-down U, open on both short ends so customers could drive through the building and purchase beverages without leaving the car. To facilitate this automotive use, all surfaces inside and outside the structure are paved, and ample parking is provided. This material configuration continues to today and the asphalt and concrete surfaces surrounding the building seamlessly blend into the street and alley. The Fresh Market is serviced by the Mid-Ohio Foodbank and the hard surfaces facilitate delivery trucks at the back of the building accessed from the alleyway. The parking spaces originally used for beer hall customers, are now used by market members while they shop and by the congregation during Sunday services at the church across the street. Fresh Market members arrive on foot or by bus, as the market is located near a bus stop secured by the church. The bus stop, having a bench, also functions as an impromptu gathering space. Communication among market members, including those who do not speak English, occurs through collaboration, signifying a social complexity and a sense of community (fig. 4). The hard spaces surrounding the market were especially helpful during the Covid-19 pandemic; to minimize person-to-person contact, pre-packaged food boxes were prepared in advance and were placed in trunks of members' cars. The cars would drive around the building, and the hard spaces facilitated cars waiting in line. During the pandemic, the Fresh Market serviced customers with a record-breaking 680 families in a single day.[14]

While the distribution of fresh produce is its first objective, the Fresh Market serves also as an informal community center with daily activities on health and wellbeing. In February 2025, if offered a Health Education Club, nutrition and wellness gatherings, relaxation events, blood pressure and blood sugar checkups, Alzheimer's and dementia classes, cooking demonstrations, and dance classes. Thus, the hard surfaces facilitate a wide range of social activities within and around the building.

In the summer of 2025, with a grant from the City of Columbus, the Neighborhood Design Center started a new collaborative initiative; the CoLab Studio,[15] where ten high school interns worked on bringing the Fresh Market surroundings to life with a mural, a road mural, and landscaping. Students mentioned that this initiative helped them to stay of the street and making money, and it brought the community together (fig. 5).

Street as Third Space

The South Side community has designated Parson's Avenue as a third space; a term used for a space that is separate from the home–"first space," and the workplace or school– "second space." A third space provides opportunities for social relationships and experiences with a diversity of human beings.[16] It is usually associated with a distinct space like a pub or a park, but it is remarkable that here, the entirety of Parson's Avenue is considered a third space, thus emphasizing the importance of this street as a communal space. As a midwestern city, Columbus residents primarily move by cars but Parson's Avenue is heavily used by pedestrians. The street seamlessly connects to the Fresh Market and all its outside and inside spaces serves for gathering. However, as an asphalt and concrete space, it absorbs heat and is inhospitable during hot summers. The church across the street serves as a cooling center during especially hot days for residents who do not have access to home cooling, and in the winter, it serves as a heating center. In the summer, umbrellas, tents, and water (fig. 4) attempt to mitigate the heat, but mostly people accept the heat in these spaces. There have been unsuccessful attempts to create more permeable surfaces and introduce trees but cutting asphalt seems a daunting task omitting these improvements. A planter with shrubs and trees behind the bus stop is the only vegetated area here. Planter boxes on the asphalt surface have herbs, vegetables, and flowers, and are maintained by the market's manager. Street trees in this area have long disappeared. Nationwide Children's Hospital to the north is expanding its campus and it is expected that Parson's Avenue will need to accommodate even more traffic further limiting spaces for trees and other vegetation. Notwithstanding its success as a diverse and inclusive social space, the Fresh Market area remains a hard, hot, and inhospitable environment, lacking human comfort. Yet, as mundane as Le Guin's collecting oats in a bag, the Fresh Market space embodies the anti-heroic, the non-glorious, the mundane—a place that serves ordinary yet essential human needs.

Figure 3. Hard spaces around the Fresh Market
Figure 4. Fresh Market members waiting in line
Figure 5. CoLab Studio interns

The Eleanor

Since the housing and banking crisis of 2008, CD4AP has bought foreclosed homes and other buildings, renovated them, and rented them back to residents and local entrepreneurs, working toward keeping residents in this neighborhood. Its recent undertaking is the development of a mixed-use project, called the Eleanor, that entails the entire block of the Fresh Market (fig. 6). Two single family homes were demolished to make space for this development. The Eleanor would house the Fresh Market on the ground floor with residential units above, with 50% designated as affordable and market-rate housing. Code requirements are met through the inclusion of an underground stormwater runoff retention basin under the building as well as parking at the back and under the building. It is an admirable ambition to provide affordable housing in a rapidly gentrifying neighborhood. Yet, the resulting built project maximizes the site's footprint, leaving little room for connectivity between soil and air, and vegetation. The design prioritizes an economy of means to maximize the affordability for residents, while considerations of nature and porosity are lacking in the discussion.

The building maximizes the site vertically and horizontally, and in its object-like form, the Eleanor embodies a techno-heroic project. But its intention to secure affordable housing for the local community in the face of gentrification and current construction cost and financing is undeniably heroic. The development process involves challenges such as underground stormwater retention basin, meeting parking requirements, negotiating affordable and market-rate housing, and securing funding. It is a complex and non-linear narrative. Some people express a sadness to lose the former beer hall, others view this project as risky, as combining affordable and market-rate housing within a single building is unprecedented in Columbus and creates uncertainty in securing the necessary funds.

Figure 6. The Eleanor

Belly of the Universe

While both the existing Fresh Market and the proposed Eleanor are respected endeavours, they also embody complexities and unsolved urban conflicts that deviate from an idealized world—an environment that socially engaged designers aspire to create. In this material environment, hard surfaces are often continuous; a material glue connecting urban components, and nature is often absent. This hard world is messy, conflicting, and complex, yet it is the world we must engage with as landscape designers and thinkers who shape the lived environment. In articulating science fiction, Le Guin writes that its role is to describe "what people actually do and feel, how people relate to everything else in this vast sack, this belly of the universe."[17] Navigating this universe requires tenacity—a stubbornness and determination to accept non-ideal situations and work towards positive changes, small and large.

NOTES

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HOW RELIABLE ARE OPEN DATA SOURCES IN MEASURING THE 15 MINUTES PROXIMITY: A CASE STUDY OF LAHORE PAKISTAN

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INTRODUCTION

The 15-minute city has been the hot topic since post-covid. Most studies measuring the 15-minute proximity to basic services rely on open data sources such as OpenStreetMap. These open data sources are quite accurate in European case studies because open data sources are voluntarily well managed for these areas. But this accuracy is highly questionable for case studies from developing countries. Therefore, the reciprocity of the 15-minute city concept into the developing countries is difficult. We aim to measure 15-minute proximity to the health services, and schools using open data sources and data provided by local authorities. So, we can compare how much difference we get in terms of proximity when we change the data sources. The centroids of H3 hexagons at resolution 9 will be used for Lahore city boundary and computed as origins in the r5r package to calculate shortest travel times to each type of points of interest, i.e., education, transport, and health. Access scores will be given to each hexagon proportionally to their access to each type of facility. The difference in the access score will provide useful information on the level of accuracy that we attain by using different data sources. We could make a claim on which type of sources are better in order to calculate 15-minute proximity.

CASE STUDY

Lahore, a metropolitan city in Pakistan, is the capital of Punjab and one of the most populated urban areas. In 2020 the city hosted about 10.8 million inhabitants, rising from just over one million in 1950 to nearly twelve million in 2022. The urban area expanded rapidly, doubling its extension between 1999 and 2011, and now covers 1772 square kilometres.

In the last fifteen years, mobility conditions have deteriorated due to strong demographic growth and increasing levels of car ownership. Registered private vehicles per 1000 residents grew markedly, while daily trips reached several million. As a result, active mobility has declined and dependence on motorised modes has intensified.

To respond, the Government of Punjab established in 2015 an authority responsible for mass-transit, with the aim of coordinating public transport services in the city. At present, three main systems have been integrated: the Orange Line metro train, the bus rapid transit line, and the feeder bus network. The metro train operates along an elevated corridor of more than 27 km, with multiple stations and hundreds of thousands of daily trips. The bus rapid transit line, partly on the ground and partly elevated, also runs

about 27 km with high ridership. The feeder bus service extends the reach of this system with a fleet of standard buses.

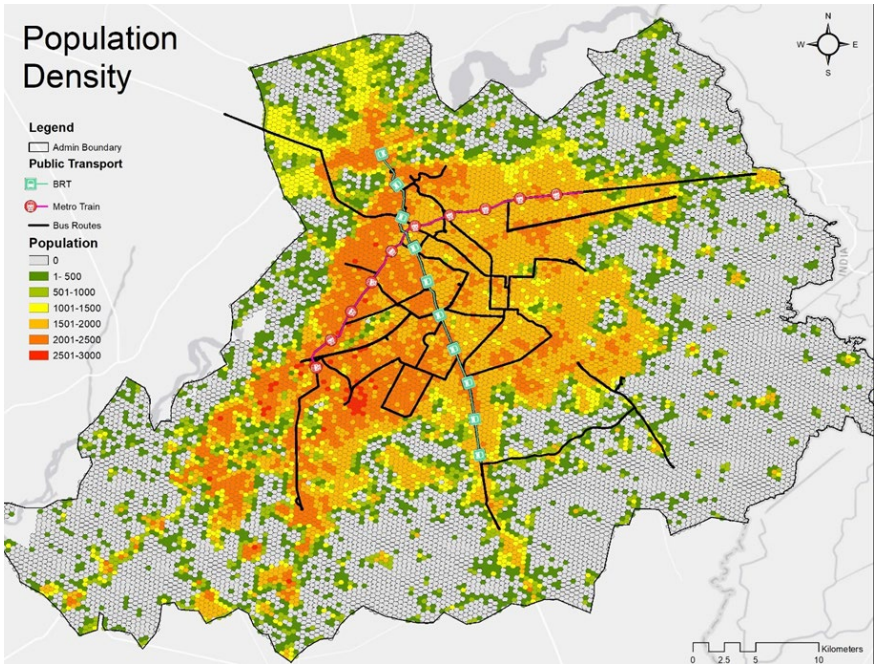

Figure 1. Case study

MEASURING 15-MINUTE PROXIMITY

Recently, numerous studies have evaluated how cities comply with the 15-minute or x-minutes city notion.[1] Although the accessibility measuring methods differ, there are three core components defining each methodology: (1) identification of trip origins; (2) choice of urban amenities; and (3) network analysis settings.[2] Selecting trip origins signifies determining the scale and detail of spatial analysis. Case studies commonly rely on population data available at the level of administration units or census tracts, prompting many studies to apply aggregated spatial units as representations of trip origins. Other research uses customized grid cells (100x100 m to 500x500 m) or utilizes housing units for greater granularity.[3] The second component concerns the selection of urban amenities, which varies among studies depending on their relevance to people's quality of life in each case. These amenities can include grocery stores, healthcare services, educational facilities, restaurants, worship places, banks, parks, and employment. The third component involves network analysis settings where transport mode, speed, and time or distance thresholds are determined (shown in Figure 1). Most studies[4] conduct such network analysis in GIS environments, while others use R or Python packages and libraries (e.g. r5py, r5r, networkx) in integrated development environments.

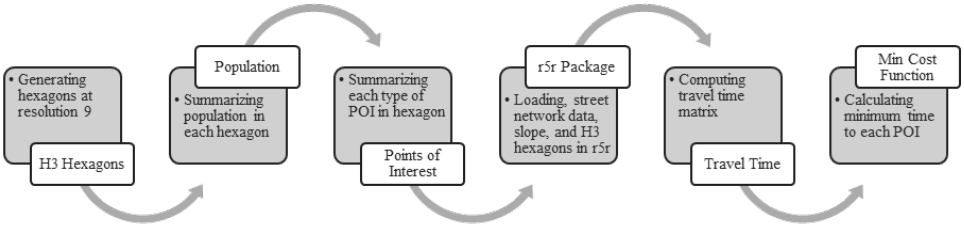

Figure 2. Measuring 15-minute proximity

The process of measuring 15-minute proximity follows the steps shown in Figure 2. For the case study area, H3 hexagons were generated at resolution 9 using the H3 library in R, and population values were aggregated within each hexagon. Obtaining population data at fine spatial scale is a major challenge in the developing world. To address this, we applied an open dataset from WorldPop, available in GeoTIFF format with a resolution of 3 arc (approximately 100 m).[5] Points of interest (PoI) for each category of basic facility were collected from OpenStreetMap and summarized per hexagon. The selected categories of urban amenities are listed in Table 1.

For the network analysis, the street network dataset was extracted from OpenStreetMap,[6] while elevation or slope information in GeoTIFF format was obtained from the OpenTopography platform.[7] Including slope data improves the accuracy of the travel time matrix. GTFS data is especially valuable for multimodal accessibility, but in this study the stops.txt file was used to identify public transit stops. Centroids of the hexagons were used as origin-destination points in the r5r package, where travel time matrices were computed using "Walk" as the travel mode.[8] For each facility type, the minimum cost function to the closest location was applied to estimate travel times.

Urban Amenities	Category	Data Sources
Education	Facilities/Education	OSM Features: childcare, kindergarten, school, university, college, language_school, driving_school, music_school, dancing_school, prep_school
	Public Schools	OFFICIAL Data: School Census 2018 (Programme Monitoring & Implementation Unit Punjab Education Sector Reform Programme, 2019)
Transport	Bus Stops	OFFICIAL Data: GTFS data
Health	Facilities/Health	OSM Features: hospital, clinic, doctors, dentist, pharmacy, baby_hatch, veterinary, orthodontics, physiotherapist, alternative, laboratory
	Registered Health Services	OFFICIAL Data: Licensed Hospitals by Punjab Healthcare Commission
Shops	Shop	OSM Features: Supermarket, convenience, general, kiosk, bakery, butcher, seafood, dairy, cheese, frozen_food, deli, pastry, confectionery, chocolate, tea, coffee, herbalist, marketplace, greengrocer, farm, organic, water, alcohol, beverages, wine, cannabis, nutrition_supplements, health_food, spices, clothes, boutique, fashion,_accessories, fashion, shoes, shoe,_repair, bag, outdoor, dry_cleaning, laundry, tailor, fabric, computer, electronics, mobile_phone, hifi, video, video_games, music, radiotechnics, doors, furniture, appliance, electrical, kitchen, houseware, lighting, curtain, window,_blind, art, frame, bed, etc.
Restaurants	Facilities/Food+ Drinks	OSM Features: restaurant, fast_food, food_court, café, bubble_tea, ice_cream, pub, biergarten, bar
Leisure	Facilities/Leisure	OSM Features: slide, swing, cinema, bandstand, zoo, escape_game, resort, swimming_pool, fitness_station, sauna, dog_park, miniature, toy_library, playground, picnic_site, picnic_table, bbq, fishing, firepit, bird_hide, amusement,_arcade, adult_gaming_centre, nightclub
Place of Worship	Facilities/Place of Worship	OSM Features: christian, muslim, jewish, buddhist, hindu, shinto, sikh, monastery,
Money	Money	OSM Features: Bank, bureau_de_change, money_transfer, atm, payment_centre, payment_terminal, pawnbroker, money_lender

Table 1. Urban amenities and data sources

RESULTS

Travel time matrix is calculated using the minimum cost function of r5r package. Figure 3 shows the walking times to each type of facility. Facilities like shops, food/drinks, bank/atm, and health are found to be concentrated in the central city while schools are more or less evenly distributed. In terms of access to bus stops, the city provides high access in the central area, while the outskirts of the city suffer from low access. Lahore lacks opportunities for leisure activities. Places of worship can be seen sparsely

distributed. On average, it is seen that Lahore hardly provides 15-minute access to all types of facilities in some central areas. Figure 3 shows that the city center and some parts in the middle have 15-minute access to all facilities.

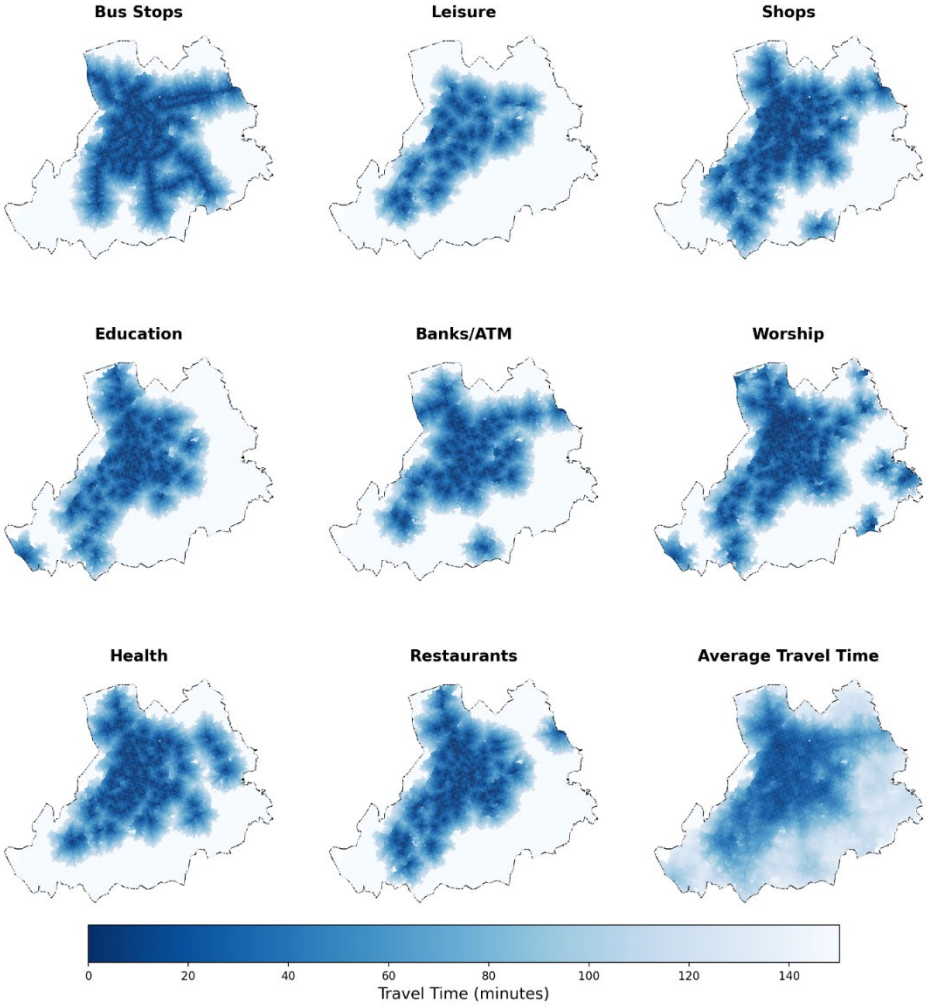

Figure 3. Travel times to facilities

A drastic difference is observed between OSM and official data while calculating travel times using official data from school census shown in Figure 4. Paired t-test p-value = 0.0000 (very significant) shows a statistically significant difference in mean walk times between OSM and official data for education POIs. OSM walk times are systematically higher. Similarly, visually significant differences can be observed for health data as well. Although Spearman correlation = 0.303 shows weak positive correlation, so the order/ranking of education walk times between the two sources does not match well.

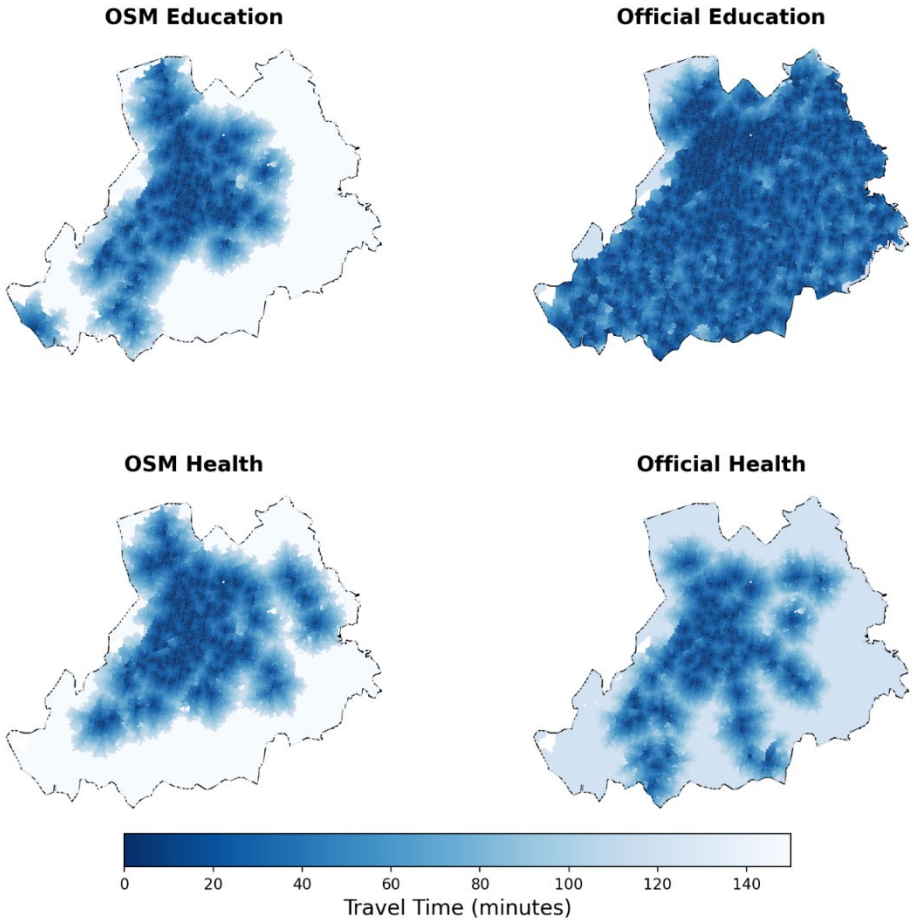

Figure 4. Comparison between OSM and Official data

CONCLUSION

This case study of Lahore highlights important challenges in applying the 15-minute city approach in developing contexts. Results show that the city provides limited proximity to many basic facilities, with only a few central areas reaching a complete 15-minute access. A clear difference emerges when comparing open data sources with official datasets: accessibility levels measured with OpenStreetMap tend to be systematically less accurate, especially for education and health services. The significant statistical difference between the two sources confirms that the reliability of open data cannot be assumed in all contexts. Therefore, the measurement of proximity must carefully consider the availability and quality of local data, as depending only on volunteered geographic information may lead to misleading outcomes. At the same time, the findings suggest that integrating multiple data sources allows a more realistic evaluation of accessibility and provides useful guidance for planning actions aimed at improving equity in access to essential services.

NOTES

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HOW TO ACHIEVE GREEN AND LIVABLE CITIES? COMPARATIVE ANALYSIS OF 10 CITIES IN SERBIA TOWARDS NEW IMPROVEMENT

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INTRODUCTION

Green and livable cities maybe be concerned as utopistic idea, but yet humanity is for past ten years trying to push the urban development towards this new concept.

At the global level, numerous strategies in the field of sustainable development and climate change towards achieving greener and low carbon cities have already been developed, supported, and implemented at lower, national levels of decision-making.[1,] On the other hand, although the extreme consequences of climate change are central to many of these strategies, long-term risk reduction policies should also enable alternative forms of intervention and reorientation - toward the advantages of climate-responsive urban planning and the design of buildings and public/open spaces.

Current theoretical considerations in the field of urbanism have shifted the discourse from enhancing the sustainability of cities toward strengthening their resilience.[2] This transition is largely driven by increasingly frequent and severe climate changes, accompanied by elevated risks that may jeopardize the survival of certain urban areas.

Cities are dynamic and essential components of contemporary society, serving as primary engines of social, economic, and technological development. According to the United Nations, approximately half of the global population currently resides in urban areas, a figure expected to exceed 60% by 2030. As indicated in the Intergovernmental Panel on Climate Change (IPCC) report, cities account for around 70% of global energy consumption and generate approximately 80% of total carbon emissions.[3]

In addition, cities face a range of pressing environmental challenges, including poor air quality, traffic congestion, and increasing pressure on limited green spaces, as well as land and water resources. The organization of urban activities significantly influences environmental conditions and directly affects the overall quality of life for urban populations.

The Green Cities Programme Methodology, developed based on the work of the OECD and ICLEI, defines a Green City as:

"A city which shows high environmental performance relative to established benchmarks in terms of: (i) quality of environmental assets (air, water, land/soil, and biodiversity); (ii) efficient use of resources (water, energy, land, and materials); and (iii) mitigating and adapting to climate change-related risks, while maximizing economic and social co-benefits, and taking into account its specific context (population size, socio-economic structure, and geographic and climatic characteristics)".[4]

These issues are especially relevant in Serbia, which serves as a pilot area for the research of green cities, where urban areas exhibit particularly low levels of energy efficiency, use of renewable energy resoures, poor urban mobility, as well as inadequate municipal solid waste management. Most cities produce municipal solid waste that is deposited in non-sanitary landfills without any prior treatment, and recycling rates remain extremely low (up to 5%) compared to the EU average of 39% and the EU's target of 50% recycling of municipal waste by 2020.[5]

To ensure the sustainable development of green cities, it is essential to recognize the interdependence between environmental, economic, and social dimensions. This perspective aligns with the United Nations 2030 Agenda for Sustainable Development, particularly Goal 11, which calls on governments to make cities and human settlements inclusive, safe, resilient, and sustainable.

Through the paper, new concepts and ideas for achieving more sustainable, livable and greener cities are proposed through evaluation of the 10 cities in Serbia. The research was conducted within the collaborative effort between the World Bank Group and the SECO SURGE Trust Fund through project "Technical assistance: Strengthening capacities of local self-governments in Serbia towards low-carbon and resilient urban development investments" conducted from 2022-2024 (study conducted in cooperation of GFA South Eastern Europe and Institute of architecture and urban&spatial planning). The selection of ten cities for this study was based on their significance to the World Bank Group and SECO program objectives.

The research of this paper is covering two major clusters - strategic planning and governance as well as green urban development. The ten cities- Niš, Novi Sad, Kragujevac, Kraljevo, Šabac, Zrenjanin, Novi Pazar, Sombor, Užice, and Leskovac in Serbia—were selected based on an initial survey identifying them as key areas of interest.

GREEN LIVABLE CITIES-DEFINITIONS, GOALS, APPEARANCE, CONCEPTS

Green livable city is an urban area that integrates environmental sustainability, social inclusiveness, and economic viability.[6] The main goal for achieving green city is to ensure socially, economically and environmentally adequate quality of life for all the inhabitance and to incorporate climate resilient principles[7]

Those cities should have well developed green infrastructure, sustainable mobility, energy efficient buildings, effective use of renewable energy sources and accessible public spaces as well as inclusive governance. Also, they are promoting biodiversity, climate change adaptation and mitigation, resource efficiency and public health and participation of all groups (including the vulnerable ones), through strategic urban planning and participatory decision-making processes.

Green livable cities are envisioned as urban areas characterized by compact and mixed-use spatial forms that contribute to higher land-use efficiency, improved accessibility for all, and enhanced support for urban mobility systems. This form of spatial organization facilitates greater functional integration and reduces the need for long-distance commuting, thereby lowering transport-related emissions. Cities like Copenhagen and Vienna have long promoted compactness and accessibility through integrated public transport and land use policies that foster pedestrian-friendly and socially inclusive environments.[8] By promoting the integration of housing, work, services, and leisure in close proximity, compact urban development enables more sustainable daily living patterns.

A fundamental element of green city strategies is the deployment and preservation of green and blue infrastructure. This includes the provision of parks, urban greenery, green roofs, riverbanks, lakes, and other nature-based solutions that mitigate the urban heat island effect, enhance biodiversity, and improve residents' well-being. Cities such as Singapore and Berlin have invested in green corridors, rooftop gardens, and urban wetlands as part of their long-term environmental strategies.[9] In parallel, sustainable mobility and transit-oriented development (TOD) are emphasized, with investments in

bicycles, trams, and car-sharing schemes aimed at reducing car dependency. Amsterdam is often cited as a benchmark city for its bicycle infrastructure and culture of low-carbon commuting.[10] Energy efficiency and the use of locally available renewable energy sources, such as solar panels and small wind power plants, are essential components of a city's decarbonization efforts and transition toward long-term sustainability.

Equally important is the dimension of climate resilience, requiring local governments to adopt action plans and risk assessment strategies that prepare cities for the impacts of climate change. The city of Rotterdam stands out for its adaptation strategies, including floating neighborhoods and a climate-proof urban water system.[11] Public participation is a cornerstone of these processes, ensuring that planning frameworks are co-created with stakeholders and reflect local needs. This is closely linked to the promotion of circular economy principles, as seen in cities like Ljubljana, which has become a European leader in zero-waste and circular waste management.[12] Ultimately, a green livable city aspires to secure high quality of life for all its residents while minimizing ecological impact and enhancing the city's adaptive capacity in the face of an uncertain climate future.

THE SERBIAN CONTEXT: BRIDGING SCIENTIFIC INSIGHT AND PRACTICE IN ACHIEVING GREENER CITIES

In Serbia, a considerable segment of the scientific community is actively engaged in research related to low carbon development, both through national initiatives funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia and through participation in international scientific projects. Numerous studies have been published in domestic and international journals, as well as in scientific monographs, while researchers have regularly presented their findings at conferences dedicated to low carbon development.[13] However, despite this evident academic productivity, the practical implementation of scientific results remains limited.

In the field of urban planning and design, legislative measures appear to be the most prominent route toward low carbon development and climate change mitigation in Serbia. Nonetheless, the real-world impact of these legal mechanisms remains difficult to assess due to insufficient monitoring and evaluation. Despite this challenge, the country has made important initial steps in aligning urban development with climate goals.

Among key national priorities are energy efficiency and the promotion of renewable energy sources, both of which are recognized as fundamental for reducing CO_2 emissions. Yet, awareness and commitment to energy-efficient practices remain low across multiple stakeholders, including government institutions, local administrations, investors, citizens, and even the media. Serbia's energy consumption is currently double the average of the 35 OECD countries.

The increasing frequency of extreme weather events (floods, droughts, strong winds, and cold spells with heavy snowfalls) presents both a challenge and an opportunity to assess the vulnerability of Serbia's urban fabric and built environment. Addressing these issues requires a multidisciplinary approach that involves planners, architects, engineers, and environmental scientists.

The planning and design professions also bear the responsibility of actively participating in forecasting climate risks and developing effective, cost-efficient adaptation strategies in Serbian cities. These planned interventions should be contrasted with spontaneous, ad hoc responses that typically arise without professional oversight or strategic vision. Integrating expert-driven adaptation into mainstream urban and environmental policy will be essential for increasing resilience in the years ahead.

However, in order to develop effective strategies for low-carbon development at the local level, it is essential to first assess the current state and readiness of cities in their transition toward zero CO_2 emissions. This involves a comprehensive review of existing local planning documents, an analysis of

their mutual alignment or discrepancies, and an evaluation of their current environmental performance and status.

Main challenges in Serbian cities

Serbian cities are facing a complex set of interrelated challenges in their transition toward sustainability and low-carbon development and climate resiliency. The processes of urbanization, accompanied by the impacts of climate change and environmental degradation, are intensifies by long-standing infrastructural neglect and deeply rooted institutional fragmentation. This fragmentation is not only sectoral but also hierarchical, resulting in unequal capacities and decision-making mechanisms across governance levels, which significantly hampers integrated planning efforts.[14]

Depopulation trends further complicate this trajectory, Serbia has recorded a population decline of 11.3% between 2002 and 2022,[15] disproportionately affecting smaller and peripheral municipalities. These dynamics contribute to spatial inequality, with pronounced discrepancies between more developed urban centers and lagging rural or post-industrial areas. Simultaneously, the lack of adequate infrastructure and basic services, particularly in marginalized settlements, perpetuates cycles of socio-economic and environmental vulnerability.[16]

Although Serbia has formally committed to European and global sustainability frameworks, such as the Covenant of Mayors and the European Green Deal, implementation remains weak and fragmented.[17] Strategies often exist only on paper, with insufficient operationalization, monitoring, or financing mechanisms. Furthermore, while national legislation and strategic frameworks have undergone formal harmonization with EU acquis, the planning and governance landscape remains overwhelmed by a proliferation of binding documents that are frequently overlapping, inconsistent, and inadequately coordinated. Many of these are externally funded (e.g., through EU funds or World Bank support), but lack systemic integration and continuity in local institutional practice.[18]

Collectively, these issues underscore the urgent need for policy coherence, institutional capacity-building, and truly inclusive urban governance, if Serbian cities are to effectively pursue resilient, climate-smart development paths.

Economic growth in Serbia has predominantly been concentrated in its two largest urban centers (Belgrade and Novi Sad) which together account for approximately 60% of the population and over 75% of the country's jobs. Such concentration of development has further deepened spatial inequalities, as smaller cities and rural areas remain largely excluded from the dominant economic and infrastructural trends. Development tends to cluster along key transport corridors and in the vicinity of larger cities, while peripheral regions continue to lag behind in terms of accessibility, services, and public investment.

Despite an urbanization rate of about 60%, Serbia still remains below the European Union average, reflecting not only demographic patterns but also structural challenges in urban governance, infrastructure provision, and policy implementation.[19] In response to these disparities, a group of ten Serbian cities: Niš, Novi Sad, Kragujevac, Kraljevo, Šabac, Zrenjanin, Novi Pazar, Sombor, Užice, and Leskovac (Figure 1), has been selected as a testing ground for green and climate-resilient urban development initiatives, aiming to promote a more balanced spatial development strategy. Selection of those cities is based on initial research identifying them as representative case studies. These are large and medium-sized cities that differ significantly in their geographical location, morphology, level of development, economic structure, and environmental conditions. Although these differences presented certain challenges during the comparative analysis, they also enriched the research by providing a more diverse contextual framework.

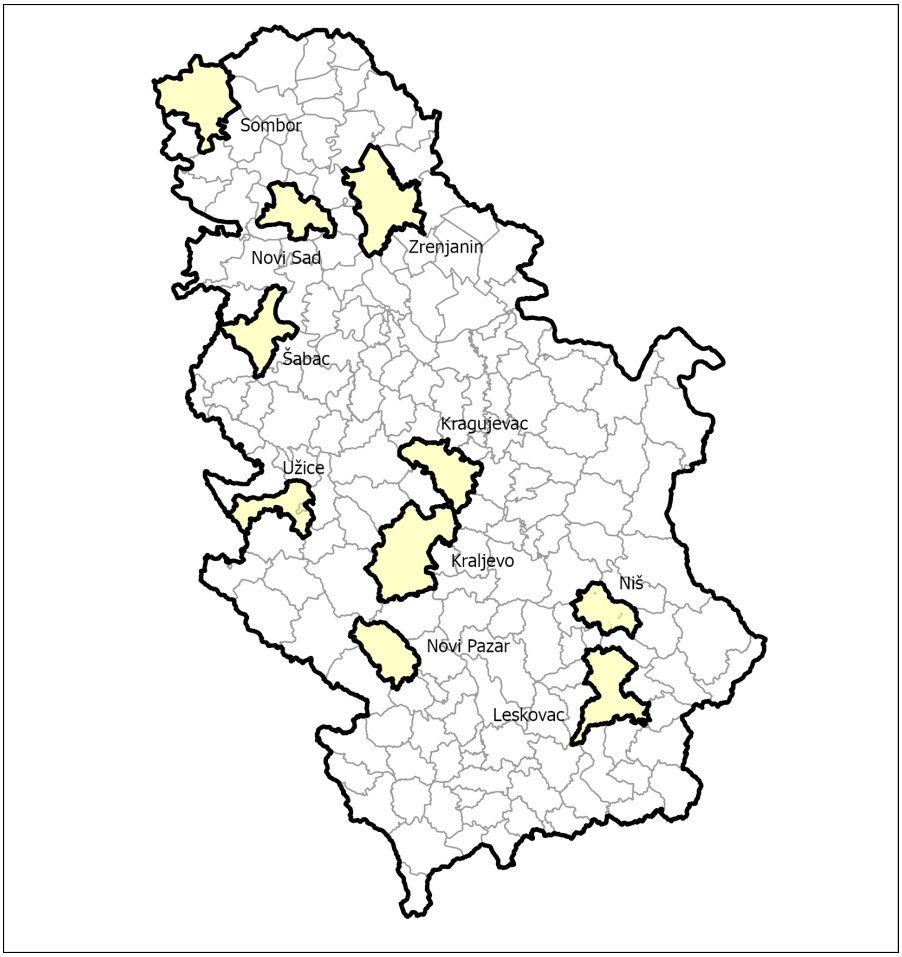

Figure 1. Position of the pilot cities in Serbia, Authors, 2025.

Analysis of the pilot cities

In the research of 10 cities, a combination of qualitative and quantitative research methods, including structured questionnaires and participatory workshops, was employed to gather data related to key aspects of sustainable urban development. The information collected spans strategic and urban planning processes, demographic trends and projections, as well as climate and environmental conditions across selected cities. This comparative analysis focuses on assessing the performance of ten selected secondary and mid-sized cities in Serbia. Through a adapted evaluation framework, the study identifies both the shared challenges and unique development pathways of each city, in relation to their capacity for transitioning toward a green, livable, and climate-resilient urban future. The results aim to demonstrate a clear correlation between the existing institutional, infrastructural, and environmental capacities of cities and their potential for targeted improvement.

KEY FINDINGS AND CHALLENGES IN SERBIAN SECONDARY CITIES

The comparative assessment of ten selected Serbian cities (Niš, Novi Sad, Kragujevac, Kraljevo, Šabac, Zrenjanin, Novi Pazar, Sombor, Užice, and Leskovac) reveals a complex interaction between demographic shifts, environmental degradation, and urban governance gaps. Although differing in geographic location, morphology, development levels, economic base, and environmental pressures, all cities face overlapping structural challenges that inhibit sustainable and climate-resilient urban transitions.

Natural risks, particularly river flooding, intensify social vulnerability, with approximately 200,000 people in urban areas in Serbia affected annually. Despite this, urban planning largely fails to integrate climate risk scenarios. Since the 1990s, flood-prone areas have expanded due to unregulated sprawl across former green zones, worsening exposure to floods. Simultaneously, decrease of areas under vegetation and infrastructure-centric development have intensified urban heat islands, contributing to more frequent and prolonged heatwaves in Serbian cities.

Climate change impacts, including increased temperatures, deteriorating air quality, and public health issues are already evident. Environmental performance remains consistently below the EU average, reflecting systemic underinvestment in mitigation and adaptation. Urban services are inadequate, especially in water, waste, and green infrastructure provision.

Despite a decade of depopulation, cities continue to sprawl, challenging disaster resilience and sustainability. Rapid construction, often speculative and economically-driven, has failed to deliver affordable housing. Vulnerable groups, including rural migrants and Roma communitiesare frequently pushed into informal settlements lacking basic utilities. In all ten cities, unregulated land use contributes to marked inequalities in access to services.

These findings point to entrenched patterns of fragmented governance, institutional inertia, and policy incoherence. Addressing them requires specific custom-made strategies toward green and livable urban futures, with the stronghold in inclusive planning, long-term risk anticipation, and coordinated climate action.

Analysis of strategic and legal planning framework

Serbia's planning laws are designed to align with EU frameworks, focusing on long-term urban and spatial development. The Law on Planning and Construction of Serbia (2023) mandates the preparation of spatial and urban plans in 25-year cycles, ensuring that urban development is approached with foresight and strategic consideration. Additionally, the Law on Planning System of Serbia (2018) requires cities to develop Local Development Plans (LDPs), aligning local planning with national and regional objectives. This framework is supported by the Serbian Sustainable Urban Development Strategy (SUDS) until 2030[20] which sets clear urban goals based on Sustainable Development Goals (SDGs), addressing key aspects such as environmental protection, economic growth, and social inclusion. Problem is harmonization of the documents which are under the jurisdiction of different laws - spatial plans and national strategy of urban development since sometimes they are not consistent Also, problem is overlapping documents on the local level.

Analysis of local implementation and its achievements and gaps

The current status of local planning in Serbia reveals that almost all cities have adopted Local Development Plans (LDPs), and just 50% of them have developed Local Urban Strategies aligned with the SUDS. Despite this progress, several challenges persist, notably overlapping documents such as strategies, action plans, and LDPs, which complicate the planning process. Furthermore, the absence of a centralized national database hinders coordination and accessibility of key planning documents. Additionally, the implementation of these plans is often obstructed by conflicts with older spatial and urban plans, further impeding the development of cohesive urban strategies. Green priorities, including climate mitigation and adaptation, brownfield revitalization, the expansion of green space, and the enhancement of mobility, are present within the framework of local urban strategies, highlighting an ongoing focus on sustainable development in urban areas.

Sectoral green plans in Serbia are primarily driven by external donors such as the EBRD, AfD, JAICA, GIZ, and EU Interreg, with a focus on GCAPs, SUMP, low-carbon strategies, and brownfield redevelopment. However, challenges persist, notably uneven local capacities, with implementation

heavily dependent on external funding and project-based support. Public participation has been transparent and participatory, but room for improvement exists due to lack of formal citizen engagement. In conclusion, while local planning frameworks are in place, their effectiveness remains limited, requiring improvements in policy alignment, sectoral coordination, and institutional capacity for better implementation.

CONCLUSION

The analysis of strategic frameworks and gaps reveals that while most cities have strategic documents, including local development plans, sector strategies, and action plans, key limitations hinder their implementation. These challenges include fragmented implementation, poor alignment with urban plans, and limited local capacities. Climate resilience challenges are particularly evident, with uneven integration of sustainable planning principles. Issues such as poor waste and water management, limited renewable energy use, inefficient brownfield revitalization, and inadequate protection of green spaces remain critical.

Positive examples from cities like Novi Sad, Kragujevac, and Šabac show the potential for integrating green and resilient elements into urban plans. However, systemic integration of climate and ecological goals is still lacking across all planning stages.

The national analysis findings serve as the basis for recommendations applicable both nationally and internationally. These include aligning sector policies with urban plans, strengthening local capacities, and improving coordination between local and national strategies. It is also crucial to integrate climate and ecological goals into all planning phases, update brownfield databases, and prevent unnecessary land expansion to protect natural resources.

Inclusive governance is also essential, emphasizing transparency and participatory mechanisms. Both formal and informal citizen involvement should be promoted, alongside reporting on participation and gender-inclusive planning. These recommendations offer a roadmap for sustainable urban development that can be applied globally, fostering stronger coordination, institutional capacity, and alignment with international climate and environmental goals.

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NEW METHODOLOGICAL APPROACH FOR SEA IN CLIMATE CHANGE ADAPTATION AND MITIGATION PLANS EXAMPLE OF TWO SERBIAN CITIES

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INTRODUCTION

For more than two decades, Strategic Environmental Assessment (SEA) has served as a key regulatory and evaluative mechanism in the domain of spatial and urban planning. As a procedural and analytical instrument, SEA enables the systematic research and examination of potential negative effects of spatial and urban development on environmental integrity and human well-being, while also providing a framework for the formulation of measures aimed at preventing, minimizing, mitigating, remediating, or compensating harmful impacts on the environment and public health. Its methodological orientation is directed toward identifying and assessing the consequences that both minor and large-scale urban interventions may generate on environmental quality, quality of life, cultural and natural heritage, and biodiversity.

In the past decade, however, urban planning has been confronted with an additional layer of complexity arising from climate change on all levels. This evolving and unpredictable factor introduces a novel variable into the urban planning equation, fundamentally reshaping the scope and objectives of SEA. It has therefore become imperative to investigate the cause-and-effect relationship between climate dynamics and urban development: on the one hand, to assess the extent to which climate change influences planning processes, and on the other, to evaluate how urban expansion contributes to climate-related challenges.

The methodological approach to conducting SEA has always been a subject of different opinions and severe conflicts among experts in urban, spatial, and environmental planning. Each plan and strategy require a adapted methodology for environmental assessments closely aligned with the research focus. Over the past decade, new challenges have emerged, predominantly related to climate change, which adds an uncertain variable to the urban planning framework.

Accordingly, SEA is now tasked with integrating a new generation of objectives and indicators explicitly addressing climate change, and with assessing their implications for sustainable urban development. Planning in climate-sensitive contexts requires a wide range of supportive mechanisms, among which SEA plays an important role by defining adaptation and mitigation measures capable of addressing the uncertainties of climate variability. The primary objective of SEA is thus to systematically identify planning goals and relevant indicators, including those related to climate resilience and to evaluate planning alternatives through tools such as Multi-Criteria Decision Analysis (MCDA). Based on expert judgment, SEA subsequently formulates recommendations designed to

overcome, neutralize, or reduce negative repercussions on the environment. In the present context, measures for climate adaptation and mitigation occupy a central place within such recommendations, and their appropriate formulation and implementation carry far-reaching consequences.

By synthesizing existing knowledge and highlighting best practices in Serbia, through SEAs prepared for mitigation and adaptation action plans in the cities of Užice and Smederevo[1] - this paper emphasizes the importance of SEA not only as a regulatory or controlling mechanism, but also as a fundamental precondition for integrating climate considerations into all stages of urban planning. The discussion introduces climate-related goals and indicators within SEA, outlines procedures for assessing the potential impacts of urban development on these parameters, and proposes corresponding measures for adaptation and mitigation. SEA provides an anticipatory framework, enabling the identification of planning solutions that may generate significant climate-related risks or spatial conflicts, while at the same time offering strategies for their neutralization or reduction.

The idea is to inform policymakers and researchers about the benefits and challenges of systematically integrating SEA into climate adaptation and mitigation strategies and/or action plans.[2]

TOWARDS A NEW METHODOLOGY FOR SEA UNDER THE PRESSURES OF CLIMATE CHANGE

Climate change represents one of the most pressing global challenges of the 21st century, posing profound obstacles to sustainable urban development while simultaneously reshaping ecosystems, cultural and natural assets, social structures, and economic systems worldwide.[3] Rising global temperatures, coupled with the increasing frequency and intensity of extreme weather events, underscore the urgent need for proactive adaptation and mitigation strategies, particularly within urban contexts where vulnerabilities are often concentrated.[4]

By evaluating the environmental implications of proposed policies, plans, and programs, SEA enables decision-makers and stakeholders to identify risks, trade-offs, and synergies at an early stage, while also accounting for cumulative and synergistic impacts.[5] In this sense, SEA does not merely function as a technical assessment but as a proactive governance tool that fosters climate-sensitive planning and promotes more sustainable, resilient urban development pathways.

The SEA systematically determines measures aimed at preventing, minimizing, mitigating, remediating, or compensating for harmful impacts caused by specific activities. Following a critical evaluation of all anticipated environmental effects, SEA informs decisions on whether such activities should proceed, and under what conditions, or whether they should be modified or abandoned altogether.

In recent years, the integration of climate change considerations into SEA has introduced a new research and methodological dimension, particularly within the scope of MCDA.[6]

SEA has integrative role in advancing climate change adaptation and mitigation efforts by incorporating both socio-economic dimensions and bio-geographical components of the environment into evaluation processes. SEA also operates as a policy instrument that facilitates the inclusion of sustainable development principles into urban planning decision-making, with the overarching aim of preventing or reducing adverse effects on the environment, public health, and the socio-economic status of local communities.

THE SERBIAN CONTEXT: CLIMATE ADAPTATION AND MITIGATION CHALLENGES

Over the past fifteen years, global CO_2 emissions have continued to rise sharply. Countries worldwide have sought to meet commitments established from the Kyoto Protocol (1998) to the Paris Agreement (2015) and most recently COP 28 in Dubai, which emphasize holding the increase in global average temperature “well below 2°C above pre-industrial levels” and pursuing efforts “to limit the temperature

increase to 1.5°C".[7] Yet, a persistent challenge lies in the misalignment of national and regional targets with international commitments. These objectives are often not systematically evaluated through SEA, particularly in sectors responsible for the majority of emissions: transport, energy, housing, agriculture, and forestry.[8]

Reducing the share and volume of greenhouse gas (GHG) emissions is essential for mitigating the impacts of human activities on climate change. GHGs, primarily carbon dioxide, remain the main driver of global warming. Low-carbon development implies minimizing the release of CO_2 and other GHGs during economic growth. Within this framework, the adoption of a new development model is imperative, facilitating the transition from a fossil fuel–dependent economy towards one oriented to low-carbon alternatives.[9] However, planning and designing urban development under climate-related risks is constrained by numerous obstacles, many of which require resolution through the application of SEA and its multi-criteria decision-making tools.

Serbia, like other European states, has faced severe adaptation and mitigation challenges over the past decade. According to the Notre Dame Global Adaptation Index, Serbia ranks as the 86th most vulnerable country in the world, and the most vulnerable in Europe.[10] The index reflects indicators ranging from urban population density and disaster preparedness to water availability and agricultural capacity. Serbia also belongs to a recognized "climate change hot spot": its average temperature increase exceeds the global mean, while extreme events such as droughts and intensive precipitation occur more frequently.

At present, most Serbian strategic and urban planning processes insufficiently account for low-carbon development principles and lack robust assessment criteria. Consequently, effective tools to operationalize low-carbon objectives in policy and planning remain underdeveloped, leaving low-carbon development as a declarative rather than an operational principle.

Under the Paris Agreement, Serbia committed to reducing GHG emissions by 9.8% by 2030 compared with 1990 levels. It also recognized the importance of reducing risks and losses from natural disasters. In parallel, as a candidate country for EU membership, Serbia faces additional obligations related to harmonizing national and EU legislation. Part of these obligations derives from the Energy Community Treaty (EnZ), and they have been reinforced through the European Green Deal, which seeks to achieve carbon neutrality in Europe by 2050.

In line with these commitments, Serbia has recently adopted the *Climate Change Strategy/Low-Carbon Development Strategy for the period 2023–2030 with projections to 2050*, accompanied by SEA (2023). This umbrella strategy provides a framework for subsequent climate-related strategies and action plans at the national and local levels.[11]

SEA IN PILOT AREAS OF SMEDEREVO AND UŽICE

Research into climate change impacts in Serbia is of particular importance given its strategic geographic position at the intersection of Mediterranean and continental climate regimes. A significant rise in air temperature was recorded during the 1990s at most meteorological stations, marking the onset of an accelerated warming trend. Empirical data reveal that air temperatures in Serbia have increased significantly, particularly from 1989 to 2010, with mean annual warming observed across most regions and especially pronounced during summer. Overall rates of increase ranged approximately from 0.01 °C to 0.04 °C per year over the period 1961–2010.[12]

The duration and frequency of heat waves are especially relevant in assessing risks to ecosystems, the economy, and human health. Over the past decade, Serbia has experienced, on average, more than 20 days of heat waves annually, with increases of over 30 days recorded in western and central regions. Between 2008 and 2017, the average number of extreme heat waves rose by 2–3 per year compared to

the reference period, with the most pronounced increases—over 4 annually—observed in western and southwestern Serbia.

At the same time, Serbia has experienced a notable intensification of heavy rainfall, particularly in the last decade. The number of days with very heavy precipitation has increased by 1–2 times on average, while in certain regions the frequency of extreme events (precipitation exceeding 40 mm/day) has risen more than fivefold compared to the reference period. Moreover, maximum daily values of eight-hour accumulated precipitation increased by more than 5% in most areas, and in some parts of the country by more than 10%.

Serbia has begun developing local action plans for climate change adaptation and mitigation, aligned with the national climate strategy. The *Cities and Climate Change* program, implemented by the Ministry of Environmental Protection and supported by the French Development Agency has been particularly significant in advancing these efforts. Following the entry into force of the *Law on Climate Change* (*Official Gazette of RS* No. 26/2021),[13] the program has aimed to strengthen adaptation and mitigation initiatives at both national and local levels. The first two pilot projects involved the preparation of a climate adaptation plan for the city of Smederevo and a climate mitigation plan for the city of Užice.[14]

Smederevo, located in the Podunavlje District of eastern Serbia, occupies a strategic position along major transportation corridors: the Pan-European Railway, the international E-75 highway (Corridor X), and the Danube River (Corridor VII). Traditionally an important industrial center, the city faces considerable environmental pressures, including significant water and energy consumption, deteriorating air quality, and concerns over pollution of the Danube from industrial discharges. Since 2011, the air quality of the Smederevo agglomeration has consistently been classified as Category III – "excessively polluted." Beyond anthropogenic pressures, the city is increasingly exposed to climate-related hazards such as heat waves, droughts, intense rainfall, landslides, and wildfires.

In preparing the Climate Adaptation Plan for Smederevo, comprehensive analyses and projections were undertaken. These included assessments of future temperature and precipitation changes, shifts in climate indices, and evaluations of local vulnerabilities across multiple domains: population, urban services and infrastructure, social systems, economy, water resources and quality, agriculture, forests, ecosystems, and biodiversity. Taken together, these assessments illustrate both the immediate and long-term climatic vulnerabilities of Smederevo, highlighting the need for integrated adaptation measures at the municipal level.

	VULNERABILITY						
	Temperature Change	Heat wave	Extreme cold	Drought	Precipitation Regime Change	Floods	Storms
Urban services							
Built Environment							
Housing /Building stock	Low	Medium	Medium	Low	High	Very high	Medium
Urban functionality	Low	Medium	Low	Low	High	Very high	Medium
Urban Infrastructure							
Transport	Low	Low	Low	Low	Medium	High	Medium
Electricity and heat supply	Medium	Medium	Medium	Low	Medium	Medium	Medium
Water supply, wastewater management, drainage and flood protection	High	Very high	Very high	Medium	Very high	Very High	Medium
Social infrastructure	Medium	Medium	Medium	Low	Medium	Medium	Medium
Urban Green Areas	Medium	High	High	High	Medium	Medium	High

Figure 1. Near past climatic vulnerability of Smederevo (urban parameters)[15]

Užice, located in western Serbia near the border with Bosnia and Herzegovina and approximately 180 km southwest of Belgrade, functions as the administrative center of the Zlatibor District and a cultural, social, and economic hub for southwestern Serbia. The city's industrialization and rapid urban growth after the Second World War significantly increased pollutant emissions, contributing to long-term environmental degradation. The principal causes of air and water pollution have been associated with outdated industrial technologies, insufficient plant maintenance, the use of low-quality energy sources, an obsolete vehicle fleet, stagnation in infrastructure development, widespread informal construction, and inadequate solid waste management practices.[16]

Air quality monitoring has been conducted in Užice for more than two decades. However, the city's geographic position in the Đetinja River valley, surrounded by mountains on all sides has exacerbated air pollution episodes for nearly thirty years. This topographic enclosure limits air circulation, causing frequent temperature inversions and prolonged retention of pollutants in the atmosphere. Several reports have therefore categorized Užice among the most polluted urban areas in Serbia, particularly during the winter heating season.[17]

In preparing the *Climate Change Mitigation Plan* for Užice, a comprehensive GHG emissions inventory was compiled at the city level, using 2019 as the baseline year. The inventory followed the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC), developed by C40 Cities,[18] the World Resources Institute, and ICLEI. This protocol provides a transparent and standardized methodology for measuring and reporting GHG emissions at the urban scale, consistent with internationally recognized GHG accounting principles.

The assessment has so far quantified emissions arising from fossil fuel combustion in district heating boiler plants, the consumption of fossil fuels in public buildings, and the burning of natural gas in individual boiler systems within the residential and commercial sectors. These findings provide the foundation for identifying priority measures to reduce GHG emissions and to align the city's development pathway with national and EU climate objectives.

SEA and MCDA – analysis of action plans for Smederevo and Užice

The action plans for climate change adaptation and mitigation in the cities of Smederevo and Užice required the implementation of SEA, not only as a legal obligation but also as a tool for the systematic integration of environmental considerations into strategic decision-making, in line with the principles of sustainable development. SEA provides a framework for early identification of potential environmental impacts and for balancing planning objectives with sustainability indicators.

In practice, SEA commonly employs expert methods such as checklists, matrices, MCDA, SWOT analysis, Delphi method, vulnerability and risk assessment, and spatial analysis. These methods produce matrices and charts that reveal potential environmental and spatial changes arising from the implementation of plans and their variants, by linking planning objectives, solutions, and assessment indicators.[19]

The methodology adopted for the SEAs in Smederevo and Užice builds upon the scientific project *Methods for Strategic Environmental Assessment in Planning the Spatial Development of Lignite Basins*, conducted by the Institute of Architecture and Urban & Spatial Planning of Serbia. This approach, patented as *Methodology for SEA Plans, Programs and Strategies on the Environment – Method of Multi-Criteria Evaluation* (Intellectual Property Office of the Republic of Serbia, No. A-336/2021), was developed by Dr. Božidar Stojanović, Dr. Boško Josimović, and Dr. Tamara Maričić. The applied model of qualitative expert evaluation assessed the strategic goals of the action plans against SEA objectives and sustainability indicators.

Graphical representations of positive and negative impacts of each planning solution facilitated transparency and supported participation of relevant authorities, organizations, and the public. The methodology followed general SEA principles: establishing a baseline scenario, assessing current environmental conditions, qualitatively and quantitatively evaluating potential impacts, and proposing measures for environmental improvement and monitoring.

Finally, the MCDA-based expert evaluation considered criteria related to climate change adaptation and mitigation, structured around SEA objectives such as: protection of water quality, reduction of harmful air pollutants, sustainable use of agricultural land, preservation of biodiversity and geodiversity, protection of human health and cultural heritage, and promotion of socio-economic development. These criteria and indicators formed the foundation for the evaluation of planning activities (Figures 2–4).

Size of impact	Label	Description
Critical	**- 3**	It overloads the capacity of the space
Bigger	**- 2**	It damages the environment to a greater extent
Smaller	**- 1**	It damages the environment to a lesser extent
No impact	**0**	No impact on the environment
Positive	**+ 1**	Less positive changes in the environment
Favorable	**+ 2**	Favorable changes in the quality of the environment
Very favorable	**+ 3**	Changes significantly improve the quality of life

Figure 2. Criteria for evaluating the size of the impact, Authors, 2025

Significance of influence	Label	Description
Regional	**R**	Possible regional impact
Municipal	**C**	Possible impact on the City area
Local	**L**	Possible influence of local character

Figure 3. Criteria for evaluating the spatial scales of possible impacts, Authors, 2025

Probability	Label	Description
100%	**S**	Certain impact
more than 50%	**V**	Impact likely to be happen
less than 50%	**M**	Possible impact

Figure 4. Impact Probability Rating Scale, Authors, 2025

RESULTS OF THE ANALYSIS

SEA – Smederevo

The Local Climate Change Adaptation Plan for Smederevo aims to prepare the city for the adverse consequences of climate change while also identifying opportunities that may emerge from altered climatic conditions. Successful adaptation does not imply the complete elimination of negative impacts, but rather their reduction compared to a scenario without adaptive measures.

The Action Plan sets out several strategic goals: strengthening the resilience of public health services and infrastructure to changing climatic conditions; urban planning and construction adapted in accordance with climate-related vulnerabilities; protection from harmful hydrological impacts; ensuring sufficient water supply; promoting agricultural practices that reduce the vulnerability of agricultural production; developing urban green infrastructure; and strengthening the institutional, managerial, and financial capacities of local government and community actors.

The SEA evaluated these strategic goals to determine their potential negative effects on the environment and climate. The assessment was conducted using matrices that combined the intensity, likelihood, and probability of impacts (Figure 5). The results indicate that negative effects are almost negligible, with possible risks identified only in the field of urban design. Even in such cases, the likelihood of negative consequences remains minimal, particularly since precautionary measures are incorporated to prevent adverse effects on cultural and historical heritage. By contrast, all other proposed measures demonstrate strong positive impacts at both local and city levels, improving environmental quality, public health, and overall well-being. These results are consistent with the conceptual foundation of the Action Plan, which emphasizes spatial protection, environmental quality, and citizens' health.

Adaptation measure	The rank of influence in relation to the objectives of the SEA									Impact rationale
	1	2	3	4	5	6	7	8	9	
Reducing the impact of heat load due to the effects of weather extremes on public health		+1LMD				+3CSD		+3CSD		This adaptation measure can show low positive possible long term impact on reducing the populations' exposure to harmful substances from the air and higher positive impact on the city level to protection and preservation of human health, quality of life and improvement of information as well as on accident protection
Strengthening existing and developing and implementing new services in the health system of Smederevo						+3CSD				Greater long-term positive impacts of the city character on the protection and preservation of human health quality of life and improvement of information

Figure 5. Example of evaluation of two adaptation goals within matrix, Authors, 2025

SEA – Užice

The Climate Change Mitigation Action Plan for Užice provides a greenhouse gas (GHG) emissions inventory for the city, prepared using the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). The inventory includes total emissions, calculations by source, and sectoral contributions, thereby outlining how the city intends to fulfill its commitments to climate change mitigation.

The Action Plan identifies the main emitting sectors and establishes mitigation goals, which include: improving energy efficiency in public buildings, expanding renewable energy, modernizing the district

heating system, promoting active mobility, supporting recycling, and raising public awareness. These objectives were assessed within the SEA framework through multi-criteria decision analysis (MCDA), with results presented in the evaluation matrix (Figure 6).

The assessment concludes that negative impacts are minimal and arise only in activities related to the reconstruction and energy-efficiency retrofitting of public buildings. Potential long-term risks include impacts on cultural heritage, particularly façades of protected buildings. However, such risks can be mitigated through careful architectural design, appropriate installation of insulation, and compliance with the requirements of heritage protection authorities.

Overall, the mitigation measures proposed within the SEA are oriented toward the protection of air quality, noise reduction, soil and water conservation, and safeguarding human health. Monitoring provisions accompany these measures to ensure continuous improvement of climate-related conditions at the local level.

Planning solutions	The rank of influence in relation to the objectives of the SEA									Impact rationale
	1	2	3	4	5	6	7	8	9	
Reconstruction and improvement of energy efficiency		+3LSD			+1LMD	+3LSD	-1LMD		+1LMD	Greater positive impacts of a local nature on reducing the population's exposure to harmful substances from the air are possible, as well as certain greater impacts at the local level on the protection of the population and the preservation of human health and the improvement of information about environmental protection. In addition, minor negative long-term impacts of a local type on the preservation of cultural heritage are also possible due to potential interventions on the facades of buildings.
Thermal insulation of public buildings						+3LSD	-1LMD		+3LMD	Greater long-term positive impacts of the local character on the protection and preservation of human health and smaller negative long-term impacts of the local character on the preservation of cultural heritage due to potential interventions on the facades of buildings are expected. A special contribution relates to the creation of conditions for the economic development of the entire city area

Figure 6. Example of evaluation of two mitigation goals within matrix, Authors, 2025

CONCLUSION

The SEAs conducted for Smederevo and Užice confirm the value of SEA not only as a legal requirement but also as a governance tool for integrating climate considerations into local planning. In both cases, negative environmental impacts of proposed measures were minimal and manageable, while strong positive effects were identified in terms of air and water quality, public health, ecological conditions, and resilience.

More broadly, SEA proves to be a powerful instrument for embedding adaptation and mitigation measures into urban development from the earliest stages, thereby fostering sustainable, low-carbon, and climate-resilient cities. Its effectiveness depends on stakeholder collaboration, reliable data, and continuous monitoring, which allow local authorities to link climate ambitions with concrete actions and prioritize investments. The cases of Smederevo and Užice illustrate how specialized technical support can help municipalities define strategies tailored to their socio-economic and environmental contexts, while contributing to Serbia’s national climate agenda and the wider European green transition.

At the international level, these findings underline the need to mainstream SEA within global climate governance. Sharing methodologies, strengthening capacity-building, and aligning SEA standards with commitments such as the Paris Agreement and the European Green Deal would amplify its role in supporting sustainable urban transitions and ensure that local initiatives contribute meaningfully to global climate objective

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ORIGIN-DESTINATION MATRIX ESTIMATION WITHOUT A BASE MATRIX: A TOOL FOR SUSTAINABLE URBAN MOBILITY PLANNING

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INTRODUCTION

The structure and performance of a city's transportation system are intrinsically linked to its activity patterns and urban form. The interaction between land use, infrastructure, and travel behavior underpins the mobility system,[1] influencing mode choice, trip frequency, and accessibility. Compact urban areas often promote walking and cycling, while sprawling layouts typically increase dependence on motorized transport.[2] Urban form, infrastructure quality, and policy interventions collectively shape mobility flows, modal distributions, and congestion dynamics, especially during peak periods.

In this context, understanding how and why people move is essential for creating efficient, inclusive, and sustainable urban environments. Origin-Destination Matrices (ODMs) are foundational tools in transportation planning, revealing how trip flows are distributed across zones and enabling data-driven infrastructure investments.[3] ODMs support the evaluation of public transport systems, the integration of multimodal networks, and the formulation of policies aligned with spatial development goals. However, constructing an ODM typically requires intensive household surveys or mobility tracking, both of which are resource-demanding and often unavailable in developing contexts.[4]

To address these limitations, this paper presents a method for estimating ODMs that does not rely on a pre-existing base matrix. The approach integrates the four stages of the classical transport model: trip generation/attraction, trip distribution, modal split, and traffic assignment. It leverages secondary data sources, such as population and housing censuses, as well as georeferenced databases of jobs, education, commerce, and recreation facilities (POIs), to estimate mobility patterns with minimal reliance on primary data collection. Given the relevance of identifying origin-destination flows for urban planning, this study compares alternative techniques for estimating trip destinations based on travelers' sociodemographic and geographic attributes, using as a baseline the OD matrix obtained with the doubly constrained Gravity Model. The accuracy of the estimation is assessed through comparison with the observed matrix from the Household Travel Survey.

This method accommodates various transport modes, trip purposes, and temporal scales, offering a scalable and cost-effective alternative, particularly suited for cities in the Global South. By reducing reliance on traditional surveys and enhancing the resolution of travel demand estimation, this approach serves as a practical tool for sustainable urban mobility planning.

Materials and Methods

To comprehend urban mobility, cities are segmented into Traffic Analysis Zones (TAZs), defined by geographic or infrastructural boundaries that capture homogeneous sociodemographic and mobility patterns.[5] Within the classical four-step transportation model, which includes Trip Generation, Trip Distribution, Modal Split, and Traffic Assignment, this study focuses on the first two stages, represented by an Origin-Destination Matrix (ODM), where each cell quantifies the number of trips from zone *i* to *zone j*.

Trip Generation

The model uses disaggregated demand based on gender, age, and education for each individual, categorized by trip purpose. The probability of a work trip, for example, is calculated using Bayes' Theorem (1), where variables include gender (G), age (A), and education level (EL). "yes_work trip" denotes an individual leaving home for work. The prior probabilities are computed from the census data.

$$P(yes_work\ trip \mid G, A, EL) = \frac{P(yes_work\ trip\ and\ G\ and\ A\ and\ EL)}{\sum P(G\ and\ A\ and\ EL)} \quad (1)$$

Regression models are used to estimate the probability that an individual leaves home for study purposes (2).

$$P(yes_study\ trip \mid G, A) = \frac{P(yes_study\ trip\ and\ G\ and\ A)}{\sum P(G\ and\ A)} \quad (2)$$

Other purposes (shopping, leisure) rely on secondary sources or household surveys to estimate trip rates, accounting for cultural variations.[6]

Trip Attraction

Attraction depends on the availability of opportunities in each zone, such as employment, education, healthcare, commerce, and leisure facilities. Points of Interest (POIs) are weighted according to type, service capacity, operating hours, and demographic reach. Georeferenced POI databases enhance accuracy, while field data may refine estimates of accessibility and service provision.

Trip Distribution

Trip distribution allocates flows between origins and destinations. Three approaches are compared:

Gravity Model

Trips are proportional to productions (*Oi*) and attractions (*Dj*), inversely related to travel impedance (*F(Cij)*).[7] A doubly constrained formulation balances origins and destinations (3) and (4). Impedance is modeled with a negative exponential deterrence function (5), reflecting preference for shorter trips. Travel cost (*Cij*) incorporates distance, time, transfers, and attraction diversity (6) and (7). Balancing is achieved with the iterative Furness method.

$$\sum_j T_{ij} = O_i \qquad for\ i=1\ldots m \quad (3)$$

$$\sum_i T_{ij} = D_j \qquad for\ j=1\ldots n \quad (4)$$

$$F(Cij) = e^{-\beta * Cij} \quad (5)$$

$$DA_{ij}^{r} = \frac{log(0.09 * DA) + 7}{4.59} \quad (6)$$

$$C_{ij} = min_r(T_{ij}^{r} + AC_{ij}^{r} + TC_{ij}^{r} + DA_{ij}^{r}) \quad (7)$$

Logit Model for trip distribution

Based on discrete choice theory, the Logit model assumes individuals choose among alternative destinations according to their utility (10). Utility is a linear function of observable attributes V_{ij}, such as distance, cost, and attractiveness, with a random component capturing unobserved factors, ε_{ij}. Assuming Gumbel-distributed errors, the probability of choosing destination *j* from origin *i* is given by the multinomial Logit formulation (11). This probabilistic approach accounts for competition among destinations and allocates trips based on their relative attractiveness.

$$U_{ij} = V_{ij} + \varepsilon_{ij} \quad (8)$$

$$P_{ij} = \frac{e^{V_{ij}}}{\sum_{k=1}^{J} e^{V_{ik}}} \quad (9)$$

Regression Models for Trip Distribution

Trip distribution can also be explained using multiple regression, which relates flows to explanatory variables such as distance, travel time, or socioeconomic indicators (12). Logarithmic transformations may be applied to capture non-linear effects. Regression is instrumental when detailed flow data are available, enabling empirical calibration and evaluation of significant predictors.

$$Y=\beta 0+\beta 1X1+\beta 2X2+\cdots+\beta pXp+\epsilon \quad (10)$$

Where *Y* is the dependent variable, *X1,X2,…,Xp* are the predictor variables, *β0* is the intercept, *β1,β2,…,βp* are the regression coefficients, and ϵ is the error term.

Model Evaluation

Accuracy of distribution models is assessed using standard metrics:

- **Mean Absolute Error (MAE)** measures average deviations between observed and predicted flows.

$$MAE = \frac{1}{n}\sum_{i=1}^{n}|y_i - \hat{y_i}| \quad (11)$$

Where y_i and $\hat{y_i}$ are the observed and predicted values, respectively, and n is the number of observations.

- **Root Mean Squared Error (RMSE)** penalizes larger errors:

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(y_i - \hat{y_i})^2} \quad (12)$$

- **Pearson correlation coefficient (r)** evaluates the linear association between observed and predicted values, ranging from -1 to 1:

$$r = \frac{\sum_{i=1}^{n}(y_i - \bar{y})(\hat{y_i} - \bar{\hat{y}})}{\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}\sqrt{\sum_{i=1}^{n}(\hat{y_i} - \bar{\hat{y}})^2}} \quad (13)$$

Where $\bar{y}$ and $\bar{\hat{y}}$ are the means of observed and predicted values, respectively. A correlation close to 1 indicates strong positive agreement between predictions and observations.

This integrated method enables detailed ODM construction without relying on initial matrices, providing a scalable solution for sustainable mobility planning, particularly in data-scarce urban contexts.

Case study

Cuenca, located in southern Ecuador, is the capital of Azuay Province (712,127 inhabitants) and the Canton of Cuenca (505,585 inhabitants).[8] The study focuses on the city's urban area and parish center, with a population of 456,034 (Figure 1). Cuenca has a dispersed urban form, characterized by low-density areas and concentrated activities in a few sectors. This imbalance fosters increased motorization, longer travel distances, and congestion, primarily due to underperforming public transportation services.[9]

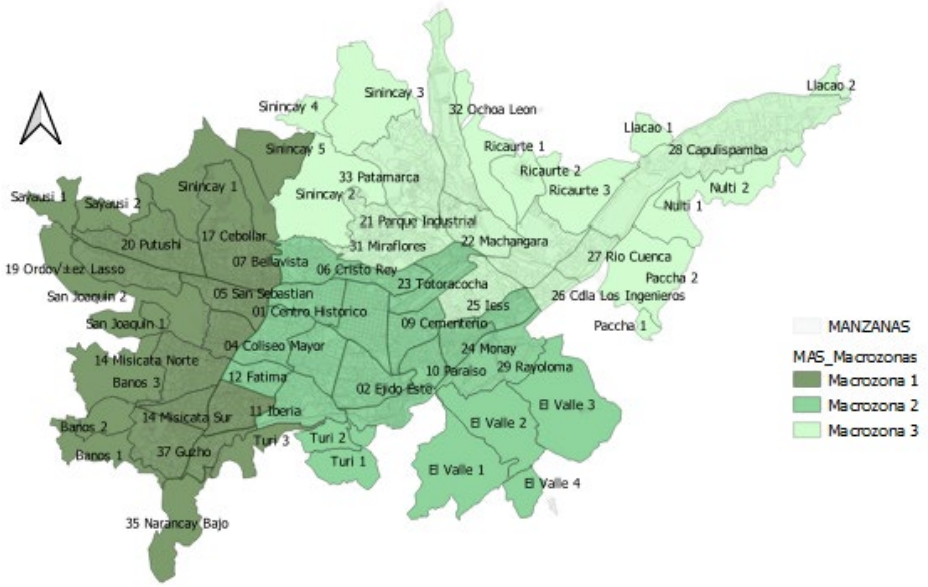

Figure 1. Study area in the city of Cuenca-Ecuador.

In 2011, the city developed an ODM for public buses only, lacking comprehensive data for other modes of transport. As a result, planning decisions often diverge from expected outcomes. Sixty-five TAZs were defined, aligning with the 2015–2025 Mobility Plan, with adjustments made in areas such as Misicata and the Centro Histórico to reflect actual mobility patterns.

RESEARCH ANALYSIS AND RESULTS

In 2010, the study area had a population of 456,034 inhabitants. Due to the ten-year gap between the census (2010) and the supply data (2020), a population projection was carried out following INEC's Method of Demographic Components.[10] This method estimates population changes based on fertility, mortality, and net migration (immigration minus emigration), using the Balancing Equation (17):

$$N^{t+5} = N^{t} + B^{t,t+5} - D^{t,t+5} + I^{t+5} - E^{t+5} \quad (14)$$

The equation projects the population every five years, broken down by age and gender. Applying it, the population was projected from 2010 to 2015 and then to 2020. Although the model is national in scope, its curves were adjusted to the study area, yielding a 2020 population estimate of 553,763. The proportions by gender, age, and education level from 2010 were retained for disaggregation.

Centro Histórico had the highest projected population, followed by Miraflores and Totoracocha; Nulti 1, Paccha 1 and IESS had the lowest projected populations. Disaggregating the population by gender,

age, and education enables the identification of potential trip generators. For example, children aged 6–11 indicate educational travel demand, while the 25–65 group represents working-age travelers (Figure 2). After projecting the population for the analysis year, calculating the demand for each travel purpose becomes imperative, following the previously outlined method.

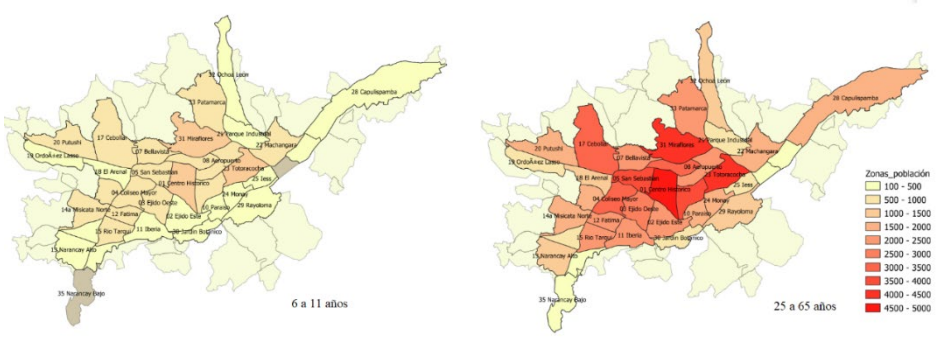

Figure 2. Population density for the 6-11 years age group (left) and for the 25-65 years age range (right).

Cuenca lacks data on the average number of trips individuals make for purposes such as shopping, administrative tasks, healthcare, and leisure. To fill this gap, the research team conducted a Frequency Activity Survey, collecting 1,049 records across eight sections. The survey captured information on respondent demographics (age, gender, income), activity frequency, preferred days, items purchased, administrative and financial tasks, and specific queries about the Historic Center. After cleaning, 1,031 valid entries were used to calculate daily trips per purpose across TAZs, as summarized in Table 1.

	Travel purpose				
	Shopping	**Recreation/ Leisure**	**Healthcare**	**Administrative Task**	**Financial Task**
Average trip per person	0.162	0.047	0.029	0.037	0.933

Table 1. Average daily number of trips per person in the city by travel purpose

Using the method described in the previous section, travel demand was calculated for each purpose, resulting in a total of 4,855,546 trips per week: 1,775,198 for work, 1,219,084 for education, 723,349 for shopping, 855,304 for recreation and leisure, 123,490 for health, 49,673 for administrative tasks, and 111,448 for financial purposes. Table 2 details the peak day, period, and hour for each travel motive.

Travel Purpose	**Highest Trip Generation Zone**	**Peak-Demand Day**	**Peak Period**	**Peak Hour**
Work	Centro Histórico	Jueves	5:00 – 10:00 h	7:00-8:00 h
Study	Centro Histórico	Lunes	5:00 – 8:00 h	7:00-8:00 h
Shopping	Centro Histórico	Sábado	9:00-19:00 h	9:00-10:00 h
Recreation/Leisure	Rio Tarqui	Sábado	9:00-19:00 h	10:00-13:00 h
Administrative office	Coliseo Mayor	Lunes y Jueves	9:00-17:00 h	9:00-10:00 h
Financial Office	Cebollar	Jueves y Viernes	10:00-17:00 h	10:00-13:00 h
Healthcare	Cementerio	Jueves	9:00-17:00 h	15:00-17:00 h

Table 2. Peak-demand day, peak period and peak hour per travel purpose

Trip attraction

The survey covered 16,550 Points of Interest (POI) across 65 TAZs. Analysis revealed clusters primarily hosting health facilities, educational institutions, and commercial outlets. High-density zones include the Centro Histórico, San Sebastián, Ejido Este and Oeste, and Cementerio. In contrast, peri-urban zones like Turi, Nulti, Llacao, El Valle, and Baños show fewer and less diverse POIs.

In the Centro Histórico, POIs concentrate as follows: residential complexes (15.6%), commercial services (20.7%), mixed-use buildings (28%), markets (33.3%), supermarkets (40%), educational facilities (11.4%), shopping malls (20%), religious temples (27.5%), administrative offices (34.5%), and financial institutions (22.2%). Totoracocha has the most housing units (6.82%) and parks (10.7%), Ejido Este leads in healthcare facilities (15.4%), Aeropuerto hosts most transport terminals (54.5%), Miraflores contains mega parks (75%), and Parque Industrial concentrates industries (45.2%) (Figure 4).

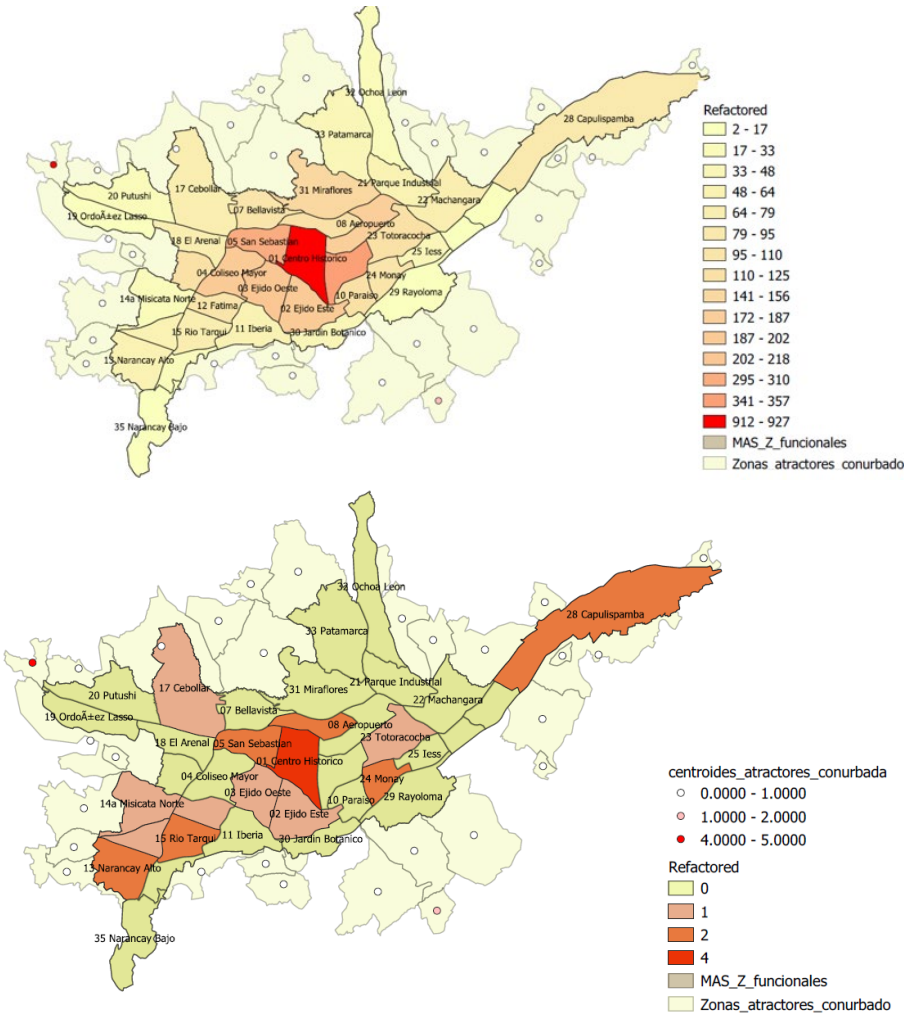

Figure 3. Concentration of POI in the study area. Commercial outlets and services (top) and supermarkets (bottom). The color scale from yellow to red indicates increasing concentration levels

From POI data, an inventory of 6,894,185 weekly service offerings was generated. Work-related offerings total 2,220,215; study, 1,348,994; shopping, 1,583,735; recreation/leisure, 1,024,592; and administrative, financial, healthcare, and other categories, 716,649. Supply availability varies by purpose and timing: for example, education offerings follow fixed schedules, while labor offerings are more dispersed. This pattern provides insight into both the spatial and temporal distribution of services.

Trip Distribution

The study represents Cuenca's infrastructure network (roads for motorized vehicles, bus lanes, bicycle lanes, sidewalks) as a graph, with nodes corresponding to TAZs and links defined by the shortest paths for each transport mode. The graph specifies directed connections for private vehicles, taxis, buses, and motorcycles, as well as undirected connections for walking and cycling.

Gravity Model

Using the (3) to (7), 2,450 matrices (65×65) were generated, covering 10 hourly intervals from 5 a.m. to after 9 p.m., seven days a week, seven transport modes (walking, cycling, taxi, bus, motorcycle, private vehicle, school/mixed), and five travel purposes (work, study, shopping, recreation, others).
Centro Histórico had the highest demand and attraction for work, study, and shopping trips. Recreation peaked in Miraflores, with Aeropuerto attracting most trips. Administrative demand was highest in Coliseo Mayor, financial trips in El Cebollar, and healthcare trips in Ejido Este. Figure 5 shows the daily trip flows.

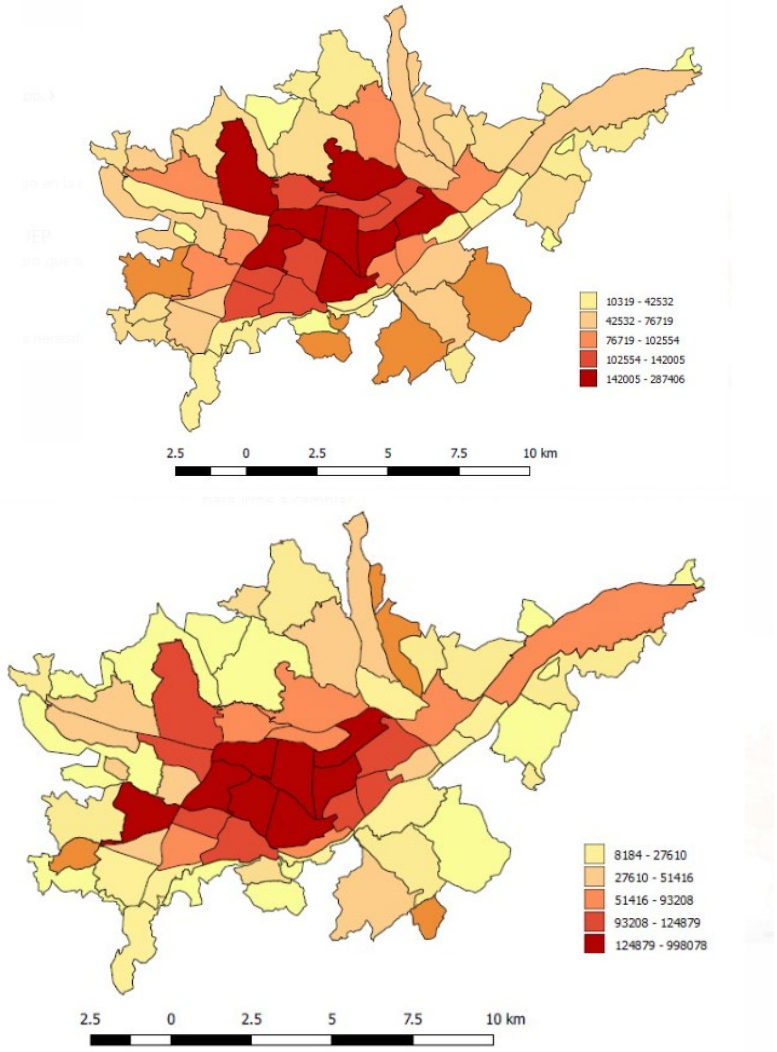

Figure 4. Total trip generation (top) and total trip attraction (bottom) in the study area. The color scale from yellow to red indicates increasing concentration levels

The analysis identified zones with greater autonomy, areas where residents fulfill most of their travel needs locally. The most autonomous areas are Centro Histórico (19.24%), Ejido Este (18.41%), Turi 2 (12.13%), Aeropuerto (9.71%), and El Cebollar (6.90%). The least autonomous are peripheral zones such as Turi 1, Turi 3, Sinincay 5, Baños 1, and El Valle 3. Demand peaks occur on Fridays and Thursdays, especially between 7:00 and 8:00 a.m., with a secondary peak from 1:00 to 5:00 p.m. (Figure 6). Weekday peaks align with work and school schedules, while weekends reflect leisure-driven travel.

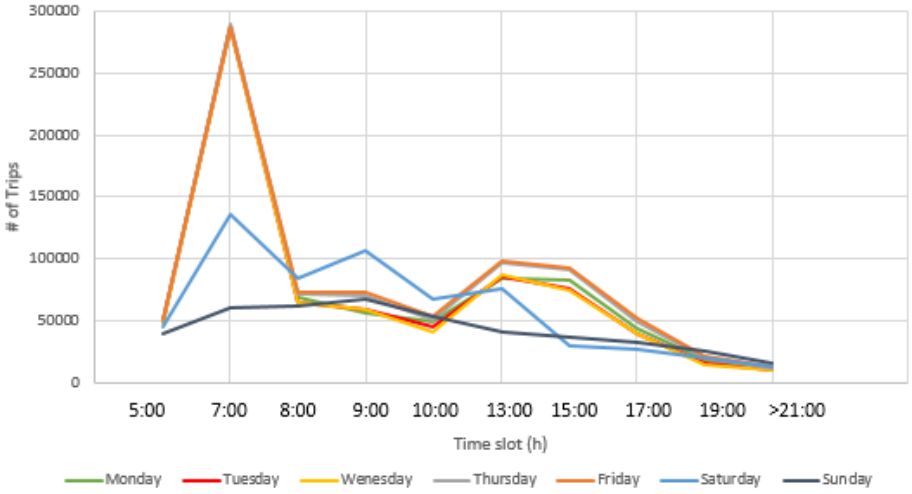

Figure 5. Hourly variation in demand by weekday.

A custom MATLAB algorithm (Student License 1851266, 2019b) distributes trips among TAZs using a negative exponential deterrence function, as shown in (5). The calibration process adjusts the deterrence parameter β.

The iterative calibration of the β parameter minimizes the RMSE between the observed ODM (from a household survey) and the computed ODM (from the gravity model). The search began with [−10, 10] at a step of 1, refining the interval around trend changes to finer steps (e.g., [−1, 1] at 0.01). Both matrices were normalized (19) to allow fair comparison:

$$\widehat{T_{ij}} = \frac{T_{ij}}{\sum_{i,j} T_{ij}} \quad (15)$$

For work trips, 975 sample trips (2023) corresponded to 195,983 estimated population trips (2020). The minimum RMSE of 1.4515 occurred at β=0.28, indicating a good model fit. The β value reflects high distance sensitivity: trip likelihood decreases significantly as distance increases, while the RMSE shows minor discrepancies between observed and estimated flows.

Logit Model

Work-trip distribution was estimated using a Multinomial Logit model with secondary data on labor supply, demand, and interzonal distances. The input matrices (distance, supply, demand, and observed OD trips) were structured in long format, and both observed and estimated trips were standardized for comparability (20).

$$Trips_est_adjusted = \text{trips_est.} \left(\frac{\sum trips_obs}{\sum trips\ est}\right) \quad (16)$$

The utility function included two parameters: β1 for distance (impedance) and β2 for labor supply attractiveness. The iterative calibration of parameters minimizes MAE and RMSE while maximizing correlation. Optimal values were $\beta1=1\times10^{-5}$ and β2=0.3216, with MAE = 2.23, RMSE = 4.81, and

correlation = 0.48. The model then adjusts the estimated trips to match observed demand by origin, and graphical validation confirms its performance.

Regression Models

To estimate the work-related OD matrix, two regression models were tested: a log-transformed model and a direct linear model. Both included labor supply in the destination zone, labor demand in the origin zone, and interzonal distance as explanatory variables.

The linear model (Table 3) revealed that labor supply ($\beta = 1.03 \times 10^{-4}$, $p < 0.001$) and distance ($\beta = -0.152$, $p = 0.011$) are significant predictors of observed trips, whereas labor demand was not statistically significant ($\beta = 1.57 \times 10^{-5}$, $p = 0.697$). The model explains approximately 26% of the variance ($R^2 = 0.263$, adjusted $R^2 = 0.257$), indicating moderate explanatory power. Results suggest that zones with greater employment opportunities attract more trips, whereas longer distances between zones reduce them.

Variable	Estimate	Std. Error	t value	p-value
Intercept	2.104e+00	4.935e-01	4.264	2.59e-05***
Labor supply	1.033e-04	9.898e-06	10.432	<2e-16***
Labor demand	1.571e-05	4.034e-05	0.389	0.697
Distance	-1.518e-01	5.929e-02	-2.560	0.0109*

Table 3. Linear Regression Results

Residual standard error: 3.14 on 349 degrees of freedom
Multiple R-squared: 0.263, Adjusted R-squared: 0.257
F-statistic: 41.52 on 3 and 349 DF, p-value: < 2.2e-16

By contrast, the log-transformed model achieved an adjusted R^2 of 0.14, despite supply and distance remaining significant. Comparative performance metrics (Table 4) confirm that the linear specification provides a better representation of the observed OD patterns, with improved fit indices (MAE = 1.98, RMSE = 3.14, correlation = 0.613). Labor demand was not significant in either model, suggesting that it does not adequately capture the dynamics of trip generation.

Overall, the direct linear model offers a more robust estimation of the spatial distribution of work-related trips, making it a more suitable choice for OD matrix calibration in urban contexts.

Performance Metrics	Log-transformed model	Linear model without transformation
R^2 adjusted	0.138	0.257
MAE	2.23	1.98
RMSE	4.81	3.14
Correlation	0.481	0.613
Significant Variables	Labor supply, distance	Labor supply, distance

Table 4. Performance metrics for the log-transformed and linear regression models

CONCLUSION

This study proposes and validates a scalable methodology for estimating Origin–Destination Matrices (ODMs) without relying on a pre-existing base matrix. The approach targets data-scarce contexts, where household surveys and real-time mobility records face limitations due to cost and logistics. The framework integrates the first two stages of the classical transport model, trip generation/attraction and distribution, using secondary sources such as census data and georeferenced Points of Interest (POIs).

The model probabilistically generates trips at the individual level, linking travel behavior to sociodemographic attributes such as age, gender, and education. In Cuenca, the estimated weekly demand reached 4.86 million trips, primarily for work and study purposes. Temporal analysis revealed purpose-specific peaks, while spatial patterns highlighted the Centro Histórico as the primary attractor for work, education, and shopping, and Río Tarqui as the primary generator of recreational trips.

Weighted POIs across 65 TAZs represent trip attraction, considering both availability and service capacity. Centro Histórico, San Sebastián, Ejido Este, and Ejido Oeste exhibit the highest concentration of opportunities.

Trip distribution was tested with three models: Gravity, Logit, and Regression. The Gravity Model ($\beta = 0.28$) minimized large deviations (RMSE = 1.415) but showed weak spatial correlation ($r = 0.36$). The Logit Model improved correlation ($r = 0.48$) but generated higher errors (RMSE = 4.81). The Regression Model offered the most balanced performance, with the lowest MAE (1.98), a competitive RMSE (3.14), and the highest correlation ($r = 0.613$).

These findings underscore that model selection depends on the intended application: models with higher correlation are preferable for strategic analyses focused on spatial patterns, while those with lower RMSE or MAE are more suitable for operational contexts where minimizing estimation errors is critical.

The study makes three main contributions: (i) it introduces a replicable methodology for ODM estimation without base matrices, (ii) it demonstrates the feasibility of integrating sociodemographic data and POIs to model both trip generation and attraction, and (iii) it provides a comparative evaluation of distribution models, offering practical guidance on their selection depending on planning goals.

NOTES

[1] J.E. Immers and L.H. Stada, *Traffic Demand Modelling* (Katholieke Universiteit Leuven, 1998); Ryuichi Kitamura et al., "A Micro-Analysis of Land Use and Travel in Five Neighborhoods in the San Francisco Bay Area," *Transportation* 24 (1997): 125–58.
[2] Yosef Rafeq Jabareen, "Sustainable Urban Forms: Their Typologies, Models, and Concepts," *Journal of Planning Education and Research* 26, no. 1 (2006): 38–52, https://doi.org/10.1177/0739456X05285119; Todor Stojanovski, "Urban Form and Mobility Choices: Informing about Sustainable Travel Alternatives, Carbon Emissions and Energy Use from Transportation in Swedish Neighbourhoods," *Sustainability* 11, no. 2 (2019): 548.
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[4] Akash Anand and Varghese George, "Modeling Trip-Generation and Distribution Using Census, Partially Correct Household Data, and GIS," *Civil Engineering Journal* 8, no. 9 (2022): 1936–57.
[5] Ennio Cascetta, *Transportation Systems Analysis: Models and Applications*, vol. 29 (Springer Science & Business Media, 2009); Immers and Stada, *Traffic Demand Modelling*.
[6] Tanjeeb Ahmed et al., "Trip Generation Rates of Land Uses in a Developing Country City," *Transportation Research Record* 2674, no. 9 (2020): 412–25.
[7] Alan M Voorhees, "A General Theory of Traffic Movement: The 1955 ITE Past Presidents' Award Paper," *Transportation* 40, no. 6 (2013): 1105–16.
[8] INEC, *Info Azuay 2023*, Infografía (Instituto Nacional de Estadísticas y Censos, 2023), https://www.censoecuador.gob.ec/ecuadormap/.
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[10] INEC, *Dirección de Metodologías y Normativas Del Censo Nacional: Proyecciones de La Población de La República Del Ecuador 2010-2050* (2012), https://www.ecuadorencifras.gob.ec/documentos/web-inec/Poblacion_y_Demografia/Proyecciones_Poblacionales/metodologia.pdf.

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CLIMATE CHANGE AND EARTHQUAKE CHALLENGES AND OPPORTUNITIES IN JERUSALEM: URBAN RENEWAL BETWEEN RISK MITIGATION AND URBAN TRANSFORMATION

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INTRODUCTION

This paper presents the impacts by earthquake risk mitigation and climate change in the city of Jerusalem, Israel, which through mitigation policies, is taking the form of massive and high rise development. The author, as an urban planner for the city of Jerusalem, is directly involved in these processes, from the point of view of public response and public action: on one hand accept the need for seismic risk mitigation and renewal of urban infrastructure, yet emphasize the need to adhere to approved Master Plans and preservation restrictions. In order to make these projects suitable to the local context and responsive to the challenges of climate change and community resilience.

Today, through urban renewal projects, Jerusalem faces a systematic alteration of the character of historic neighborhoods, endangering culturally protected structures, displacing long-standing communities, and generating significant environmental costs – in massive cutting down of mature trees, in construction waste, in wasted embodied energy of demolished buildings and discarded materials, in sun-blocked and windy microclimates generated by high rises, driven by a market of rising real estate prices, thus also failing to provide affordable housing and community resilience to the city population, especially younger couples who want to live in the city.

This paper examines an example of the effects of seismic risk mitigation. How seismic risk-mitigation planning in Jerusalem has led to contested urban redevelopment and market-led urban renewal, altering the traditional urban scale and fabric, while endangering social cohesion and community integration. Arguing for the need of a balanced approach that integrates safety, heritage, affordability, public participation, and sustainability.

The City of Jerusalem

Jerusalem is a city of great religious and historical significance, revered by Judaism, Christianity, and Islam. A city with deep historical roots, important religious and historic sites, and a layered archaeology that dates back to the First Temple period (1000-586 BCE), yet still maintaining layers from its recent past as a thriving Roman (63 BCE-324 CE), Byzantine (324-637 CE) and Ottoman city (1517-1917) and a modern garden city planned anew during the British Mandate (1917-1948).[1] The city is greatly defined by the land topography and the geography of the Old City, divided into four quarters: Muslim,

Christian, Armenian, and Jewish, encircled by well-preserved walls, and surrounded today by green spaces. Although urban renewal development – including the construction of modern infrastructure, primarily transportation – encompass the entire city, the Old City, as a protected monument,[2] has strict building policies, maintaining most of its historic character, yet, offering modern services to the diverse population living within its boundaries, thanks to infrastructure renewal over the years, within the historic and traditional urban context and limitations.

Figure 1. Aerial view of the Old City of Jerusalem in the 1930s from the G. Eric and Edith Matson Photograph Collection (source: Library of Congress, Prints and Photographs Division https://www.loc.gov/resource/cph.3c37060/).

Planning of the City of Jerusalem

Jerusalem's urban fabric reflects cycles of construction and destruction. Archaeology has revealed historic layers, in periods of prosperity, development and renewal and periods of distress. The Old City, reveals historic layers from Roman times through the Ottoman and British Mandate periods. Under the British (1917–1948), the city expanded from a provincial town, that started to grow in the late 19th century during Ottoman rule, into a modern administrative, political, religious, and cultural center beyond the Old City walls to the west, with zoning, density controls, and a distinct architectural style. The stone facade ordinances, created a unified urban character, evident until today. The "garden-city" vision shaped neighborhoods such as Rehavia and Talpiot, and set three "red lines": protecting the skyline, requiring natural stone, and preserving the valleys.[3]

After the 1967 reunification of the city, a large construction project was developed, aiming at surrounding the historic city center with rings of new neighbourhoods —Ramat Eshkol, French Hill, Gilo, Neve Yaakov, and others—driven by political aims that diverged from the 1968 Master Plan's topographic vision.[4]

In recent years, the process of urban renewal is mostly focusing on densification of the existing fabric. It is driven by two powerful policy drivers: seismic risk and demographic growth, and enabled by new policies that enable this transformation: the national outline plans (NOP 38) for strengthening existing buildings against earthquakes (known as: Tama 38), which was adopted by the Israeli government in 2005,[5] and was adapted for Jerusalem (Plan 10038)[6] the light rail densification policy,[7] and new Master

Plans that allow for new urban renewal areas and more building rights – an outstanding example, is the Master Plan for the redevelopment of the former Industrial Area of Talpiot,[8] a site of 1200 dunam, with mixed use residential, commercial, business, institutions and education, offering 850% building rights and building heights to exceed 30 stories, despite being a short distance from historic Baka and Greek Colony with stone built 2-4 story buildings. The new policies and urban renewal decisions, have challenged the three 'red lines' set by the British, which although respected by planning committees until the early 1990s, are currently slowly transforming the historic city fabric in areas of high real estate value, rather than providing seismic reinforcement to the need communities in the periphery of the country. Modern imperatives justify large-scale interventions and have gradually introduced high-rise construction and neighborhood densification, although they often come into conflict with existing neighborhood Master Plans – such as Moshavot[9] -completed in the past decade through intense public participation. This and other Master Plans, aim to preserve the historic built fabric and the garden city principles of the historic neighborhoods of the city.

Figure 2. Air view of Western Jerusalem in the 1930s. In the foreground the Y.M.C.A. and King David Hotel. (source: Library of Congress, Prints and Photographs Division https://hdl.loc.gov/loc.pnp/matpc.00246)

Starting in the early 1990s, the planning processes in the city also integrated a dominant participatory presence of the residents, through the creation of a network of 27 Community Councils[10] throughout the city serving a population of nearly one million residents.[11] These public bodies, each representing about 50,000 residents, formed residents groups – urban forum, ad hoc committees, groups of active citizens, and more - to discuss and evaluate urban renewal plans and then submit objections to the planning committees. Although their effectiveness is limited, they have managed to successfully divert urban renewal projects that threatened the sensitive balance between the built and unbuilt spaces of the city, have reduced the height of new development, and have secured public uses and amenities in densifying neighbourhoods.[12]

Seismic and Demographic Projections as Development Drivers

The state of Israel is located between the African and Arabian Plates, an area with tectonic activity. Jerusalem lies near the seismically active Dead Sea Rift, also known as the "Syrian-African Rift ." Due to this proximity, the country and the city of Jerusalem are exposed to what studies warn of the risk of

a major earthquake within decades.[13] To address this, a national mitigation market-led policy, called Tama 38 was approved in 2005, encouraging private entrepreneurs and homeowners to initiate urban renewal projects without any governmental budget, through building rights and tax-reliefs. Initially aiming for retrofitting unsafe 1950s structures, it proposes two principle paths: reinforcement of existing building, or demolition and construction of new anti-seismic building, and additional building rights for sale, to finance the accrued costs and secure profit.[14] Despite the well-intended policy, it effectively transformed into a developmental opportunity. Investment concentrated in prestigious neighborhoods in the central metropolitan areas of Israel,[15] threatening the historic fabric, while weaker communities in the periphery—most in need of reinforcement—were largely neglected. Private financing and planning committees have failed to respond to public interest, allowing real estate economics to dominate.[16]

Figure 3. An example of a Tama 38 project in the German Colony of Jerusalem under construction where a one-story modest traditional structure was replaced by a modern luxury-apartment residential building (source: author).

At the same time, Jerusalem's population grew from 250,000 in the 1970s to nearly one million in 2024, surpassing the national average growth of 1.4%, with projections of 1.2 million by 2040.[17] Densification aims to protect green peripheries, but accelerated renewal and infrastructure demand vast resources.
This demographic projection, present and future demand for new apartments, has generated new residential construction throughout the city, and has produced large-scale transformation of historic centers and neighborhoods, where high real estate prices make the return of investment more attractive. New construction, involving reinforcement and floor additions, often clash with preservation guidelines, eroding heritage and altering the city's historic character. Public discontent has grown, exemplified in debates and public action to enforce guidelines and the protection of historic structures – such as in the class-action decision for the protected historic house on Rachel Imenu 17.[18]

Figure 4. A 'characteristic' historic structure within the preserved Greek Colony, which was slated for partial demolition. It's demolition was prevented by a decision of the Appeals Committee in 2018 (source: Google Street view).

Transformation of the Urban Fabric

With 54% of the global population in urban areas,[19] cities worldwide face demographic pressure. In many historic centers, renewal followed World War II reconstruction, often replacing traditional forms with repetitive blocks that eroded historic urban structure.[20] Istanbul's late-20th-century transformation, captured by Orhan Pamuk *A Strangeness in My Mind*, shows how migrants filled apartment blocks replacing historic landscapes.[21] In 2007, the World Heritage Committee warned of similar crises in Istanbul and Cairo, calling for cultural mapping to safeguard identity.[22] Valletta in Malta, a World Heritage site since 1980, preserved its fabric, while nearby Msida succumbed to high-rises. Jerusalem's Old City, listed in 1981,[23] exemplifies stricter preservation, with its Jewish Quarter reconstructed after 1967 according to historic street patterns and archaeological finds.[24]

Outside the Old City, however, densification in the 1980s risked sprawl and loss of identity.[25] Though large-scale high-rise plans were halted, isolated towers rose in the historic centers Talbieh, and Rehavia, before their Master Plans were approved.[26]

Vertical expansion fragments low-rise neighborhoods, disrupting skylines, microclimates, and social structures. In Katamonim and French Hill, redevelopment removed courtyards and permeability, replacing them with towers – for example in Gonenim, guided by a Master Plan that aims for intensive urban renewal.[27] Rising costs have also displaced elderly residents, eroding cohesion and producing "vertical isolation"—leading to the social protest in the summer of 2011, bringing the housing issue and rising costs to the forefront of public and political debate, mixed with public dissatisfaction on government policies in particular in housing.[28]

For example, dense redevelopment in Kiryat Yovel in the south and French Hill in the north, removes green courtyards, narrows streets, and reduces permeability, while replaces horizontal buildings with vertical towers.[29] Further, high maintenance costs push out long-standing residents, particularly the elderly, who find themselves alienated in the very spaces they once called home, not able to afford the new rentals, or maintenance fees. The city is witnessing a shift from horizontal cohesion to vertical isolation, as the cityscape changes, altering the 'familiar' places and landmarks to veteran communities, while attracting new communities in mixed-use dense developments, a vision that drives mayor Moshe Leon, who "plans the city for the future."[30]

Figure 5. The Jerusalem City Entrance project currently under construction (source: Jerusalem Development Authority - https://www.jda.gov.il/en/%D7%A4%D7%A8%D7%95%D7%99%D7%A7%D7%98-%D7%94%D7%9B%D7%A0%D7%99%D7%A1%D7%94-%D7%9C%D7%A2%D7%99%D7%A8/)

Climate Change Policies, Environmental Indicators and Urban Renewal Conflicts

Buildings consume 40% of Europe's energy and a third of GHG emissions; in Israel, not a 'leading country' in terms of setting targets under the Paris Agreement,[31] the share is higher—64% of energy and 34% of emissions, with national targets to reduce GHG emissions by 2030 (27%) and in 2050 (85%) showing a significant gap of 52-93% between targets set by Israel and targets set by developed countries – with reduction target of -27% for 2030, the actual reduction in 2020 was 2% only.[32] Under the Paris Agreement, Israel pledged a 27% emissions cut by 2030 and 85% to net-zero by 2050, emphasizing efficiency, transport, and building performance. Jerusalem's climate plan focuses on retrofits, renewables, trees, and mitigating heat islands.[33] National Green Building Standards 5281 and 5282 became mandatory in 2022, gradually enforced.[34]

Figure 6. Interior renovation of a private apartment in Jerusalem that complies with the energy requirements of the IS5281 Green Building Standard – Architect: E. Messinas (source: author)

The set targets for GHG emissions reduction targets for solid waste are at least 47% and 92% by 2050 (compared to 2015) for GHG emissions originating from urban waste, while targets for construction and agriculture sectors have not yet been established.[35]

Urban renewal through high-rises intensifies environmental stress. Construction and demolition waste, representing about 13% of city level carbon emissions, estimated at 10 tons of construction waste per 100 m2, reaches 1 million tons annually mostly unmanaged and unrecycled.[36] Demolition of existing structures, erases embodied energy of historic buildings and undermining climate goals.

The construction sector in Israel accounts for a large share of total national waste, generated by four sources: 300,000 tons from new construction (residential and office); 320,000 tons from renovations and repairs; 260,000 tons from infrastructure projects; and 80,000 tons from demolition of existing buildings in urban renewal projects[37] with limited to insignificant mechanisms in place for recycling or reuse. Moreover, embodied energy in historic buildings is often wasted through demolition, contradicting climate-conscious building strategies.

Profit-driven architecture often neglects sustainability and community values, in particular the seismic-demographic framework over the years, has legitimized interventions that do not necessarily align with broader public interest. In Jerusalem, renewal justified by seismic and demographic pressures paradoxically harms ecological assets—trees, open spaces, passive cooling, and solar access—while conflicting with climate policy and sparking public criticism.[38]

Figure 7. Cutting down of numerous adult trees on the historic Emek Refaim street, within the framework of the light rail infrastructure works (source: author)

Gentrification, Social Displacement and Public Backlash

Urban renewal has fueled housing speculation. On one hand, neighbourhoods are redeveloped, but on the other affordable units are replaced with luxury apartments and pricing out long-time residents and new couples. Gentrification remains a central concern, as renewal often prioritizes individual property rights, at the expense of the more complex communal rights.[39] Rising housing costs, tied to the general cost of living, have increased the share of residents unable to afford new units.[40] Government measures aim to lower land costs and offset rising maintenance through mechanisms such as rental units to finance maintenance expenses for 10 years. Yet, as projects multiply, public backlash intensifies.

Affected neighbourhoods have organized petitions, protests, and formal objections, often backed by Community Councils and city officials of the opposition. Objections cite opaque procedures, exclusion, and threats to cultural identity. Criticism targets excessive building footprints, massing, tree removal, and the lack of meaningful public spaces.[41] Community Councils advocate participatory frameworks early in the planning process to safeguard vulnerable groups and ensure local needs are addressed,[42] challenging planning authorities seen as favouring developers over residents.

Figure 8. Public Participation meeting on the planning of new high speed Road 16, a development that affects the adjacent neighbourhoods (source: author)

Heritage Loss and Environmental Impacts

The physical consequences of urban renewal in Jerusalem include widespread demolitions of early to mid-20th-century structures, many of which hold historical and architectural value. Conservationists warn that the character of neighborhoods like Rehavia, the German Colony, the Greek Colony and Talbieh is being seriously altered in favor of modernist architecture,[43] incompatible with the traditional scale, materials, proportions, and character, as detailed in preservation guidelines and Master Plans which are often ignored. The environmental toll is also severe. Mature urban trees are routinely cut down almost entirely prior to construction,[44] to make room for underground parking and larger building footprints. The densification of traditional building plots and the increase in land covering, also intensify the urban heat island effect by reducing open green areas and increasing surface albedo. These outcomes contradict local and global climate goals and raise questions about the sustainability of risk-based planning in historic cities. Further, they jeopardize new Master Plans, which belatedly, aim for the preservation of shade in the city, by prioritizing protecting mature trees and planting new.[45]

Figure 9. New high rise developments in the Jerusalem city center (source: author)

CONCLUSION

Jerusalem illustrates how urban renewal, how the economic pressure of the private market driving urban renewal, when driven by national policies for seismic and demographic urgency and coupled with weak conservation enforcement, can result in unintended social, historical, and environmental harm. Policies that, in order to attract private financing, frame risk as opportunity and approve deep concessions to private interests, maximize profit, while result in the displacement of communities and the erasure of cultural and ecological assets. Exceptional examples have shown that urban renewal can be recalibrated to balance seismic safety, demographic need, and the rights of existing communities to remain in their neighbourhoods. In-situ retrofitting, adaptive reuse, and low-rise densification offer alternatives to full-scale demolition, while protecting local values and the micro-climate. As development of the city progresses, local and regional authorities will be pressured to meet national climate change mitigation targets. Through public pressure, planning processes will have to become more transparent, inclusive, and accountable, and architects will have to be re-educated toward sustainable design and circular construction practices. The design process will be more participatory from the early stages and preservation regulations will have to be enforced as intended in approved Master Plans. Environmental impact assessments will have to be integral to urban renewal plans aiming for net-zero buildings and neighbourhoods, verified during design and completion phases. A paradigm shift is essential for a sustainable and resilient future for Jerusalem—the eternal city.

NOTES

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TOWARDS AN "INTERPRETIVE" SUSTAINABILITY: GLIMPSES FROM EGYPT AND OMAN

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INTRODUCTION

the United Nations[1] endorses the implementation of efficient sustainable measures based upon effective social engagement.[2] However, the Millennium Ecosystem Assessment Report[3] and the Intergovernmental Panel on Climate Change (IPCC)[4] indicate that the participatory based sustainable development does not improve, but worsen. "Much of the research looking at the success of community engagement in achieving sustainability outcomes is inconclusive…resulting in an even greater disadvantage for the most vulnerable communities."[5] Malfunctioning models of community-based development and local decentralization have led to inconvenient sustainable development.[6]

Thus, Mansuri and Rao suggest not only to enhance the "induced" efforts that trigger formal participation-based projects, but also to foster the "organic" engagements that provoke local change.[7] Moreover, Dr. Hes proposes the development of a sustainability ecological worldview, which is more relational, emotional and mental—and through which "humans are irreducible."[8] Though, the UN-Agenda and the aforementioned proposals overlook the impact of social perception(s) and interpretation(s) on realizing sustainability. Alike, the local readiness for socially undertaking global sustainable plans endures ambiguity, especially in the Middle East. Hence, isn't it the time to learn from 'interpretive sociology' for the sake of creating an 'interpretive sustainability'?

OUTLINE

The research theoretically contextualizes interpretive sociology,[9] glocalization[10] and socio-semiotic,[11] as, together, they facilitate studying the social perception(s), global-local challenge(s), and connotative meaning(s) of sustainability. The three theories will be then used to analyze and synthesize the practical part which consists of two Middle Eastern case studies.

Interpretive sustainability

Unlike Comte and Durkheim, who depended on quantitative data for studying society,[12] Weber and Simmel praised qualitative investigations. Weber developed interpretative sociology,[13] which focuses on 'das Verstehen'—that is, the "empathic understanding of human behavior."[14] According to Weber, sociology "is a science concerning itself with the interpretive understanding of social action and thereby with a causal explanation of its course and consequences."[15] Thus, within the sustainability context, interpretive sociology gives inspiration to consider social interpretation as well as the meaning of actions—that is, instead of merely relying on social engagement.

GloCalization and socio-semiotics

The UN underlines that the sustainability "universal…Goals [take] into account [the] different national realities."[16] Thus, it is a global 'world-system,'[17] embodying a crucial global-local relation.

For instance, Wallerstein[18] and Barber[19] illustrate the global-local bond as an in-tension relationship: "The two axial principles of our age—tribalism and globalism—clash at every point except one: they may both be threatening to democracy."[20] Yet, Roberston opposes by proposing "GloCalization:" the homogenous and heterogenous unity of the world as a whole.[21] Homogeneity derives from following the universal global trends, while heterogeneity from validating the particular local settings.[22]

Accordingly, to investigate the social perception about the global-local nature of sustainability, the paper abides to socio-semiotics[23]—since it allows analyzing the various meaning levels of sustainability measures as signs.[24] Socio-Semiotics splits the signifier to material objects and morphological elements. The former conveys the non-codified denotation, the latter the codified connotations[25] (figure 1). Both signification levels operate according to the social context.[26] Thus, the case studies will be analyzed via unveiling their contexts, denotations and connotations.

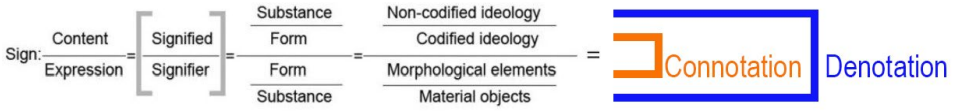

Figure 1. Sign Decomposition according to Socio-Semiotics by Mark Gottdiener edited by the author

NEW GOURNA VILLAGE

The method is analytical and library-based. The data collection derives from multiple sources. Some are official,[27] like "Luxor Governorate Website,"[28] while others are practical, like the "UNESCO" [29] and "World Monuments Fund."[30] Governmental,[31] private[32] and international[33] newspapers are considered. Architectural magazines, such as ArchDaily,[34] Archnet,[35] Architectural Review,[36] and Earth Architecture,[37] have been reviewed—that is in addition to publications,[38] and the databases provided by the AUC[39] and TU-Delft.[40] 'Al-Jabal' Novel, The Mountain, illustrated the social discourses of the villagers.[41] Thanks to Taragan[42] and Elad,[43] the novel narrations are acknowledged to be reflecting the village social facts. Also, a short survey was launched. It consisted of three focused questions, to which twenty-six regional professionals responded.

Context

New Gourna is a village in Luxor, situated within the World Heritage property of Ancient Thebes.[44] Being built between 1946 and 1952,[45] it is relatively new—but its villagers are not. They are the Old Gourna Villagers, the Gournii. The inhabitants used to live above tombs to earn from tunneling, smuggling and selling monuments. Thus, the Egyptian authorities decided to build a low-costs New Gourna—to which Gournii should have been relocated.[46] Fathy, the famous Egyptian architect, undertook the design[47] to implement his idealistic thoughts.[48] The "Architecture for the Poor"[49] documents his experiments in New Gourna, and serves as key reference for sustainable architecture.[50]

Denotation

For Fathy "the architecture of the house emerges from the dream; this is why in villages built by their inhabitants we will find no two houses identical."[51] Thus, he applied a training, participatory and cooperative system to let villagers build by themselves.[52] The new location distanced the Gournii from

the tombs, and socio-economically encouraged farming.[53] Fathy also provided a khan and exhibition halls to empower the textile and pottery crafts.[54] He reduced costs and overcame climate challenges by using local materials and techniques.[55] Thus, New Gourna offers a global vernacular and sustainable reinterpretation of the local built fabric.[56]

Connotation

Despite public participation,[57] Gournii opposed the reallocation.[58] Unlike residing the hillside, they found themselves down at the valley exposed to mud and waterborne parasites.[59] The new location negatively affected Gournii's alabaster business, due to the disconnection with tourists and from tourism.[60] Also, Fathy's design was too ideal.[61] Spontaneously adding upper floors was not anymore feasible.[62] Decorating and painting the facades to collectively celebrate social occasions became odd.[63] More, Gournii accept neither covering houses with domes,[64] nor keeping animals outside.[65] "Only the tomb of a holy man is topped with a dome...The donkey was like a member of the family…All of us sleep with one eye and keep the other on the donkey...How could I sleep with the donkey far away?"[66] Via a survey, the paper found that slightly more than Fifty-two percent of participants approve the statement: 'The social interpretation of the resemblance between Al-Gourna architecture and tombs has negatively affected the inhabitants' willingness to move in the new settlements.'

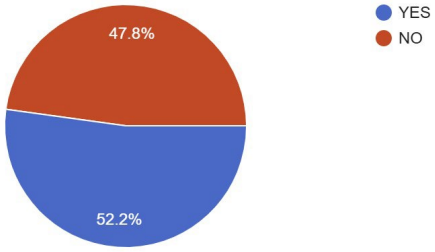

Figure 2. Survey result: approving statement 01 by the author

MUSCAT PUBLIC TRANSPORTATION

To retrieve qualitative emergent data, four focus group-interviews have been conducted. They investigated interviewees' perception about public transportation in Muscat. Thirty-one female students were involved—as, according to the interviews, almost all Omani males own private cars. The interviewees preferred being anonymized, but coded. The questions were semi-structured, open-ended, and diversified. The analyses consisted of debriefing, constant comparison, and categorization.

Context

Oman National Spatial Strategy (ONSS) outlines the country's urban growth over the next twenty years. It realizes the local Oman Vision 2040 which aligns with the global SDGs.[67] As ONSS seeks social satisfaction, public participation represents a cornerstone in all its development phases.[68] Strategically Oman plans to achieve sustainable mobility.[69] Thus, the ONSS works on raising the share of public transportation use from five to sixteen percent. It aims at serving more than half-million passengers via investments in Muscat and major hubs.[70]

Denotation

According to G02-SS, public transportation "is highly recommended." G01-BH justifies: "the Taxi is so expensive…[,as well as] the petrol." G01-LA adds: "using Nakleyat (private buses) is so exhausting." G03-AD indicates that "some people work outside Muscat, while others come to Muscat for work... A bus taking to destination and bringing back would be easier and more comfortable…Using buses in the morning for work, and maybe personal cars only in the evening for pleasure, will reduce traffic." Thus, G03-SU wishes "for more public transportation, instead of needing multiple cars," especially that "the transportation in Oman is experiencing major progress. Nowadays students can enjoy free Wi-Fi inside the public bus, which is also free for students"— stated by G01-AA.

Connotation

G04-RB emphasizes that "according to the culture of Oman, females don't use public buses"—unless "in emergency, with family, or if accompanied by a relative male" as stated by G04-RY. Also, G03-MA reacts by saying: "Alhamdollah (Thanks God), I have my own car. I use it everywhere. The female usage of public transportation is somehow a taboo." G03-IS makes it clear "We fear harassment." Thus, G01-SG points out: "the Omani man would surely choose to carry his family over his shoulders, rather than letting them use public transportations." Suddenly, G04-NT unveils that "Public bus is for expats, and the poor." G03-MA admits that other than the bus driver "you will rarely find any Omanis on the bus." G01-SG even states: "If we see an Omani using the public bus, we will say: what a poor guy– GOD helps him!!" Surprisingly, G03-AD declares with confidence: "I prefer my own driving; I like to be in control—and above all to switch on my own favorite playlist."

CONCLUSION

Despite being located in different countries, the paper found that the case studies share similarities. They receive governmental support, apply sustainable techniques, and consider social engagement. Both signify the decision makers' intention of locally coping with the global sustainability goals.

Socio-semiotically, the denotations signified the projects' technical feasibility, social relevance, and sustainable significance. But in contrast, the connotations revealed the social (negative) perception and (mis)interpretation of the measures. For example, the reallocation settings connoted socio-economic loss, socio-urban disruption, and socio-architectural inappropriateness. Alike, the public transportation vision connoted unsafety, lose control, as well as otherness and stratification processes. Thus, the case studies indicate that social engagement reflects neither local perceptions, nor social interpretations. Likewise, it doesn't guarantee the social readiness, nor the implementation success.

Therefore, instead of merely depending on public participation 'from outside,' "enter or step into the shoes of the other."[71] Develop a 'Weberian' interpretive[72] sustainability which relies on internal understanding, and on discovering the social realities 'from inside.'

The paper proposes a sustainability approach which considers social actions and meanings, as well as which recognizes causal explanations and consequences. This is to avoid Weber statement: "No one knows who will live in this cage in the future…at the end of this tremendous development...For of the last stage of this cultural development, it might well be truly said: Specialists without spirit, sensualists without heart"[73]—,or maybe sustainabilists without sense.

NOTES

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SMALL-SCALE INFRASTRUCTURE FOR NEIGHBORHOOD RESILIENCE: CASE STUDIES FROM NEW ORLEANS

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INTRODUCTION

As the planet warms and the climate changes, natural disasters are becoming an increasingly frequent issue, causing devastation to communities both socially and economically. According to the North Carolina Institute for Climate Studies, the number of billion-dollar disaster events is increasing in frequency.[1] In the Southeast, including places like New Orleans, this means increasing numbers of tropical storms and hurricanes that flood urban expanses and leave people without access to critical resources for days or weeks.

While there is no way to prevent a severe weather event from happening, an initiative known as the Get Lit Stay Lit program has found a way to outfit local neighborhoods with resilience hubs which allow people to have basic needs better met following a disaster. This is not done through the creation of new spaces or buildings but rather by utilizing existing restaurants and equipping them with sustainable energy infrastructure in the form of microgrids to allow these establishments to maintain power after a storm.[2] The access to electricity and an attitude of community mindedness transforms eateries into resilience hubs. In the scope of this paper, the analysis of the case study of this initiative and its flagship resilient restaurant project showcases how disaster resilience can be embedded into existing contexts by way of infrastructure.

New Orleans Context

New Orleans is a city in southern Louisiana that sits in the Mississippi River Delta. While at its founding the city was settled on natural levees or along higher ground, over time, water was pumped from the marshland which allowed development to sprawl into lower elevation zones. Presently half of the city is at or below sea level, making it especially vulnerable to flooding issues.[3]

This problem, combined with the city's location in the Gulf Coast, means that hurricanes are a severe threat to inhabitants. Hurricanes in the last two decades, including Hurricane Katrina in 2005, have resulted in thousands of deaths, mass evacuations from the city, and hundreds of billions of dollars in damages. [4] In such storms, there are also many who are unable to evacuate due to lack of resources.[5]

Though unfortunately the built environment has been significantly changed and damaged by such storms, the city still maintains a wide array of historical architectural styles and neighborhoods, with more than twenty National Register historic districts and many national landmarks.[6] The city is also characterized by a strong sense of community. This stems from the unique culture and history of the area, which includes an influx of French, Spanish, African, and American influences and a variety of

immigrant communities in the present day. [7] Today, neighborhood social organizations or groups such as Mardi Gras Krewes continue to foster close-knit relationships among city residents. [8]

GET LIT, STAY LIT

The Get Lit Stay Lit initiative began as the brainchild of Devin de Wulf, founder of Feed the Second Line. During the COVID-19 pandemic, the organization Feed the Second Line connected out of work musicians with local restaurants to employ them to deliver meals to hospital staff or other vulnerable populations.[9] Through this program, de Wulf cultivated relationships with various restaurant owners and began to see restaurants as a piece of infrastructure.

Then, in 2021, Hurricane Ida hit and left most of de Wulf's neighborhood without power for days. In an interview conducted in November 2024, de Wulf explained that he saw how people in his neighborhood used his home, which was equipped with solar panels and thus had electricity, to help meet basic needs by charging devices or cooling off with ice or fans. This experienced served as inspiration for the initiative Get Lit Stay Lit.

Figure 6. A diagram showing the conceptual idea behind the Get Lit Stay Lit program on one of the initiative's restaurant buildings.

Through this initiative, locally-owned restaurants in minority-dominant neighborhoods with high rates of poverty are equipped with solar panels and microgrids that allow them to "stay lit" following an outage or natural disaster. The neighborhoods and restaurants were specifically selected considering poverty demographics given the logic that people with fewer resources are less likely to be able to evacuate and thus will have to survive without power for days or weeks following severe storms and hurricanes. [10] The initiative ultimately benefits both restaurant owners and the local community. The restaurants can preserve their ingredients safely in their still-functioning refrigerators and freezers, preventing financial loss. Meanwhile, the surrounding communities can use the restaurants to get safe-

to-consume meals, power up phones or medical equipment, cool off in air conditioning, or otherwise capitalize on functions facilitated by access to reliable electricity.

Figure 7. A conceptual diagram explaining how the microgrid and battery systems allow for a transformation of program within the restaurant architectures.

As of early 2025, the Get Lit Stay Lit initiative has installed microgrids and back up battery systems on four restaurants in four different neighborhoods in New Orleans. These restaurants include Queen Trini Lisa's in Mid-City, Fritai in Treme, Afrodisiac Nola in Milneburg, and Addis Nola in the Seventh Ward.[11]

Analysis Strategies

The Get Lit Stay Lit program demonstrates potential strategies for making neighborhoods more resilient by way of infrastructure. To understand the project's impact on the architecture and environment of the restaurants, the people involved or affected by the initiative, and potential considerations for application in other contexts, various tactics were employed to examine the project.

All four Get Lit Stay Lit restaurants were visited and documented through photographs, diagrams and drawings. Interviews were conducted with Devin de Wulf, the founder of the initiative, as well as willing restaurant owners who had participated in the project. Following these efforts, additional drawings and diagrams that communicate strategies and explain the features of the project were created to assist in the potential application of similar tactics in other contexts.

These projects were also considered within the context of current discourse surrounding the potential futures of renewable energy projects, most namely the Pathways to Place-Based Renewable Energy Landscapes at Scale developed in 2022. This framework, presented in the whitepaper *Renewable Energy Landscapes: Designing Place-Based Infrastructure for Scale* by Pacific Northwest National Laboratory (PNNL) suggests that there are six key concepts to instituting socially and environmentally resilient infrastructure in a community. These strategies include multifunctionality, energy justice,

natural capital, resilience to climate disruption, decentralization, and generation of local value. [12] Overlaying the information gathered from site observations with this framework, design tactics specific to the use of microgrids to transform programs of restaurants in disaster times were identified.

Figure 8. The Pathways to Place-Based Renewable Energy Landscapes at Scale as promoted in a white paper by Pacific Northwest National Laboratory. [13]

Queen Trini Lisa's

In the scope of this paper, the first restaurant to be equipped with a microgrid via the Get Lit Stay Lit program, Queen Trini Lisa's, will be considered for study for the way it embodies the ethos of the project.

Queen Trini Lisa's is the first brick-and-mortar restaurant of self-taught chef and owner Lisa Nelson. She first began cooking and selling cuisine of her home country of Trinidad and Tobago in 2016 out of a New Orleans corner store. This evolved into a series of pop-up culinary endeavors before she founded her restaurant in Mid-City in 2021. [14]

The building is a two-story, pitched-roof structure with a restaurant space on the ground level that seats 20 on the interior and has outdoor picnic tables to extend the dining environment to the streetside. The interior décor includes not only a mural and other artwork representative of Trini culture but also the flag of Trinidad and Tobago, drawings from local children, and a plethora of potted plants.

Figure 9. A view of the exterior of Queen Trini Lisa's from across the street.

Two visits were made to Queen Trini Lisa's, one in November of 2024 and a second in February 2025. In both, the spaces were documented (and the food was enjoyed). In the second visit, a brief interview was conducted with Lisa Nelson. From these efforts, three key strategies that facilitate the restaurant as a resilient infrastructure in its context, by way of its micro infrastructure, were identified.
These three strategies are:
1. Let the energy infrastructure be subtle but functional to not compromise the aesthetics and characteristics of the space.
2. Utilize systems that are low maintenance and easily deployable.
3. Capitalize on beloved places that are embedded in community.

Incorporate Infrastructure Subtly

The first key tactic identified that helped to make the Get Lit Stay Lit project successful in this site was to observe that the impact of the infrastructure had little to no effect on the architecture, interior space, or ambiance of Queen Trini Lisa's.

Figure 10. View of the interior of Queen Trini Lisa's

Some items within the space – the coolers, the freezers, the outlets – would be impacted by the presence of the infrastructure, as they remain with power even during outages. Other items, like the lightweight and flexible furniture solutions, could easily be moved or reconfigured should the restaurant need to convert to a relief station following a disaster. However, the interior space has no outward signs of the microgrid's presence.

The existence of the infrastructure can only be noticed in views or spaces not generally perceived by the public. The solar panels that adorn the rooftop are only distinguishable from above or utilizing the aerial views from platforms like Google Earth, while the Tesla batteries that provide off-grid power are hidden in the garage storage space of the restaurant, tucked behind a shelf filled with extra supplies.

Figure 11. A view of the garage and storage area within Queen Trini Lisa's restaurant. The Tesla batteries are barely visible on the left behind the shelving.

This idea of integrating such a project into a context without changing the appearance of the built environment or architecture is significant in a place like New Orleans. Approximately 40 percent of the city, including over 45,000 properties, are within the 26 historic districts listed on the National Register of Historic Places.[15] Thus, within these zones, there are historic district commissioners and other governing institutions that dictate what design changes or proposals are allowed with the goal of maintaining certain aesthetic consistency in the architecture. Through their subtlety and limited changes to the building, the infrastructure projects of Get Lit Stay Lit can be implemented without a need for variances or extensive debate with historic commissioners or the community, allowing for more rapid deployment.

The largely unchanged nature of the architecture and neighborhood within the Get Lit, Stay Lit method embodies Pacific Northwest National Laboratory's Pathways to Placed-Based Energy Landscapes at Scale principles of meaningful functionality and decentralization. Per this agenda, it is suggested that solar voltaic systems integrated into building surfaces are a good example of multifunctionality, achieving overall improved performance through the layering of ecological, production, and cultural functions – which is realized with the installation of the solar panels on the rooftop of Queen Trini Lisa's.[16] Additionally, the concept of decentralization is central to the project – the microgrid functions independently and brings the energy generation method to the place of consumption. This exemplifies the framework's proposed advantages of decentralization, including the imparting of local energy

independence and network security, motivating social capital and cohesion, and supporting zero-carbon emissions in the site.[17]

Utilize Low Maintenance Systems

Infrastructural and energy generation technologies have greatly advanced in the recent decades, and in the present day, numerous groups are experimenting with generating power via new devices and materials including solar roof shingles, solar window films, or other innovations. However, to the benefit of the initiative, the Get Lit Stay Lit program uses relatively established technology – solar panels and back up battery systems – to generate and store power on the selected restaurant sites.

The use of this well-tested technology is advantageous for several reasons. The first solar panel dates back to 1884, while popular use of solar panels for energy generation gained traction the United States in the 1970's following oil shocks that caused energy prices to surge.[18] This increase in popularity facilitated further research and development that has in turn made the solar panels of the present day not only more efficient but also easy to install and maintain. According to the Department of Energy, modern solar panels have an estimated operational life span of 30-35 years.[19] Thus, a Get Lit Stay Lit project can remain active for decades with limited maintenance required.

There are also clear, positive economic repercussions to utilizing solar panels. The micro grid systems help save money for the small business owners. In conversation in February 2025, Lisa Nelson noted that not only are her monthly energy bills for Queen Trini Lisa's made more affordable due to the infrastructure but also that she does not lose costs on wasted food – when the power goes out, the ingredients in her freezer and fridge are safely stored, preventing huge amounts of waste and the added expense that comes with restocking after an outage.[20] Beyond just the cost savings that building owners and users gain from the energy generated in non-disaster times, a study from the U.S. Department of Energy's Lawrence Berkley National Laboratory found that photovoltaics also increased estimated home values in appraisals across six separate states.[21] Thus, the local business owners are rewarded economically both in the short and long term for their utilization of sustainable infrastructure that benefits them and the community.

The use of a low maintenance solar-powered system speaks to principles of resistance to climate disruption and nature capital within the Pacific Northwest National Laboratory framework previously outlined. The placement of solar panels on open rooftops for energy generation enables power to be accessible quickly following a disaster scenario, and it allows for critical functions to be restored. Additionally, the natural landscapes and ecosystems within New Orleans are maintained and preserved with this type of project, as there is no additional land use required and the technology is sustainable, preventing carbon emissions or other damage to the surrounding environment; since one primary tactic from the Pathways framework includes preserving vegetation, which is known to stabilize the climate, this project fulfills this criteria.[22]

Capitalize on Beloved Places

The final proposed principle for implementing micro infrastructures for social and environmental resiliency is to choose project sites that are already beloved or embedded in community. The logic behind this principle is that if the community already frequents an establishment, locals will be aware of the building's possible transformation into a resilience hub. Beyond this, restaurant owners who already engage with the community via cultural events, outreach, or other tactics may be more likely to act in a way that benefits their neighborhood in times of need. The people behind the food – in this case Lisa Nelson and her family who work in the restaurant – arguably are what establish the restaurant and its space as a treasured community institution that is at the ready to support others in difficult times.

Lisa Nelson of Queen Trini Lisa's is exemplary in her commitment to New Orleans and to her neighbors. Her social media presence on the Queen Trini Lisa's accounts has posts not only advertising delicious food specials but also encouraging COVID-19 vaccination or celebrating heritage months and events.[23] This outreach, via social media and in-person events, speaks to Lisa's diverse manners of connecting with people in the vicinity and activating the restaurant as a space that is more than just an eatery.

Additionally, an examination of Yelp reviews of Queen Trini Lisa's is telling in how clients often describe the people – Lisa and her family who run the restaurant – and the camaraderie and hospitality in their glowing descriptions of the place. Various reviews note that, "The experience with CJ (Lisa's son) and Queen Lisa are unmatched and they made us feel like we were right in their own home," [24] or that Lisa will make you "… feel like you've been friends for years and always will be, her energy is divine, and her food is an honor to enjoy." [25]

In public interviews, Lisa is also proud to speak to her desire to provide aid to her neighbors. Shortly after the installation of the solar panels on her restaurant, Lisa was quoted as saying "This can be a little hub of support, and that's what I want to provide… This is a community restaurant – I'm surrounded by my customers here. They're the foundation of my business, so I want to take care of them." [26]

Within the Pacific Northwest National Laboratory's Pathways to Place-Based Renewable Energy Landscapes at Scale concepts, capitalizing on beloved places for infrastructural interventions speaks to both generating local value and to energy justice. The Get Lit, Stay Lit initiative generates capital for local, black-owned businesses, thereby contributing monetarily to the community – but it additionally provides a resource that facilitates community connections and recovery in times of need; this fulfills the PNNL goal of generating local value by countering the typical infrastructural model which generates value for a company that owns the energy generation method but does not as often offer tangible value for local communities.[27] The program also promotes energy justice in that through clean energy generation and wealth generation within a traditionally disenfranchised neighborhood, the adverse health effects caused by unsustainable infrastructure projects of the past are avoided. The Get Lit Stay Lit model, when compared with the PNNL concepts, fulfills the goal of supporting sensitive clean energy development while also facilitating the preservation of neighborhood culture, through food. [28]

CONCLUSION

While it is critical in the profession of architecture to design new structures to be resilient as climate disasters become increasingly common and reach previously unscathed locations , and while there is also a need to design solutions that are deployable in response to crises, the Get Lit Stay Lit program demonstrates that disaster resilience can be embedded into existing contexts through infrastructure. The possibility of retrofitting buildings in this way is not only relatively quick and cost effective, compared to new-build projects, but it also preserves neighborhood fabrics and generally falls within existing design guidelines. Though there are unique features within the specific environment of New Orleans that contribute to the success of the micro infrastructure initiative, the outlined tactics provide guidance as to how to implement and test such projects in other contexts. And, in New Orleans, as the program expands to include more restaurants and thus densifies the microgrid infrastructure, further development or customization of resiliency strategies for the varied sites can be considered.

The Get Lit Stay Lit program suggests that one of the most effective ways to foster sustainability and resiliency is to find simple, functional ways of augmenting existing, beloved places and spaces to facilitate longevity and versatility. The locally-owned restaurants can become a social infrastructure through the design and implementation energy infrastructure, transforming the program and purpose of the architecture and promoting energy justice and disaster resiliency in communities.

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BIOPHILIC DESIGN: THE CASE OF PARK AM NORDBAHNHOF (BERLIN)

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INTRODUCTION

This paper examines how the political, economic, social, and biological conditions of West Berlin's post-World War II landscape influence biophilic ecological design practices in contemporary Berlin, using Park am Nordbahnhof as a key case study. Central to this discussion is the work of urban ecologist Herbert Sukopp, whose research redefined wastelands and spontaneous vegetation as vital ecological systems within West Berlin, influencing planning policies and design philosophies from the 1970s onward. This shift aligns with ecologist Ingo Kowarik's concept of Fourth Nature, which reframes ecological spontaneity as a cultural and biological asset. Drawing on site observations and interviews with ecologists and designers, the paper considers how these ideas materialised in the Park am Nordbahnhof design during the 2010s and demonstrates the impact of these evolving ecological conditions on an urban park design that is inherently biophilic.

The Evolution of Biophilic Attitudes in Berlin

World War Two was central in establishing Berlin citizens' positive association with spontaneous ecosystems. Destructive processes such as bombing produced ninety cubic metres of rubble, rapidly de-industrialised the city and created 500 hectares of abandoned landscape distributed across the urban landscape.[1] This novel geology, characterised by decomposing bricks, carbonates, low humus content, stones, clay, and sand, provided drier and warmer habitats compared to the city's pre-war ecological condition.[2] The new ecological conditions impacted how ruderal plant communities were distributed across the city by supporting polemochore species, or plants that spread through the process of war, to establish a network of spontaneous meadows and successive woodlands across post-war Berlin.[3]

After the nation's division into an Allied-controlled West Germany and Soviet-controlled East Germany, West Germany moved its capital to Bonn, diminishing Berlin's political significance. The intensifying political change was aggravated by the construction of the Berlin Wall in 1961, which left West Berlin isolated as an "island" city in the German Democratic Republic (East Germany), as shown in Figure 1.[4] The very nature of the wall's presence added another spatial typology to an already fragmented landscape – inaccessible voids of biodiverse urban wilderness. Berlin's division influenced the study of urban ecology in West Berlin.[5] Ecologists such as Herbert Sukopp began to explore relationships between war processes, spatial isolation and ecological succession on West Berlin's spontaneous ecosystems,[6] which were central to the development of biophilic design values among citizens.

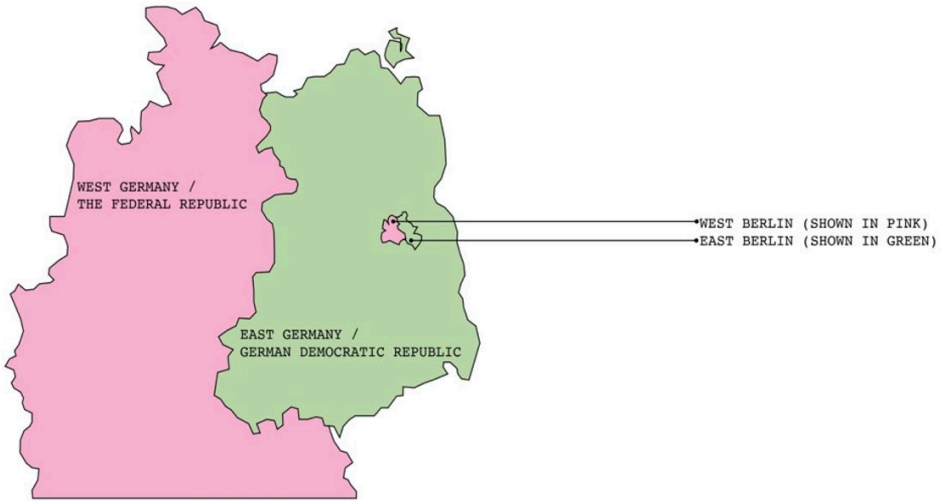

Figure 1. A diagram showing the location of West Berlin inside East Germany. Diagram by B Greene 2025.

Scientific Perspectives of Spontaneous Ecology in West Berlin

Herbert Sukopp is a significant figure in urban ecology, renowned for his revolutionary studies into West Berlin's spontaneous ecosystems in the second half of the twentieth century.[7] His discoveries projected new scientific values onto West Berlin's previously disregarded and abandoned landscapes by uncovering high levels of biodiversity among the sites' plant, animal and insect communities.[8] Sukopp's work, together with Berlin's hyper-disturbed landscapes, set the foundations for Berlin policy writers, urban ecologists and landscape architects to conceive spontaneous ecosystems in novel ways.

Sukopp's early research explored the relationship between human forces and ecological systems in West Berlin. He sought to improve understanding of the city's spontaneous environments to inform new landscape policy, which would preserve biodiverse urban landscapes from renewal. Sukopp advocated for utilising scientific knowledge to guide the development of novel landscape planning policy, which he believed could balance human requirements alongside resilient ecological functions in West Berlin.

The endeavour to connect scientific research, ecological conservation and policy development was reasserted in Sukopp's collaborative book chapter, The Soil, Flora, and Vegetation of Berlin's Waste Lands. While conservation was a central focus of this essay, the paper also highlighted the potential of harnessing West Berlin's spontaneous ecosystems as a resilient and adaptive design material.[9] Commenting on this ecological attribute, the authors wrote that the "prevailing plants of the future will certainly be those which adjust themselves best to man-made sites" and that there is a "great protective importance of these plants in cities."[10]

Sukopp's conservation perspective gained prominence in West Berlin during the 1970s, impacting the production of new management bodies and legislation. During this decade, West Germany (the Federal Republic of Germany) held revolutionary seminars with influential participants such as Sukopp, ecologists Hans-Peter Blume and Wolfram Kunick, and Wolfgang Erz, the director of the Federal Institute for Nature Conservation and Landscape Management. These talks shifted conservation perspectives across West Germany as scientists campaigned for stronger links between planning policy and ecological conservation.[11] Changes to planning perspectives were first raised in the First Species Protection Seminar in 1971, and further developed at the Changes of Flora and Fauna conference in 1975, when the preservation of interconnected landscape systems (as opposed to singular species)

became an ecological priority By arguing for the integration of systems thinking within planning and conservation policy, Sukopp, Erz and Kunick, among others, advocated for the preservation of urban wastelands as critical ecological nodes within the metropolis – a position reiterated in the 1980s. In this way, by the end of the 1980s, science had framed West Berlin's wasteland biomes and spontaneous plant communities as valuable biological resources.

The significant impact of post-war scientists in shaping ecological values and planning practices in West Berlin continued to inform Berlin's development post-reunification. Most notably, Ingo Kowarik continues this lineage, introducing the Fourth Nature concept in 1991 to theorise the cultural and ecological performances of spontaneous plants and urban wastelands, which is discussed in the following section.

The Philosophy of Fourth Nature

Ingo Kowarik extends Sukopp's legacy by theorising new associations between the city's disturbed urban environments and the community.[12] The urban ecologist is renowned for his collaborative work with landscape architects, Berlin Senate policy writers, scientists, artists and the Berlin community – and for his central role in establishing the Natur Park Schöneberger Südgelände, as shown in Figure 2.[13] Kowarik's Fourth Nature concept considers the ecological and social benefits of engaging spontaneous ecosystems through science, open space policy and design, which set foundations for a new ecological design approach that continues to impact landscape architectural practices in Berlin.

Figure 2. A photograph of Natur-Park Schöneberger Südgelände's spontaneous plant community, which is utilised by landscape architects in the design of the park. Photograph by B Greene 2019.

Kowarik developed the Fourth Nature theory in 1991 in response to inadequacies that he perceived in ecological science's classification system, which could not categorise Berlin's spontaneous ecosystems and associated wasteland habitats. To acknowledge this anomaly, Kowarik proposed the Fourth Nature theory to outline a progression of cultural landscapes in Berlin. These include first nature (patches of pristine wilderness/remnant forests); second nature (agricultural landscape such as fields, hedges, and

grasslands); and third nature (formal/maintained urban green spaces, including domestic gardens, parks and graveyards), which represent a spectrum of human influence on the landscape.[14]

Fourth nature, however, is distinct from the previous nature typologies as it exhibits traits of untamed wilderness and the cultural landscape. As Kowarik explains, fourth natures emerge "spontaneously at the edges of roads and walls, in vacant lots and arise on brownfields. It stands out from the symbolic nature as well as the remains of the original natural landscape and the pre-industrial cultural landscape."[15] Similar to Sukopp's ecological discoveries, Kowarik's Fourth Nature philosophy projects new values onto Berlin's spontaneous plant communities, abandoned landscapes and the process of ecological succession.

Significantly, Kowarik's theorem provides a critical scaffold for aligning values across multiple disciplines and groups that are engaged in the design and conservation of Berlin's wasteland biomes. Kowarik reflects that government officials were not immediately impressed by scientific data on biodiversity.[16] However, the idea that Fourth Nature represents Berlin's post-war environmental history became alluring for administrators. He sees this as evidence that the ecological system informs "new planning and architecture schemes."[17]

Berlin Senate city planner Holle Thierfelder reinforce a link between Fourth Nature and Berlin's citizens. As Thierfelder explains, Berlin residents "are special… it is such a mixed place… Berlin had always been quite a free town, and that's what makes the people here, and that's what makes the Fourth Nature."[18] Thierfelder's position is similar to Kowarik's view that Fourth Nature produces feelings of "being different or… of natural approaches, which is very easy to appreciate… it is something… that provides qualities that" makes "life richer because you have more direct contact with natural processes and elements and plants and so on."[19] Kowarik and Thierfelder's reflections reveal the influence of the Fourth Nature term in shifting perceptions of spontaneous ecology, which results in a broader acceptance of multiple ecosystems by the community (First to Fourth Nature).

Fourth Nature theory is further explored in Kowarik and Körner's publication Wild Urban Woodlands.[20] The edited book includes a collection of essays with contributions from diverse disciplinary backgrounds such as design, urban planning, urban ecology and philosophy. Critically, the publication demonstrates how positive perceptions of wild urban forests have extended beyond Berlin into Germany, Europe, the United Kingdom and Japan, which establishes a powerful argument for how these concepts can become applicable in broader contexts.

Philosophical Alignments between Fourth Nature and Wilson's Biophilia

In Biophilia, Edward Wilson examines the complex interactions between cultural and ecological systems globally. Wilson describes an inherent human attraction towards life and living systems[21], and most critically, that a culture's ecological values are not fixed – they shift through time.[22] Wilson's emphasis on changing attitudes is mirrored in Sukopp and Kowarik's research that reclassified Berlin's spontaneous ecosystems (as Fourth Nature) and revalued them as significant biological assets during the twentieth century. This perceptual shift is inherently biophilic, demonstrating a cultural capacity to appreciate previously undervalued landscape typologies (such as abandoned landscapes) and associated ecological communities (self-directing plants, for instance) in novel ways.

The following section introduces Park am Nordbahnhof. It references interview data from landscape architect Harald Fugmann, design documentation, and observation experiences from 2018 to investigate the degrees to which biophilic philosophy and attitudes are embedded within the built outcome.

PARK AM NORDBAHNHOF

Park am Nordbahnhof is located in the borough of Mitte, approximately two kilometres from central Berlin. The Nordbahnhof design is closely tied to Berlin's post-war experience and the events outlined at the beginning of this paper, most notably the building of the Berlin Wall. The park sits close to significant historic public open spaces, including Volkspark Humboldthain, Mauerpark and the Berlin Wall Memorial that runs the length of Bernauer Strasse (the old route of the Berlin Wall), as shown in Figure 3.

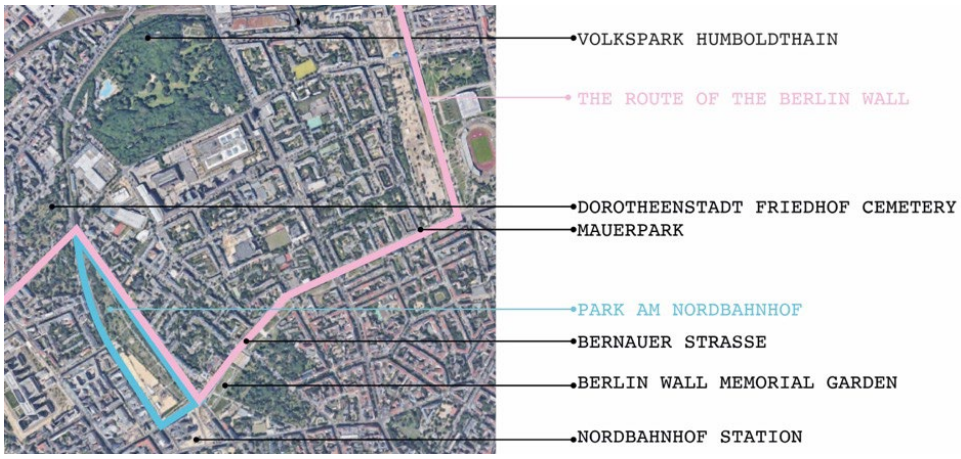

Figure 3. Park am Nordbahnhof and the route of the Berlin Wall
Diagram by B Greene 2025.

Initially the Stettiner Bahnhof train terminus, which dates back to 1842, the Nordbahnhof landscape transformed into a no man's land as political tensions between the Allies and Soviets resulted in the Berlin Wall. This event shifted Nordbahnhof's function over the next three decades. In 1961, it was reprogrammed by the Soviets as a military landscape on the frontier between East and West Berlin. Despite the city's reunification in 1989, Nordbahnhof remained abandoned. From 1990 onwards, the Nordbahnhof landscaped evolved into a biodiverse meadow of 174 perennials, grasses and trees, which included rare and endangered plants – such as *Acer campestre, Arabis glabra* (bald goose cress), *Centaurea diffusa* (sparse knapweed), *Filago arvensis* (field celandine), *Rosa subcanina* (dog-rose) and *Saxifraga tridactylites* (finger saxifrage) – that grew in the site's polluted granite, sandstone and limestone soils, broken bricks and rubble.[23]

In 1995, the Berlin Senate ran a design competition seeking visions for this landscape as a public park. Berlin-based landscape architects Fugmann Janotta and Polish architect Romuald Loegler were selected as winners. This proposal did not acknowledge the site's role in the era of division or its ecological attributes, which held high conservation value. Alternatively, the scheme proposed a traditional urban park typology with a central lawn surrounded by new tree plantings.[24] Reflecting on this first concept design iteration, landscape architect Harald Fugmann explains that in 1994, nobody spoke about protecting the ecology or the Berlin Wall; the park "could have been completed in any space" as heritage "did not play any role in design" thinking.[25] However, the project was cancelled due to financial constraints, and the Nordbahnhof landscape lay idle for another decade.

In 2000, the Berlin Senate allocated €2 million to the design of Park am Nordbahnhof, the brief of which prioritised biological conservation alongside the construction of a new urban park. German landscape architecture firm Fugmann Janotta was selected to produce Nordbahnhof's concept design. Lead landscape architect Harald Fugmann notes that the limited finances "awoke… a new drive to be more resourceful, to use materials we found on the site, and a new sensitivity to preserve the traces of

history."[26] The scheme explored the location's ecological and atmospheric qualities – and its evolution during the Cold War – to inform the spatial and ecological approach. This design responded to three key principles that the landscape architects outlined in the Park am Nordbahnhof documentation package,[27] which they delivered to the State of Berlin's Department for Urban Development (the clients). The document explained how the proposal would conserve Nordbahnhof's biodiversity; protect the site's cultural heritage as a monument to the Berlin Wall; and preserve the "openness of the meadows" and "view of the city."[28]

The constructed scheme emerged as a spontaneous meadow dissected by linear paths and railings. This network directs users through a grassland of "annual ruderal, perennial thermophilic, semi-arid and sandy-arid" plants and along the old route of the Berlin Wall, as shown in Figure 4 – a plan drawing of the concept design.[29] Three playgrounds were constructed inside the meadows to establish closer proximity between the site's social and ecological systems while accommodating the brief's main objective, conservation and views toward central Berlin. As Fugmann explains, Nordbahnhof's "ecological importance should be noticeable to those who visit", yet "flexible" enough to "incorporate new traces of history", such as novel recreational pursuits.[30]

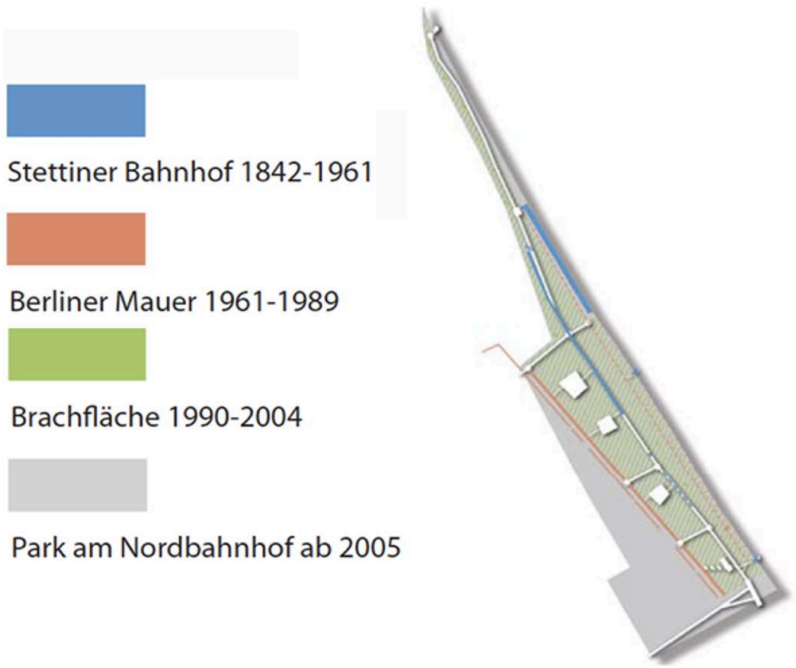

Figure 4. Park am Nordbahnhof plan diagram.
Drawing by Fugmann Janotta 2009.

The concept for Park am Nordbahnhof embodies Wilson's notion of biophilia by preserving and integrating the site's spontaneous ecology through design. Rather than replacing the biodiverse meadows that emerged during the landscape's abandonment, the design protects endangered plant assemblages while creating new opportunities for human activity. This approach encourages park users to directly engage with the design's grassland ecosystems, fostering what Wilson describes as affiliating with other life forms – an inherently biophilic association.[31] In this way, Park am Nordbahnhof is more than a novel park; it is an open-ended living system that succeeds alongside park visitors, offering a model for how urban landscapes can facilitate extreme biodiversity and a human desire for ecological connection in cities.

Experiencing Park am Nordbahnhof's Biophilic Performances

Upon entering Nordbahnhof, one becomes aware of Fugmann Janotta's engagement with the site's ecological heritage, notably the spontaneous meadow. All aspects of this biome, its unruly composition and unkempt aesthetic, reinforce the degree of ecological processes that are experienced within the park. Users are guided towards and around the meadows by linear paths and railings. The barriers encourage observation while protecting the interior grasslands from park users, as shown in Figure 5. As Fugmann notes, they are designed to be "comfortable… to put your hands on" and contemplate "the vegetation"; this vantage point, he believes, means the public can "think about what they see in the area" and become "sensitive" to Nordbahnhof's ecological system.[32] This experience balances the design brief's priorities of ecological conservation, recreation and heritage protection.

Figure 5. Traversable railing surrounding the central spontaneous meadow. Photograph by B Greene 2019.

While operating as a conservation measure, observing the park in 2019 suggests the rail design is breached by users. As shown in Figure 6, unplanned paths have emerged across Nordbahnhof, including within the internal meadows. Acknowledging this performance, Fugmann believes "there is no possibility" to stop people entering; instead, he sees the design as encouraging the development of personalised user experiences of Nordbahnhof's ecology as one decides whether or not to enter the protected landscape.[33]

Human engagement of Nordbahnhof's meadow is extended through three square islands inserted into the centre of the park, as shown in Figure 7. These islands reflect the landscape architect's previous comments of incorporating new historic and activity layers through design. As he explains the concept behind the islands as being "reached by a boat… so, we constructed these small bridges from the main path" that protect plants from treading and produce a prominent "artificial contrast" to the unruly living materials.[34] He considers the islands as moments to develop novel ecological values, explaining that it is very valuable "for children to see what nature in the city is and to visit these types of open spaces. I think it is worth it, for itself, that these kinds of spaces were protected for the future."[35] This design approach reflects biophilia philosophy by providing direct encounters with Nordbahnhof's living systems while aiming to conserve the park's biodiversity.

Figure 6. Un-designed interior path networks of Nordbahnhof, which are made by park users crossing the fences and walking across the interior meadows.
Photograph by B Greene 2019.

Figure 7. An example of one Nordbahnhof island with play and picnic areas.
Photograph by B Greene 2019.

CONCLUSION

This research demonstrates how Berlin's post-war conditions influenced novel approaches to urban ecology across science, design, and philosophy. The creation of wasteland spaces through war and spatial division fostered the emergence of spontaneous ecosystems, most notably Fourth Nature, which has since been reconceptualised through philosophical discourse and landscape practice. Within this eco-cultural context, Park am Nordbahnhof exemplifies a biophilic interface between landscape architecture, ecological design, spontaneous ecology, and human occupation. By engaging with the site's cultural and ecological histories and integrating opportunities for human occupation and exploration, the project offers a transferable framework for reimagining abandoned or vacant urban sites, showcasing how biophilic design can respond to the specific social and environmental conditions of dense metropolitan contexts.

NOTES

[1] Joseph Pearson, *Berlin*, Cityscopes, (London: Reaktion Books, 2017), 89.
[2] H. Sukopp, H. P. Blume, and W. Kunick, "The Soil, Flora and Vegetation of Berlin's Waste Lands," in *Nature in Cities*, ed. Ian C. Laurie (Chichester, New York: Wiley, 1979), 117.
[3] Jouni Häkli, "Culture and politics of nature in the city: The case of Berlin's "green wedge"," *Capitalism, nature, socialism* 7, no. 2 (1996): 128, https://doi.org/10.1080/10455759609358686.
[4] Ingo Kowarik, interview by Brent Greene, Berlin, October 6, 2014.
[5] Kowarik, Interview.
[6] Jens Lachmund, *Greening Berlin: The Co-Production of Science, Politics, and Urban Nature*, Inside Technology, (Cambridge: The MIT Press, 2013), 45.
[7] Sukopp's ecological practice began in the 1950s when he studied botany, geology and sociology before being awarded a PhD in 1958 from the Free University of Berlin. During the 1960s and 1970s Sukopp held several academic positions including professor at the Technical University of Berlin (TU Berlin), a role that later evolved into a full Professorship and head of the Department of Cosmology and Vegetation Science at the Institute of Ecology.
[8] Lachmund, *Greening Berlin: The Co-Production of Science, Politics, and Urban Nature*, 47.
[9] Sukopp, Blume, and Kunick, "The Soil, Flora and Vegetation of Berlin's Waste Lands," 127-30.
[10] Sukopp, Blume, and Kunick, "The Soil, Flora and Vegetation of Berlin's Waste Lands," 121.
[11] Wolfram Kunick, "Veränderungen von Flora und Vegetation einer Großstadt : dargestellt am Beispiel von Berlin (West)" (1974).
[12] Kowarik researched under Sukopp at TU Berlin's Institute of Ecology in the 1980s and succeeded him as a Professor after Sukopp retired in 1995.
[13] Previously a marshalling yard, Natur-Park Schöneberger Südgelände was abandoned in 1952 and fenced off from the public. This isolation supported the process of succession evolving the site into a spontaneous urban grassland and a mature forest. However, in the 1970s the government planned to re-establish train services through Südgelände and local nature enthusiasts, anticipating the ecosystem's destruction, pressured the authorities to conduct a survey that revealed the landscape was immensely biodiverse and ecologically valuable. Consequently, Südgelände was legislated by the Berlin Senate as an urban wilderness and re-opened to the public in 2000, a moment that reinforced the biological significance of spontaneous ecology in Berlin's landscape discipline.
[14] Ingo Kowarik, "Cities and wilderness. A new perspective," *International Journal of Wilderness* 19 (12/01 2013): 33.
[15] Ingo Kowarik, "Unkraut oder Urwald? Natur der vierten Art auf dem Gleisdreieck," (1991), 49.
[16] Kowarik, Interview.
[17] Kowarik, Interview.
[18] Holle Thierfelder, interview by Brent Greene, Berlin, October 14, 2014.
[19] Kowarik, Interview.
[20] Ingo Kowarik and Stefan Körner, *Wild Urban Woodlands: New Perspectives for Urban Forestry*, 1. Aufl. ed. (Berlin, Heidelberg: Springer-Verlag, 2005).
[21] Edward O. Wilson, *Biophilia* (Cambridge, UNITED STATES: Harvard University Press, 1984), 1. http://ebookcentral.proquest.com/lib/rmit/detail.action?docID=3300337.
[22] Wilson, *Biophilia*, 120.
[23] Fugmann Janotta, *Pflegekonzept zur Entwicklung der Parkanlage am Nordbahnhof in Berlin Mitte* (Berlin, 2008), 8.
[24] Till Rehwaldt, "Fugmann Janotta Landschaftsarchitektur und Landschaftsplanung bdla - Park am Nordbahnhof, Berlin / Fugmann Janotta Landschaftsarchitektur und Landschaftsplanung bdla - Park am Nordbahnhof, Berlin," (Berlin, Boston: DE GRUYTER, 2011), 54.
[25] Harald Fugmann, interview by Brent Greene, Berlin, October 8, 2014.
[26] Fugmann, Interview.
[27] Fugmann Janotta, *Park am Nordbahnhof* (Berlin, n.d). This document was shared with the author directly during the interview process.
[28] Janotta, *Park am Nordbahnhof* 3.
[29] Janotta, *Pflegekonzept zur Entwicklung der Parkanlage am Nordbahnhof in Berlin Mitte* 10.
[30] Fugmann, Interview.
[31] Wilson, *Biophilia*, 85.

[32] Fugmann, Interview.
[33] Fugmann, Interview.
[34] Fugmann, Interview.
[35] Fugmann, Interview.

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IS THE GREEK CITY A 15-MINUTE CITY?

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INTRODUCTION

Greek cities exhibit unique characteristics that can serve as catalysts for implementing the polycentric city model as a means to enhance urban sustainability. This paper explores how Greece's urban structure, historical development, and land-use patterns create both challenges and opportunities in adopting this model. While Greek cities inherently possess mixed-use neighbourhoods, which align with the core principles of polycentricity, persistent urban issues such as inefficient mobility networks, fragmented governance, and limited public participation hinder progress.

The study examines global case studies, particularly the 15-minute city model implemented in Paris and assesses its applicability within the Greek context. Key factors, including mobility strategies, land-use policies, and citizen engagement, are analysed to determine their feasibility in Greek cities. Furthermore, the research highlights the importance of fostering local adaptation rather than direct replication of international models.

Findings indicate that while Greece has a comparative advantage in certain aspects of polycentric urbanism, targeted interventions are required to address existing urban shortcomings. These include strengthening sustainable mobility infrastructures, preserving the diversity of urban functions, and fostering public participation in planning processes. Ultimately, the study advocates for a strategic, context-specific approach to integrating polycentric principles into Greek urban environments, ensuring resilience, sustainability, and improved quality of life for residents.

Context of model emergence

The 15-minutes city model was recently revisited as an option for the city operation as a response to the modern city challenges. Its main principles incorporate new technologies and a user-oriented approaches to foster greener, environmentally friendly urban spaces that help combat climate change and reduce energy consumption in the urban space. Given the urgent need to transition toward a more sustainable environment and a user-friendly urban structure aligned with the principles of sustainable development, this moder creates a polycentric urban layout - with mixed-use zones and extensive connectivity – that leads to a new urban landscape tailored to 21st-century environmental requirements. Cities worldwide, each with unique characteristics, are moving in this direction. Notable examples include Melbourne, Australia;[1] Ottawa, Canada;[2] Shanghai, China;[3] and Bogotá, Colombia.[4] In Europe, Spain, Italy, and France have also initiated similar projects. A particularly significant case study in promoting the polycentric city in Europe is the "15-minute city" concept in Paris. Since 2019, under the leadership of Mayor Anne Hidalgo and urban planner Carlos Moreno - the concept's primary proponent - the city has been rapidly redesigning its public spaces to prioritize sustainable mobility and

environmentally friendly transportation. The implementation of this model in Paris has provided valuable insights into both the successes and challenges of its application, which can serve as valuable input for strategy formation in other cities[5] (Figure 1).

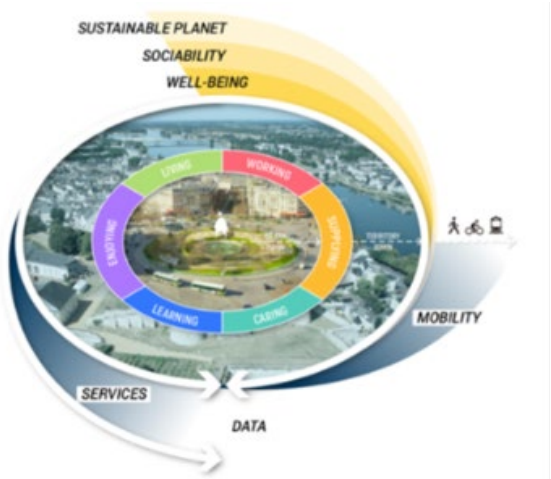

Figure 1. Moreno's representation of the 15-minute city principles[6]

MODEL DISCRIPTION

Main principles

Moreno's strategy is structured around two key axes: Mobility and Services, aiming to achieve the triad of sustainability - social cohesion - well-being. His approach suggests that rather than focusing solely on eco-friendly transportation, efforts should be directed toward reducing the need for mobility altogether. This principle is operationalized by ensuring that essential daily needs can be met within short distances from residential areas. The fundamental principles of the model is the creation of "walkable" cities that enable residents to meet their predefined daily needs within close proximity. To achieve this, the primary challenges that must be addressed include the development of safe routes and the concentration of land uses that accommodate essential functions such as education, commerce, employment, leisure, and (potentially) administration in a central and easily accessible location.

Beyond meeting essential needs (services), mobility is the second key pillar of the strategy. The objective is to connect urban functions by creating safe routes to and from neighborhood centers, with a strong emphasis on promoting sustainable mobility principles. Taking Paris as an example once again, the traffic-related changes introduced during the pandemic - when car usage was already reduced - have been reinforced and now constitute the city's primary urban planning strategy.

4+1 key components

According to Moreno, in order for these basic daily needs to be met, the subunit of the city should have four main characteristics: proximity, diversity, density, and ubiquity.[7] These characteristics should be concentrated in areas of the city that operate around a centrality, a core of this unit that provides 15-minute mobility. In several cases, as well as Paris, emerging new centers are proposed to be structured around educational institutions, as their spatial distribution has already taken into account both population density as well as the city's needs within a small radius.

In terms of available uses within this radius, Moreno identifies six fundamental everyday needs that should be accessible within close proximity: residence, work, commerce, healthcare, education, and leisure. Considering that walkability and sustainable mobility of a major part of the strategy in order to

achieve accessibility, this paper adds one more main characteristic to the four already mentioned above, connectivity. This component constitutes a major part of the already ongoing strategy in Paris[8] and in other case studies and needs to be examined additionally and thoroughly, as for several cities, it proves to be a very challenging factor. The factors “proximity” and “density” seem to be closely related and often present at the same time. The same assumption can also be made between “diversity” and “ubiquity”. However, all four of them need to be closely related to “connectivity” as without this component, the user loses the ability to benefit from the presence of the rest. This proves that connectivity not only is an extra factor that needs to be added in the strategy and examined separately, it appears to be the most needed in order to implement the 15-minutes city model.

EXAMINATION OF THE GREEK CITY

Level of compliance with the strategy

In order to determine if and at which level the Greek city is a 15-minutes city we need to examine the level of compliance with the 4+1 components presented in the strategy as set above.

Proximity

The term proximity refers to the time needed to get from the users’ residence to the place where every day need is covered. This amount of time usually refers to walking, but it can also include the use of non-engine operating vehicles such as bicycles, scooters etch. In this case, the 15 minutes mark is used as a time of reference, however scientific dialogue also includes 10 minutes, 20 minutes or the X minutes city. Time precision is irrelevant in this topic and we choose to move forward with the 15 minutes city, however the evaluation can be performed for every option of the X minutes city.

Proximity is closely related to the city scale. Small scale city blocks and small-scale constructions can lead to a more walkable formation within the urban fabric. The Greek city due to its peculiar history of forming and expanding, that lead to small scale city blocks, smaller constructions and multiple ownerships per building, can provide a walkable urban fabric in terms of scale and proximity. For reference, a 500m radius in Paris can extend to two city blocks, whereas in Kypseli, Athens, to up to ten blocks as demonstrated in Figure2. This is indicative of a city formation closer to the human scale that could promote easy access to multiple functions of the city if utilized appropriately. It is thus safe to assume that “proximity” can be present in the Greek city.

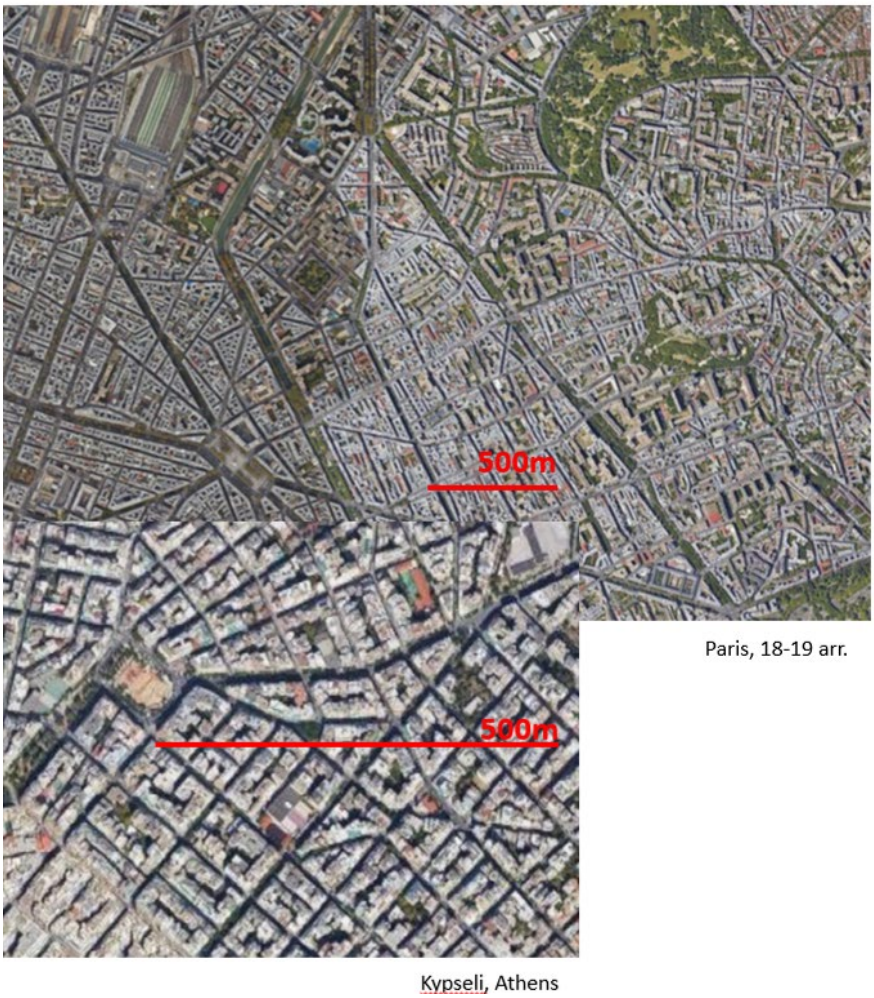

Figure 2. 500m radius in Paris, France compared to Athens, Greece

Density

The term density can be referred to as the "compact city". We need to examine if the Greek urban fabric is coherent and functioning. Greek cities inherently possess this small-scale, mixed-use characteristic, a byproduct of land development processes in the past century. During Greece's urban expansion, the absence of a coordinated city planning strategy allowed small landowners to develop their properties autonomously, leading to the mosaic of land uses and ownership seen today. This is also the reason most Greek cities suffer from lack of open green spaces. However, apart from the immediate need to create more public spaces in the city, this characteristic of the dense and diverse urban fabric can serve as an advantage in adopting the 15-minute city model, a major challenge for many European cities designed under modernist planning principles that emphasize strict zoning.

Diversity

Building on the previous arguments, the multiple ownership led to several uses being introduced to the small units constructed as the Greek city expanded. The usual practice of "antiparochi", that was the main means of space production during the 20th century in Greece, often included the construction of a block of flats with a small shop on the ground floor, particularly in central areas of the city. This created a large variety of land uses in the Greek city, a characteristic that is still present and very indicative of the Greek everyday life (Figure 3). This formation is far from the zoning practices of the modern

movement in urban planning that strictly predetermined the land use of large areas and was largely used in the development of the European cities after the 1930s.

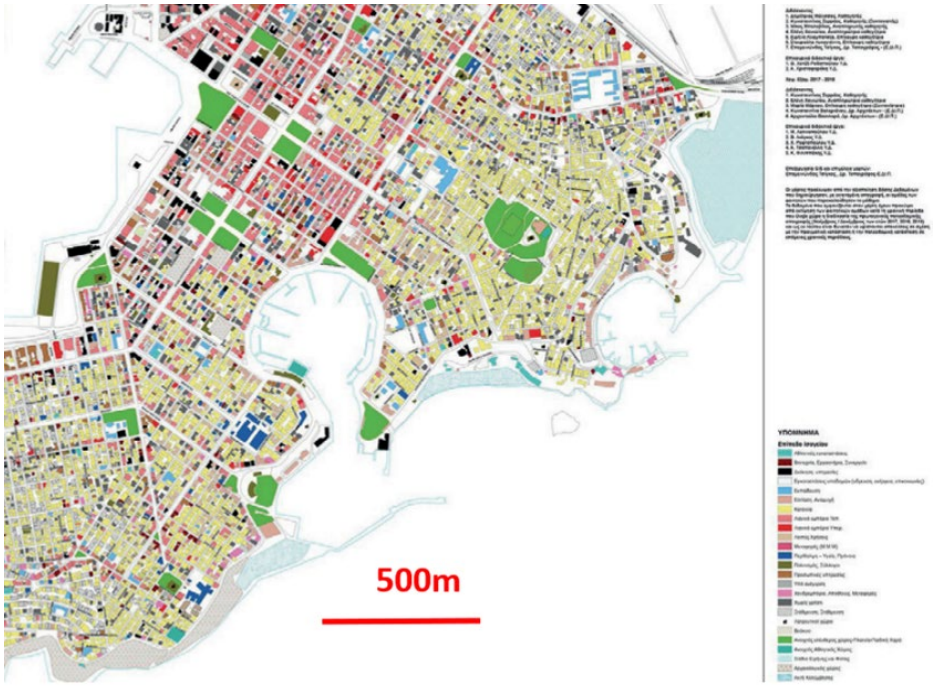

Figure 3. 500m radius in Piraeus and Ground floor Uses, NTUA, 2021

Ubiquity

As mentioned before, ubiquity is closely related to diversity and therefore it is easy to understand that since the Greek city was developed following a specific pattern, the characteristic of mix uses found in a small-scaled area is present in the vast majority of cases. This is also shown in the example of Municipality of Piraeus, as displayed in Figure 3. On this map, we can identify mix of uses throughout the Municipality and not only at the central area around the port as expected. When looking into other areas of Athens or other Greek cities, we get the same picture on a bigger or lesser extent.

Connectivity

We observed through a brief analysis that the four initial parameters, as set out by Moreno, are satisfactorily met by the Greek city. However, we must now examine the fifth parameter, which has been added here and is considered a necessary condition for the smooth functioning of the 15-minute city model: connectivity.

Connectivity has always been a significant challenge within the Greek urban context. With a fragmented and insufficiently designed public space, fast and safe pedestrian mobility is often a luxury in everyday life.

According to the theory on which we base our analysis, an easy and safe connection must be achieved among the following six functions: living, working, leisure, education, supplies, and healthcare.

But how can such a connection be ensured once we have achieved the concentration and presence of these functions within a reasonable distance from one's residence? In most European cities, residents benefit from the availability of an extensive and reliable public transportation network. Unfortunately, in Greece, this option is often marginalized, as the available network is not only extremely limited but also unreliable and ineffective (Figure 4).

Without the necessary frequency and punctuality, public transport is not the preferred option for users in Greek cities—especially when the alternative of a private vehicle is available.

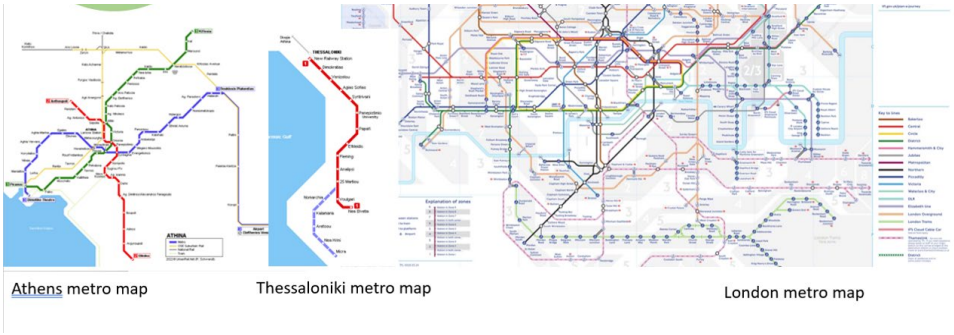

Figure 4. Comparison of Athens, Thessaloniki and London metro maps

Another alternative to discourage the use of private vehicles is the creation of sustainable mobility routes that promote walking, cycling, and the use of other non-motorized means of transport. Such an extensive network could form a strong foundation for the implementation of the 15-minute city strategy and, as we have seen in the example of Paris, it is a key priority in this direction (Figure 5).

Figure 5. Paris sustainable mobility interventions (2024)

Unfortunately, in the case of the Greek city, we find that even this alternative cannot support the safe mobility of pedestrians. Especially in city centers, there is often no available space for the development of sidewalks, and even when they do exist, they are either occupied by other uses or are not treated with the respect they deserve as public space (Figures 6, 7).

Therefore, despite the fact that Greek cities are preparing sustainable mobility plans and attempting to align with the directives of both the European Union and the needs of the modern city, we observe that the outcomes of these strategies are not yet visible—and cannot yet be leveraged in the implementation of the 15-minute city model.

Connectivity, therefore, remains a parameter that is not fulfilled in this context.

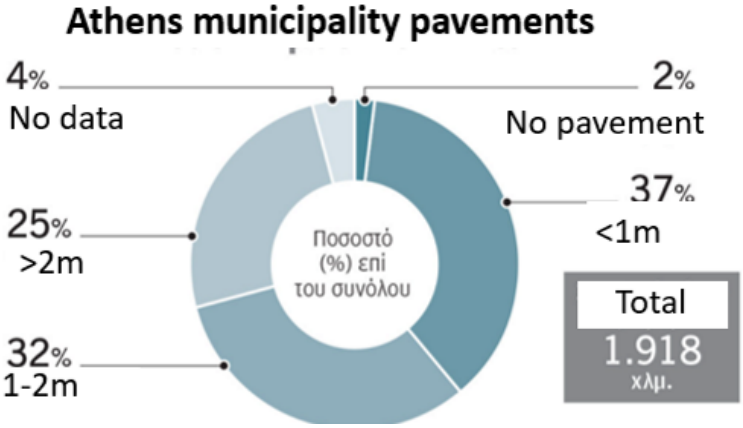

Figure 6. Athens Municipality pavements[9]

Figure 7. Athens Municipality pavements

Can we tackle the absence of the +1 component?

Can we work around the fact that the Greek city is still far from being able to offer fast and safe pedestrian mobility for daily needs?

Beyond the obvious solution, -which calls for the smooth and extensive development of a public transportation network, as well as the gradual reclaiming of public space and regulation of sidewalks and other pedestrian routes-, a more immediate measure would be to limit the need for long-distance travel altogether.

The largest portion of time spent by the average user in a car is typically devoted to commuting to and from work (Figure 8).

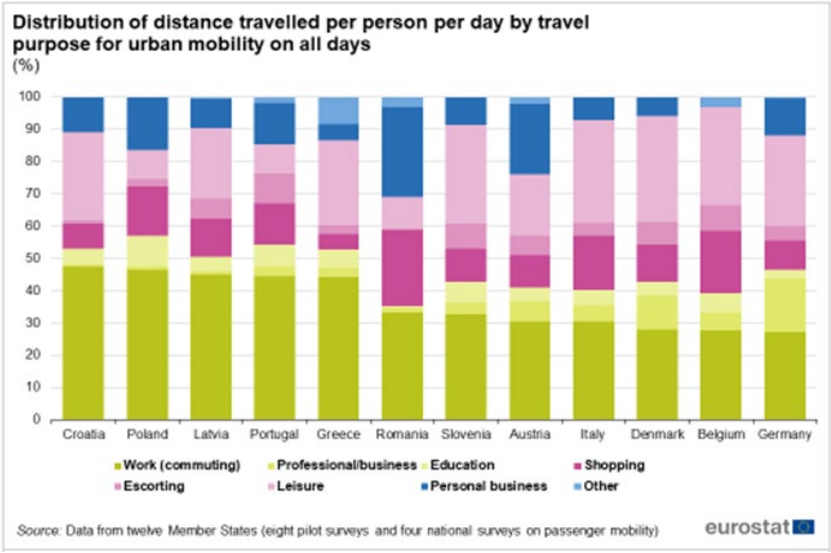

Figure 8. Distribution of distance travelled by purpose[10]

However, the experience of the COVID-19 pandemic demonstrated that a significant number of employees can work remotely with equal efficiency. At the same time, this period marked the gradual rise of co-working spaces—shared environments where individuals can work independently of their employer's physical office location. (Figures 9, 10)

This practice could serve as an immediate and practical solution to reducing daily car use. One could, for example, propose the strategic placement of co-working spaces throughout the city, designed to accommodate workers from the surrounding area within a 15-minute radius.

Specifically, the use of shared spaces is recommended over working from home, in order to avoid several of the issues identified during the pandemic—such as social isolation, increased personal costs, inadequate space or equipment, and so on.

Figure 9. Co working space advertisement, Lisbon, Portugal (2025)

			5-Year growth 2017 to 2021	2022 growth Based on 1mo of data + (!) COVID	2021 growth (!) COVID	2020 growth (!) COVID	2019 growth	2018 growth	2017 growth	NL rank	All green (except 2020 COVID)
#1	Playa del Carmen	Mexico	+228%	+300%	+94%	+82%	+50%	-27%	+41%	#14	
#2	Medellín	Colombia	+205%	+689%	+98%	-58%	+13%	+28%	+54%	#47	
#3	Canggu, Bali	Indonesia	+195%	+714%	-57%	-50%	+29%	+49%	+114%	#11	
#4	Athens	Greece	+194%	+161%	+98%	-46%	+7%	+51%	+27%	#163	
#5	Lisbon	Portugal	+194%	+414%	+87%	-34%	+39%	-8%	+61%	#1	
#6	Mexico City	Mexico	+185%	+408%	+108%	-13%	+22%	+36%	+38%	#29	
#7	Porto	Portugal	+148%	+125%	+155%	-52%	+15%	+33%	+26%	#5	
#8	Rome	Italy	+126%	+320%	+81%	-67%	+37%	-5%	+13%	#612	
#9	Vienna	Austria	+122%	+112%	+43%	-67%	+4%	+30%	+19%	#93	
#10	Munich	Germany	+120%	+155%	+22%	-52%	+34%	-22%	+36%	#116	

Figure 10. Established remote working hubs, Growing destinations, D. Pettas 2025

CONCLUSION

As demonstrated by both empirical evidence and Moreno's own advocacy, the 15-minute city model - designed to enhance urban quality of life - must be adapted to the unique socio-economic, cultural, and spatial characteristics of each city[11]. The Parisian model, while a compelling prototype, cannot be directly replicated in every urban setting. Flexible and adaptive approaches are required to account for local particularities and priorities.

What is the case for Greece, however? The assessment of the Greek city through the lens of the 15-minute city model reveals a mixed landscape of strengths and challenges. Four out of the five key components proposed by Moreno—**proximity, density, diversity, and ubiquity**—are inherently present in the Greek urban fabric due to its historical development patterns. The application of the 15-minute city model to the Greek urban context reveals a landscape characterized by both structural advantages and critical limitations. Historical patterns of urban development—marked by small plot subdivisions, fragmented land ownership, and incremental construction practices—have given rise to compact and diverse urban forms. These forms support proximity, density, diversity, and ubiquity, four of the five key components identified as essential to the 15-minute city framework.

However, the fifth and newly introduced component, connectivity, remains largely unmet and represents the most significant barrier to the implementation of the model in the Greek context. In the Greek city connectivity is not only underdeveloped but often actively hindered by fragmented public space, a lack of pedestrian infrastructure, and unreliable public transport. While urban functions may exist in close proximity, the ability to move safely and efficiently between them is far from guaranteed. Public transport networks, where available, are often insufficient in terms of coverage, frequency, and reliability. Meanwhile, pedestrian infrastructure remains limited or obstructed, particularly in dense city centers where sidewalks are narrow, encroached upon, or poorly maintained. These issues prevent residents from fully benefiting from the spatial proximity of services and amenities.

To address this gap, two interrelated strategies appear particularly promising. On the one hand, there is a clear need for physical improvements to mobility infrastructure, including the expansion and optimization of public transportation systems and the reclamation of public space for non-motorized modes of transport. On the other hand, reducing the need for mobility altogether offers an alternative approach that is both practical and more immediately attainable. The COVID-19 pandemic demonstrated the viability of remote work for a large segment of the workforce, while also accelerating the establishment of co-working spaces as flexible, decentralized alternatives to the traditional office.

These shared environments can help reduce long-distance commuting and support the logic of the 15-minute city when strategically located within urban neighborhoods. Unlike working from home, which introduced several social and logistical challenges during the pandemic, shared workspaces offer structured and professional environments without the burden of daily travel. Therefore, by embracing new models of work and redefining commuting needs, cities may partially compensate for the current lack of connectivity.

Discussion

The findings of this study suggest that Greek cities are, in many respects, structurally aligned with the principles of the 15-minute city model, particularly when it comes to urban form and land-use distribution. However, structural potential does not necessarily translate into functional reality. The presence of proximity and diversity within the urban fabric does not guarantee accessibility if the connective tissue—both physical and infrastructural—is weak. This distinction is crucial in assessing the applicability of internationally derived urban models within local contexts.

What the Greek case illustrates is the importance of treating models such as the 15-minute city not as fixed blueprints but as adaptable frameworks. The Parisian example, while pioneering, cannot be directly transferred to cities with entirely different governance structures, spatial constraints, and socio-political cultures. In Greece, any attempt to implement the model must account for the limits of existing infrastructure, the cultural norms surrounding car use, and the persistent underfunding of public transport and pedestrian facilities.

At the same time, the Greek context offers an important counter-narrative to dominant planning paradigms that often associate urban sustainability with large-scale redesign or technological innovation. The qualities of proximity, density, and mixed-use diversity, so often lacking in post-war European cities built under modernist planning regimes, are already present in Greek cities. What is missing is not so much the spatial condition, but the policy coordination and infrastructure required to make it function effectively. Looking ahead, it is evident that improving connectivity—both by enhancing physical mobility and by reducing the need for travel—is essential.

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15-MINUTE CITIES: RETHINKING MOBILITY AND EQUITY IN URBAN PLANNING

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INTRODUCTION

Cities around the world are facing increasing challenges related to automobile dependency, climate change, air pollution, and social inequalities.[1] Car-oriented urban development through on-road transportation contributes significantly to CO_2 emissions,[2] urban sprawl,[3] and negative public health outcomes, including increased sedentary behaviour, respiratory and cardiovascular illnesses, and traffic injuries.[4] A growing body of research shows that urban and transport planning decisions such as road layout, traffic density, and distance to major roads influence environmental exposures including air pollution, noise, and heat. These exposures affect population health more broadly and are not limited to drivers or road users.[5] Studies on car-free or low-car neighbourhoods have shown substantial health benefits such as reduced NO_2 and noise pollution, higher levels of physical activity, improved access to green space, and ultimately lower morbidity and mortality.[6] For example, case studies of traffic interventions in European cities suggest that reducing NO_2 exposure through (permanently implemented) car-free days could lower incident paediatric asthma by up to around 30 percent in high-traffic zones.[7]

The concept of the 15-minute city

A widely discussed model in contemporary urban planning is the fifteen-minute city, introduced by Carlos Moreno and colleagues. This concept proposes that residents should be able to access all essential services including housing, work, healthcare, education, shopping, and leisure within a fifteen-minute walk or bike ride.[8] It is based on principles such as proximity, mixed land use, compact development, and local density.[9] During the COVID-19 pandemic, the relevance of local living became especially clear as many communities relied on nearby services and adopted active modes of travel.[10] Several cities, including Paris, Brussels, Milan, and Barcelona, have integrated the concept into their urban planning agendas.[11] However, critics have pointed to seven key pitfalls in the 15-minute city framework, such as overstated originality, unrealistic decentralization, aggregation biases, neglect of public transit, and disregard for interpersonal mobility differences. Mouratidis[12] argues that without addressing these gaps, the model risks overlooking the complexity of equity and access in practice.

From vision to Evidence

Despite its appeal, the fifteen-minute city remains underexplored in terms of empirical evaluation. Most studies to date are conceptual or based on selected case studies in large cities.[13] More systematic, population-level analysis is needed to determine whether accessibility indicators linked to the 15-minute

city are genuinely associated with lower car ownership and more equitable access to services.[14] Research also indicates that accessibility alone does not ensure equity. Disadvantaged communities are often more exposed to air pollution than more affluent areas, although recent policies such as low-emission zones have shown disproportionately positive effects in those same neighbourhoods.[15] In Belgium, existing studies have identified relationships between car ownership and income, education, or region, but rarely combine these with fine-grained spatial accessibility measures or deprivation indices.[16]

Aim and contribution of this study

This paper investigates the relationship between two indicators of local accessibility, namely walkability, the national Mobiscore index and household car ownership and socioeconomic deprivation across Belgium. We examine whether higher accessibility correlates with lower car dependency, using both descriptive correlations and regression models adjusted for socioeconomic deprivation. To explore potential contextual differences, we compare patterns across urban, suburban, and rural municipalities and assess whether associations between accessibility and car ownership vary by settlement type. In addition, we examine whether certain effects only emerge once a sufficient level of accessibility is reached. As a secondary analysis, we explore the link between car ownership and health outcomes, focusing on diabetes prevalence as a proxy for indirect public health effects, again adjusting for deprivation.

DATA AND METHODOLOGY

Data: accessibility indicators

To assess local accessibility in line with the 15-minute city concept, we used two complementary indicators: walkability and Mobiscore. Each captures a different aspect of how easily people can reach key destinations without relying on a car.

Walkability was measured using the official score developed for Flanders and Brussels by the Flemish Institute for Healthy Living in collaboration with the Flemish Department of Environment, the Agency for Care and Health, and VITO. The score is calculated for each statistical sector and integrates three components: street connectivity, residential density, and function mix. All are computed within a 1 km network distance using the 2019 version of the Belgian road registry (Wegenregister), which serves as the basis for pedestrian-accessible infrastructure.[17]

The walkability score is computed using the following formula:

$$\textit{Walkability score} = (\textit{street connectivity} \times 2) + \textit{function mix} + \textit{residential density} \quad (1)$$

Each subcomponent is normalized using z-scores, and street connectivity is given double weight. The resulting score is a relative index that compares each neighbourhood to others in Flanders and Brussels. Higher scores indicate better pedestrian accessibility. However, no absolute thresholds are defined for what constitutes high or low walkability.

It is important to note that the score reflects only structural aspects of the built environment. It does not include qualitative features such as sidewalk presence or condition, traffic safety, lighting, or greening, even though these may strongly affect actual walking behavior.[18]

Mobiscore is a composite accessibility indicator developed by the Flemish Department of Environment and calculated by Transport & Mobility Leuven (TML). It evaluates the extent to which a household can meet its daily mobility needs via sustainable modes such as walking, cycling, or public transport. The score incorporates spatial data on population density, public transport access, and service availability, and produces a score from 0 to 10.[19] Higher scores reflect lower expected car dependency and a lower environmental impact of travel behaviour. The Mobiscore data are publicly available at the address level and have been aggregated to the statistical sector level for this study.

Data: Socio-economic Deprivation

We incorporate the Belgian Index of Multiple Deprivation (BIMD) as our measure of neighbourhood-level socioeconomic disadvantage. The BIMD provides a multidimensional indicator of deprivation at the statistical sector level, combining six thematic domains—income, employment, education, housing, crime, and health—into a single composite score. These scores are then ranked and divided into deciles, where decile 1 represents the most deprived 10 percent of areas and decile 10 the least deprived.[20]

We use the most recent version of the BIMD, based on the 2011 population census. More recent deprivation indices are not yet publicly available at the statistical sector level. In our analyses, BIMD serves both as a standalone measure of spatial inequality and as a control variable in regression models exploring associations between accessibility indicators (walkability and Mobiscore), household car ownership, and health outcomes. In this way, the BIMD helps account for socioeconomic confounding in both mobility and health-related analyses.

Data: Cars owned per household

We use official data from Statbel reporting the average number of cars per household at statistical sector level for the year 2021. The data include both privately owned and company cars, and are considered the most reliable national estimate of household car ownership.[21] This indicator allows us to assess spatial variation in motorisation and explore how car ownership relates to accessibility and deprivation.

Data: Diabetes Prevalence

To explore the relationship between accessibility and public health, we use diabetes medication consumption as a proxy indicator for the prevalence of type 2 diabetes at neighbourhood level. Data were obtained from the IMA-Atlas Gezondheid en Zorg, a national open-access health data portal managed by the Intermutualistic Agency (IMA).[22] Specifically, we use the indicator "Prevalentie van personen met een terugbetaling voor minstens twee verstrekkingen van antidiabetica," available at statistical sector level for the year 2021. This variable reflects the proportion of the population receiving reimbursement for at least two dispensations of antidiabetic medications (ATC code A10), and has been widely used as a reliable ecological indicator of diagnosed diabetes prevalence. It captures diagnosed and pharmacologically treated cases, predominantly type 2 diabetes, and is corrected for age standardization. Although medication-based proxies have limitations: e.g., not all cases may be diagnosed or treated pharmacologically, they provide a consistent, population-wide measure that allows for spatial comparisons across Belgium.

Methodology: Analytical approach

Our analytical strategy proceeds in four steps. First, we use LOESS-based visualizations to explore bivariate associations between spatial accessibility indicators (walkability and Mobiscore) and socioeconomic deprivation, as well as between deprivation and car ownership. These contextual plots provide intuitive insights into the social and spatial patterning of our key variables. To visualise potential non-linear associations between BIMD and the outcome variables, we applied locally estimated scatterplot smoothing (LOESS) with 95% confidence bands. Second, we fit multivariate regression models to estimate the relationship between spatial accessibility indicators and household car ownership, while controlling for area-level deprivation (BIMD). Third, we stratify these regression models by municipality to assess whether the strength of association between accessibility and car ownership varies between urban and smaller cities. The resulting coefficients and confidence intervals are compared visually across municipalities. Fourth, we conduct an exploratory case study using type 2 diabetes prevalence as a health outcome. We first show bivariate relationships between diabetes, deprivation and accessibility using LOESS plots. We then estimate two regression models with diabetes

prevalence as the dependent variable: one with Mobiscore, and one with car ownership as explanatory variables. All models adjust for area-level deprivation using the BIMD.

RESULTS

Context: Relation between BIMD and Car Ownership, Accessibility and Diabetes

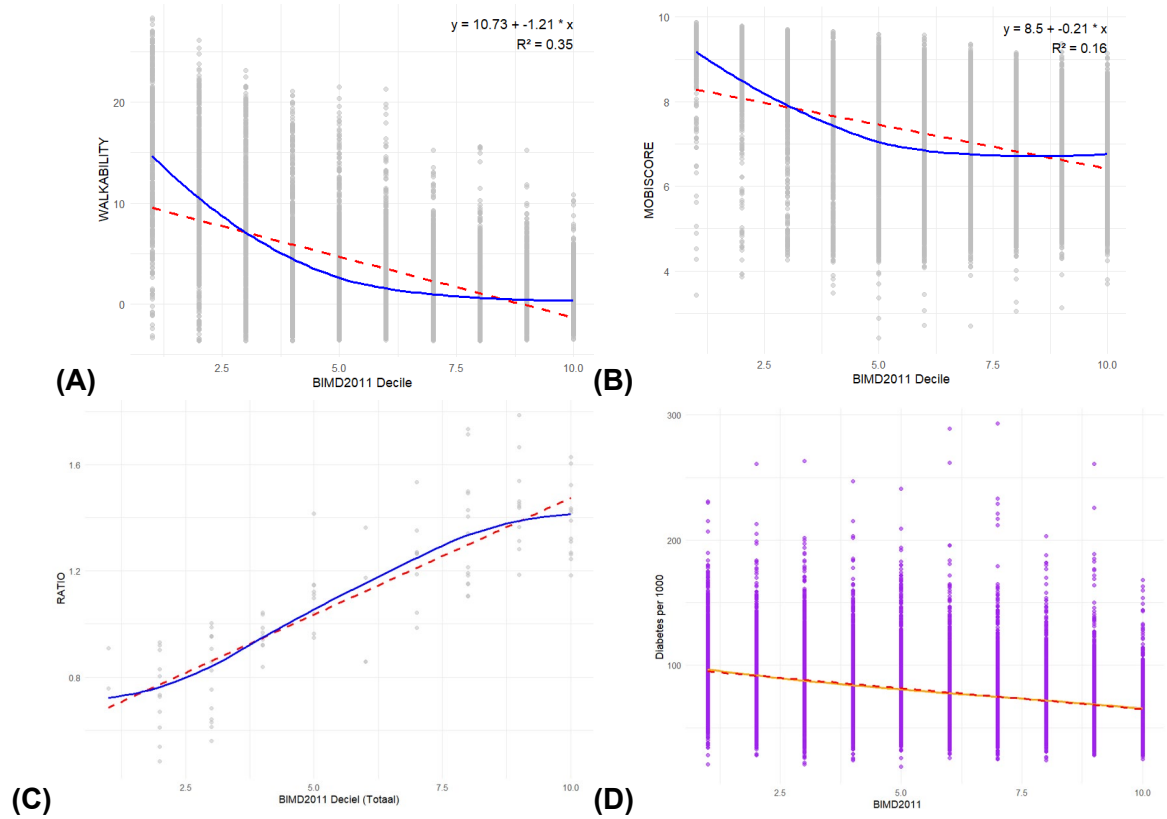

Figure 1. Socio-economic deprivation. Relation between BIMD 2011 and other variables: (a) BIMD vs. walkability (b) BIMD vs. MOBISCORE (C) BIMD vs. RATIO numbers of cars owned per household (D) BIMD vs. Diabetes prevalence per 1000 people.

Before examining the associations between accessibility indicators, car ownership, and health outcomes, it is important to situate these variables within their socio-economic context. Figure 1 shows the bivariate relationships between the Belgian Index of Multiple Deprivation (BIMD 2011; low values indicate high deprivation, high values indicate low deprivation) and four key variables. Walkability (Fig. 1A) and Mobiscore (Fig. 1B) both decrease with higher BIMD, meaning that more deprived statistical sectors tend to have higher accessibility scores, while less deprived areas generally show lower accessibility. In contrast, the ratio of cars per household (Fig. 1C) increases with higher BIMD, reflecting lower motorization rates in more deprived areas. Diabetes prevalence (Fig. 1D) displays a modest negative gradient with BIMD, with higher prevalence in low-BIMD (more deprived) areas, albeit with considerable variability within each decile. These patterns underline the importance of socio-economic deprivation as a contextual factor and make its inclusion as a covariate in subsequent regression analyses warranted.

Accessibility Indicators vs. Cars owned Per Household (RATIO)

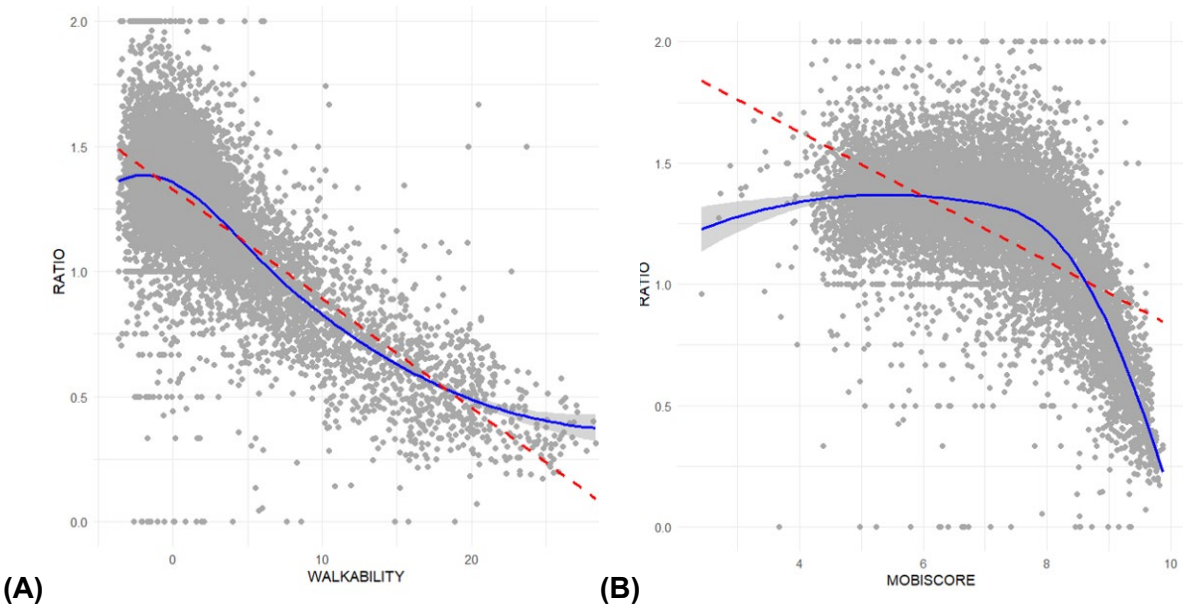

Figure 2. Relation between accessibility indicators (A) walkability and (B) mobiscore and the number of cars owned per household (RATIO).

```
Call:
lm(formula = RATIO ~ MOBISCORE + BIMD2011_deciles_domain, data = merged_data)

Residuals:
    Min      1Q  Median      3Q     Max
-1.2266 -0.1158 -0.0021  0.1076  4.6321

Coefficients:
                          Estimate Std. Error t value Pr(>|t|)
(Intercept)              1.4615620  0.0150935   96.83   <2e-16 ***
MOBISCORE               -0.0904349  0.0016471  -54.91   <2e-16 ***
BIMD2011_deciles_domain  0.0596171  0.0008492   70.20   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.2031 on 9666 degrees of freedom
  (10113 observations deleted due to missingness)
Multiple R-squared:  0.5774,    Adjusted R-squared:  0.5773
F-statistic:  6604 on 2 and 9666 DF,  p-value: < 2.2e-16
```

Table 1. Relation between cars owned per household (RATIO), BIMD and Accessibility indicator Mobiscore

```
Call:
lm(formula = RATIO ~ WALKABILITY + BIMD2011_deciles_domain, data = merged_data)

Residuals:
    Min      1Q  Median      3Q     Max
-1.2764 -0.0935 -0.0053  0.0867  4.6731

Coefficients:
                          Estimate Std. Error t value Pr(>|t|)
(Intercept)              1.0575641  0.0067414  156.88   <2e-16 ***
WALKABILITY             -0.0338713  0.0004200  -80.64   <2e-16 ***
BIMD2011_deciles_domain  0.0375167  0.0008549   43.88   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1802 on 9684 degrees of freedom
  (10095 observations deleted due to missingness)
Multiple R-squared:  0.6677,    Adjusted R-squared:  0.6676
F-statistic:  9728 on 2 and 9684 DF,  p-value: < 2.2e-16
```

Table 2. Relation between cars owned per household (RATIO), BIMD and Accessibility indicator Walkability

Figure 2 shows the association between two accessibility indicators, walkability (Figure 2A) and Mobiscore (Figure 2B), and the number of cars owned per household (RATIO), without adjusting for socio-economic differences. For walkability, car ownership decreases sharply and almost linearly with increasing scores, suggesting that more walkable environments are consistently associated with lower levels of motorisation. For Mobiscore, the relationship appears non-linear: car ownership remains relatively constant up to a Mobiscore of about 8, after which it drops steeply. This threshold effect may indicate that a certain minimum level of accessible services and amenities needs to be reached before households substantially reduce their car dependency.

Tables 1 and 2 present the results of multiple linear regression models for the same associations, but adjusted for socio-economic deprivation using the Belgian Index of Multiple Deprivation (BIMD). For the Mobiscore model (Table 1), the regression equation is:

$$RATIO = 1.4616 - 0.09043 \times Mobiscore + 0.05962 \times BIMD \quad (2)$$

This model explains 57.7% of the variance in household car ownership (adjusted $R^2 = 0.5773$), with both Mobiscore and BIMD showing highly significant associations ($p < 0.001$).

For the walkability model (Table 2), the regression equation is:

$$RATIO = 1.1574 - 0.03379 \times Walkability + 0.05893 \times BIMD \quad (3)$$

This model explains 66.8% of the variance (adjusted $R^2 = 0.6667$), again with all predictors highly significant ($p < 0.001$).

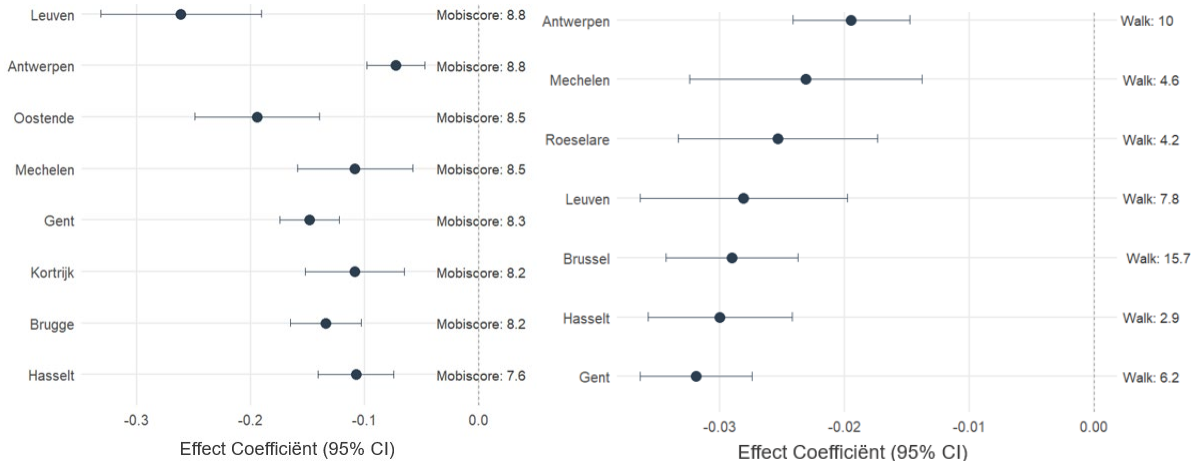

Figure 3. Effect coefficient (with 95% CI) for the relation between accessibility indicators (A) Mobiscore and (B) Walkability and the number of cars owned per household in a selected number of Belgian cities. Model is correct for socioeconomic factors through BIMD.

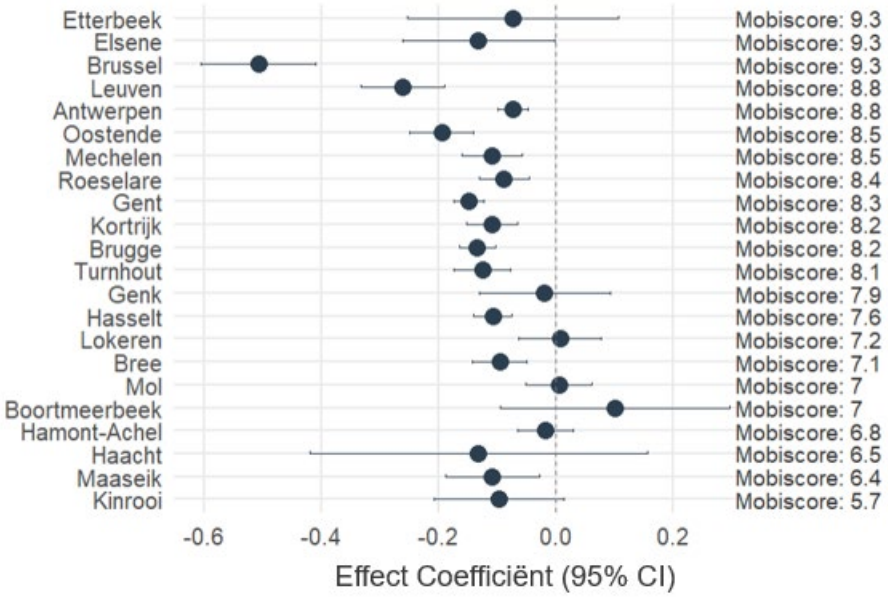

Figure 4. Effect coefficient (with 95% CI) for the relation between accessibility indicator Mobiscore and the number of cars owned per household in a selected number of Belgian urban and rural communities. Model is correct for socioeconomic factors through BIMD.

Figure 3 shows the estimated effect coefficients (with 95% confidence intervals) for the association between accessibility indicators Mobiscore (panel A) and Walkability (panel B), and the number of cars owned per household in a selection of major Belgian cities. All models are adjusted for socioeconomic differences using the BIMD. The effect coefficient represents the change in the dependent variable (car ownership ratio) associated with a one-unit increase in the accessibility indicator, holding other variables constant. In this context, a negative effect coefficient indicates that higher accessibility is associated with fewer cars per household.

In panel A (Mobiscore), all included cities display negative coefficients, ranging approximately from −0.30 in Antwerp and Leuven to values closer to zero in Antwerp. The magnitude of these coefficients varies despite relatively similar average Mobiscore values (ranging from about 7.6 in Hasselt to 8.8 in Antwerp and Leuven), suggesting differences in how accessibility translates into car ownership across cities. In panel B (Walkability), the effect coefficients are smaller in magnitude (between about −0.03 and zero), with Gent and Leuven showing the most negative associations, while other cities such as Mechelen, Roeselare, and Antwerp have a more modest effect coefficient, but still considerably below zero. Average Walkability values also vary considerably between cities, from below 3 in Hasselt to over 15 in Bruges.

Figure 4 presents a similar analysis focusing on the accessibility indicator Mobiscore, but extends the comparison to a broader set of municipalities, including both urban and rural areas. The list comprises larger cities such as Antwerp, Brussels, Leuven, Mechelen, and Ghent, as well as smaller towns and rural municipalities such as Kinrooi, Maaseik, Haacht, Hamont-Achel, Bree, and Boortmeerbeek. Across this broader set, most municipalities show negative effect coefficients, indicating that higher Mobiscore values are generally associated with fewer cars per household after adjusting for socioeconomic factors via the BIMD. The coefficients range from around −0.55 in Etterbeek (strongest negative association) to slightly positive values in Boortmeerbeek (the only municipality above zero), with several others, such as Kinrooi, Haacht, and Hamont-Achel, showing near-zero associations. Average Mobiscore values span from about 5.7 in Kinrooi to 9.3 in Brussels, Leuven, and Elsene, enabling a visual comparison of whether the association between accessibility and car ownership differs

along the urban–rural spectrum. As in Figure 3, the 95% confidence intervals indicate the statistical precision of each estimate.

Case- Study Diabetes: relation with car ownership (RATIO) and accessibility indicators

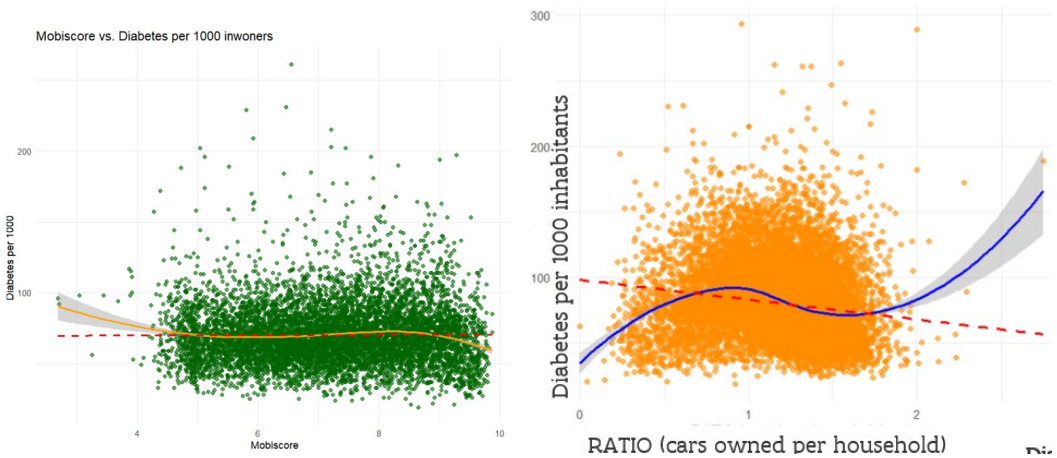

Figure 5. (a) relation between Diabetes and Mobiscore and (b) between Diabetes and cars owned per Housheold.

Figure 5 shows the bivariate associations between diabetes prevalence and two accessibility/mobility indicators: **Mobiscore** (panel A) and **car ownership ratio** (panel B). The curves are based on LOESS smoothing and represent unadjusted relationships, without controlling for socioeconomic status. Panel A suggests a weak negative association between Mobiscore and diabetes prevalence, while panel B shows no clear linear trend; in fact, the unadjusted linear fit (dashed line) slightly slopes downward, indicating marginally lower diabetes prevalence at higher levels of car ownership.

The corresponding regression models, presented in the tables below Figure 5, adjust for socioeconomic differences via the BIMD. After adjustment, the direction of association changes for car ownership: **Walkability** shows a significant negative association with diabetes prevalence (Estimate = –0.409, $p < 0.001$, $R^2 = 0.040$), indicating that higher walkability is linked to lower diabetes prevalence when holding socioeconomic factors constant. In contrast, the **car ownership ratio** becomes significantly positively associated with diabetes prevalence (Estimate = 8.576, $p < 0.001$, $R^2 = 0.135$), meaning that after adjustment, higher car ownership is associated with higher diabetes prevalence. This illustrates that failing to account for socioeconomic context can mask or even reverse the direction of certain associations.

```
Call:
lm(formula = Diabetes ~ WALKABILITY + BIMD, data = model_data)

Residuals:
    Min      1Q  Median      3Q     Max
-55.466 -13.591  -2.438  10.420 195.144

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 85.04654    0.88488  96.111   <2e-16 ***
WALKABILITY -0.49016    0.05375  -9.119   <2e-16 ***
BIMD        -2.00960    0.11085 -18.129   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 21.09 on 7963 degrees of freedom
Multiple R-squared:  0.0405,    Adjusted R-squared:  0.04026
F-statistic: 168.1 on 2 and 7963 DF,  p-value: < 2.2e-16
```

Table 3. Relationship between Diabetes prevalence (per 1000) and Walkability, in a model correcting for socioeconomic factors through BIMD.

```
Call:
lm(formula = Diabetes ~ RATIO + BIMD, data = plot_data_bimd)

Residuals:
    Min      1Q  Median      3Q     Max
-70.321 -16.745  -3.496  12.792 221.024

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 90.73131    0.95189   95.32   <2e-16 ***
RATIO        8.57596    0.93929    9.13   <2e-16 ***
BIMD        -3.85115    0.09185  -41.93   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 25.47 on 13880 degrees of freedom
Multiple R-squared:  0.135,     Adjusted R-squared:  0.1349
F-statistic:  1083 on 2 and 13880 DF,  p-value: < 2.2e-16
```

Table 4. Relationship between Diabetes prevalence (per 1000) and Car ownership per household (RATIO), in a model correcting for socioeconomic factors through BIMD.

DISCUSSION AND CONCLUSION

This study highlights an important insight: neighbourhoods that closely fit the “15-minute city” model, which is characterised by high walkability, dense amenity access, and strong transit connections — are often more socioeconomically deprived. Research across European cities confirms this: despite high overall accessibility, central areas may still concentrate disadvantaged populations. At the same time, higher variety and a greater number of available services have been associated with lower levels of inequality.[23]

Our findings confirm that better local accessibility correlates with reduced car ownership, even after accounting for deprivation. In addition, the association is not strictly linear. For some indicators such as Mobiscore, the unadjusted relationship shows a threshold-like pattern: car ownership changes little at lower accessibility values and then declines more steeply once a higher-accessibility range is reached. Similar non-linear and threshold effects between built environment accessibility and car ownership or car dependence are well documented.[24]

The diabetes case study further illustrates the importance of adjusting for socioeconomic context. Before adjustment, the association between car ownership and diabetes prevalence was slightly negative, indicating marginally lower diabetes rates in areas with higher car ownership. The relationship between accessibility and diabetes was relatively flat, although the lowest diabetes prevalence tended to occur in the highest-accessibility areas. After controlling for deprivation, walkability showed a strong negative association with diabetes prevalence, whereas higher car ownership became strongly and positively associated with diabetes prevalence.

These patterns can be explained by several mechanisms. Walkable neighbourhoods promote regular physical activity: walking for transport and leisure, which improves glucose metabolism and reduces diabetes risk. For example, residents of high-walkability neighbourhoods experienced 15–20% lower incidence of pre-diabetes, reflecting early-stage diabetes prevention.[25] Additionally, adults with type 2 diabetes living in more walkable neighbourhoods logged significantly more daily steps, up to 1,345 additional steps per day, even after accounting for self-selection issues.[26]

Ownership of household vehicles, which is closely related to higher car ownership rates, has been associated with a 14% higher prevalence of obesity, a major risk factor for type 2 diabetes, largely mediated through reduced physical activity and increased sedentary time. In the same study, the association with diabetes prevalence was smaller (≈5%) but in the same direction.[27]

Taken together, these results suggest that enhancing accessibility is a piece of the equity and public health puzzle, but not the whole. While improving walkability and local service access can reduce car dependence and support healthier lifestyles, persistent socioeconomic inequalities in accessible

neighbourhoods highlight the need for integrated, equity-centred policies. Embedding 15-minute city principles within broader strategies that address affordability, service provision, and economic resilience will be essential to ensure that improvements benefit all parts of society.

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GREENING URBAN AND RESIDENTIAL SPACES: ENHANCING PERFORMANCE OBJECTIVES THROUGH LANDSCAPING IN A CHANGING WORLD

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INTRODUCTION

In the wake of the ongoing global pandemic and the pressing challenges posed by climate change, landscaping has emerged as a pivotal aspect of urban and residential environments. As individuals and communities seek to enhance their surroundings, the demand for landscapes that not only exhibit aesthetic appeal but also align with performance objectives has grown significantly. These performance objectives encompass a multifaceted approach, including addressing water impact concerns, fostering ecological diversity, creating visually pleasing landscapes, and nurturing well-being within the community. However, while the desire to achieve these objectives is clear, there remains a notable gap in our understanding of the capacity of different landscape design typologies to meet these complex demands.

This study embarks on a comprehensive exploration of eight distinct landscape typologies, aiming to shed light on the environmental and social benefits they offer and the challenges they pose within urban and residential contexts. Through cutting-edge digital modeling and graphics, our research provides a holistic understanding of each typology's strengths and limitations, ultimately equipping designers and homeowners with informed insights for landscape design decisions. The findings contribute to our collective comprehension of landscaping's pivotal role in enhancing environmental health and societal well-being.

METHODOLOGY

This research employed a comprehensive methodology over a twelve-month period, involving an in-depth literature review and digital modeling to investigate the environmental and social benefits and challenges of eight distinct landscape design typologies in both urban and residential contexts. The eight typologies analyzed included: All Garden, All Lawn, Lawn Garden Combination, Synthetic Turf, Xeriscaping, Clover, Mulch and Rock, and No Maintenance. Each typology was reviewed at two scales: 100'x100' urban and 30'x30' residential, providing insights into performance in varying spatial contexts. The research team conducted an extensive literature review gathering peer-reviewed data to assess each typology's effectiveness in infiltration, runoff quality, air quality, cooling capabilities, and well-being benefits. Following the literature review, collected data was graphically modeled using Lumion and Adobe CC, creating visually engaging graphics that enabled informed decision-making for designers and homeowners.

RESULTS

All Lawn

In urban and residential environments, the all-lawn typology is most ideal for supporting recreational activities. At residential and urban scales, this design features uniformly manicured turfgrass providing open, accessible spaces for leisure and community gatherings. Although all-lawn landscapes generate less runoff than impervious surfaces, the shallow root system (four to six inches deep) results in lower infiltration rates (one to three inches per hour) compared to deeper-rooted vegetation.[1]

The evapotranspiration process contributes to atmospheric cooling, with temperature reductions of two to six degrees Fahrenheit. Turfgrass sequesters carbon at approximately 0.4 to 1.2 tons per acre annually, though substantially less than native plantings.[2] Air quality benefits remain modest through particulate capture, but must be weighed against maintenance emissions and chemical applications. The all-lawn typology offers substantial social benefits, providing welcoming spaces for gatherings, play, and passive recreation. Research demonstrates that regular exposure to maintained lawns correlates with reduced stress and improved quality of life in urban environments.[3]

All Garden

In contrast to all-lawn landscapes, all-garden settings provide substantially greater plant diversity, typically incorporating fifteen to thirty species of shrubs, perennials, and groundcovers. This diversity fundamentally enhances environmental performance. Garden landscapes achieve significantly higher infiltration rates (three to eight inches per hour) due to root systems penetrating twelve to thirty-six inches or deeper. Research indicates gardens can reduce surface runoff by forty to sixty percent compared to lawns, making them valuable for stormwater management.[4]

Cooling effects exceed turfgrass alone, with temperature reductions of five to ten degrees Fahrenheit. Gardens remove particulate matter at rates two to three times higher than monoculture lawns through varied mechanisms including leaf surface area for capture and stomatal uptake of pollutants.[5] Ecologically, gardens support up to ten times more pollinator species than lawns, creating functional urban wildlife corridors.

Scientific research supports the positive impact of garden immersion on well-being. Studies document that individuals with diverse garden access report higher life satisfaction, reduced anxiety, and improved mental health compared to those with only lawn access.[6] However, gardens require more specialized knowledge, involve higher installation costs, and provide less recreational space than lawns.

Lawn Garden Combination

The lawn-garden combination strikes a calibrated balance between recreation and ecological diversity. In residential applications, this typology typically allocates forty to sixty percent to lawn with the remainder dedicated to diverse plantings. Environmental performance demonstrates synergistic benefits with infiltration rates of two to five inches per hour and runoff reduction of twenty-five to forty-five percent compared to impervious surfaces.[7]

Temperature moderation shows marked improvement, achieving cooling effects of four to eight degrees Fahrenheit. The diverse plant palette captures particulate matter at rates fifty to seventy percent higher than monoculture lawns. Research indicates incorporating thirty to forty percent garden area can support sixty to eighty percent of pollinator diversity found in all-garden landscapes while maintaining substantial recreational space.[8] From a social perspective, lawn-garden combinations offer versatile spaces accommodating diverse human needs, with research suggesting landscapes offering both structured and naturalistic spaces receive higher user satisfaction ratings.[9]

Synthetic Turf

Synthetic turf consists of polyethylene or polypropylene fibers with infill materials, providing consistent year-round appearance and reliable traction with minimal maintenance. However, environmental performance reveals significant limitations. The complete absence of living plant material eliminates all ecological functions. Synthetic turf provides zero infiltration, functioning as an impervious surface generating ninety-five to one hundred percent runoff.[10]

Thermal properties present substantial challenges. Research documents surface temperatures reaching thirty to fifty degrees Fahrenheit higher than natural grass, with peaks exceeding 160 degrees Fahrenheit on summer days.[11] These extreme temperatures create dangerous conditions and contribute to urban heat islands. Air quality concerns include emission of volatile organic compounds and degradation particles impacting respiratory health, particularly for children.[12] The complete absence of ecological diversity eliminates all habitat value, and lifecycle environmental costs including petroleum consumption and landfill persistence represent significant liabilities.

Xeriscaping and Native Plantings

Xeriscaping utilizes water-efficient principles and native species to minimize irrigation while achieving aesthetic appeal and ecological functionality. Established xeriscapes require fifty to seventy-five percent less supplemental irrigation than traditional lawns, with some eliminating irrigation entirely after establishment.[13] Despite reduced water inputs, cooling effects rival or exceed irrigated lawns, with temperature reductions of six to twelve degrees Fahrenheit. Research demonstrates well-designed xeriscapes achieve cooling effects comparable to irrigated landscapes while consuming a fraction of the water.[14]

Infiltration rates commonly range from four to ten inches per hour due to extensive root systems and improved soil structure. Native plants support specialized pollinator relationships, with landscapes featuring seventy percent or more native species supporting three to five times the diversity and abundance of native pollinators compared to non-native dominated landscapes.[15] Native plantings create structural diversity supporting complex food webs, providing critical food sources and nesting sites. However, xeriscaping typically provides less recreational space than lawns.

Clover Lawns

Clover lawns present compelling alternatives to traditional turfgrass, creating low-growing, dense groundcover that remains green with minimal inputs. One significant advantage involves nitrogen-fixing capability, contributing forty to one hundred pounds of nitrogen per acre annually, substantially reducing synthetic fertilizer needs.[16] The deeper taproot system (eight to twelve inches) enables superior drought tolerance, maintaining green color and growth when conventional lawns become dormant.

Environmental performance shows improvements over conventional turf, with infiltration rates of two to four inches per hour. Ecologically, clover provides substantially greater biodiversity value. Flowering clover can support fifty to seventy percent of pollinator diversity found in complex garden plantings, representing significant improvement over conventional lawns.[17] Maintenance requirements differ substantially, with mowing needed only every two to three weeks. However, traditional grass lawns demonstrate superior tolerance for high-traffic areas and intense play activities.

Decorative Rock and Mulch

All-mulch or rock landscapes represent minimalist approaches characterized by absence of plant diversity. While offering limited ecological benefits, proper mulch application at three to four inch depths significantly reduces runoff through increased surface roughness and porous structure. Research

indicates properly maintained mulch landscapes achieve runoff reductions of thirty to fifty percent compared to bare soil, though performance remains substantially below vegetated alternatives.[18]
Mulch layers reduce soil surface temperatures by ten to twenty degrees Fahrenheit and maintain soil moisture levels fifteen to thirty percent higher than unmulched soil. However, the absence of plant material eliminates photosynthesis, providing no carbon sequestration, oxygen production, or air quality improvement. The lack of vegetation eliminates all habitat value and pollinator support. From a social perspective, mulch and rock landscapes provide minimal benefits beyond basic aesthetic organization, offering no recreational functionality or psychological benefits associated with living landscapes.

No Maintenance Landscapes

No-maintenance landscapes develop through natural succession, with plant establishment determined by seed dispersal and soil conditions rather than intentional selection. Ecologically, these landscapes serve as carbon sinks, with unmanaged herbaceous vegetation sequestering carbon at rates of one to three tons per acre annually.[19] Robust root systems stabilize soil and prevent erosion, with many pioneer species possessing deep taproots extending two to four feet or more.
Research documents that unmanaged areas can support sixty to eighty percent of native pollinator diversity found in designed native gardens when native species establish naturally.[20] However, substantial challenges limit appropriateness in most contexts. Uncontrolled establishment often results in dominance by aggressive invasive species. Increased rodent habitat raises public health concerns. Aesthetic qualities conflict with prevailing cultural preferences, potentially generating neighborhood conflict and ordinance violations. Fire risk increases where dead material accumulates, legally precluding this approach in fire-prone areas.

DISCUSSION AND CONCLUSION

The analysis reveals diverse environmental and social implications associated with each typology, demonstrating that no single approach optimally addresses all performance objectives. All-lawn landscapes offer recreational and social benefits but exhibit biological diversity limitations. With sustainable management practices, they can contribute meaningfully to cooling and community interaction.
All-garden landscapes demonstrate significant advantages across multiple environmental metrics, with ecological diversity, enhanced infiltration, superior air quality improvement, and carbon sequestration making them valuable urban environmental infrastructure. However, reduced recreational functionality and higher knowledge requirements may limit appropriateness where social uses take priority.
The lawn-garden combination merits serious consideration as a default recommendation for many sites, providing both recreation and ecological diversity. The flexibility inherent in this approach allows proportional adjustments based on specific priorities, enabling customization responding to local conditions.
Synthetic turf demonstrates severe environmental limitations including complete elimination of ecological function, extreme surface temperatures, contaminated runoff, and concerning compound emissions. These findings suggest synthetic turf should be reserved for highly specific applications rather than general landscape solutions.
Xeriscaping emerges as particularly valuable for contexts facing water scarcity or seeking maximum ecological performance. Dramatic water consumption reductions combined with excellent environmental performance make this approach increasingly relevant as climate change intensifies drought conditions.
Clover lawns represent promising middle ground between conventional turf and ecologically intensive alternatives, offering improved sustainability while maintaining general lawn functionality. Broader

adoption could generate substantial cumulative environmental benefits, though functional limitations under heavy traffic may restrict appropriateness in some contexts.
Mulch and rock landscapes demonstrate limited overall environmental performance, suggesting these approaches should be considered primarily for challenging sites where conventional plantings prove impractical. No-maintenance landscapes offer certain ecological benefits, but substantial drawbacks including invasive species proliferation, rodent habitat creation, aesthetic conflicts, and fire risk concerns limit appropriateness in most contexts.
In conclusion, the analysis underscores the need for balanced, context-sensitive approaches considering ecological diversity, stormwater management, air quality, cooling effects, carbon sequestration, habitat provision, and human well-being. The findings provide valuable insights for homeowners, designers, and urban planners, emphasizing the importance of informed decision-making to create sustainable and resilient urban landscapes effectively addressing multifaceted environmental and social objectives.

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ON LIVEABILITY IN CLIMATE EXTREMES: THE CASE OF BAHRAIN

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INTRODUCTION

Throughout the MENA region, the compound effects of resource extraction, geopolitics, rapid urbanization, and climate change are drastically changing urban environments and territories, making them more vulnerable to recurrent climate extremes. In this regard, Bahrain emerges as a revealing case. As an archipelago of 40 low-lying islands, its territory is currently being reshaped by the government's Vision 2050, under the helm of post-oil economic diversification. This vision is being played out through massive land reclamation and development projects that are transforming natural shorelines into artificial islands, displacing communities historically reliant on fishing and pearling, and creating a stark territorial duality between the urban intensification in the northern governorate- that is still very much oil-reliant, and the ongoing oil extraction in the south.

Adaptive governmental measures, such as mangrove expansion and sustainable development, aim to "balance" the impacts of the country's extractive/ development activities and meet Bahrain's climate commitments, but have often produced considerable ecological consequences. With the transformation of territory into real-estate commodity, car-oriented urbanization is quickly converting coastal open spaces into low-density development, worsening biodiversity loss, urban heat islands, and urban liveability. These conflicting interventions in Bahrain reveal broader tensions between geopolitical and economic agendas, their large-scale developments manifestations, and their footprint on fragile ecosystems and urban liveability.

In this context, the Territorial Imaginaries teaching lab presents a methodological framework for reimagining the relationship between territory, politics, ecology and liveability under climate extremes, using visualization, systems thinking and multi-scalar design approaches. Under this framing, reclamation is understood as a political narrative of nation-building that positions land-making and urban development as an economic priority that overrides environmental externalities.

The paper presents methods and student work developed in the lab that illustrate how design can critically engage with these dynamic, contested systems. Mappings and projects focusing on the Northern Governorate challenge top-down visions of resilience that prioritize capital accumulation. Focusing on three projects, the paper situates itself within this debate, exploring how spatial, economical, and ecological frameworks can enhance existing landscapes and urban localities, and prioritizing liveability, resource recovery, and climate adaptability. Through its pedagogical approach and showcased projects, the paper aims to reframe Bahrain as a territory of ecological imagination, design agency and just transition that serve as a plausible alternative to the Vision 2050.

BAHRAIN: AN ECO-SOCIO-POLITICAL CONUNDRUM

Figure 1. Bahrain aerial view via Google Earth.

As many countries in the Gulf, Bahrain's economy is based on oil, but unlike other countries, its reserves are relatively small and expected to run out in about 30 years' time.[1] As a response, the government 2050 post-oil vision[2] has revolved around aggressive coastal development, doubling the country's land area through massive land reclamation projects[3] that already reshaped Manama's coastline and large areas of Northern Governorate – as viewed in Figure 1 - where artificial islands have depleted aquifers, disrupted fisheries, transformed coastlines into speculative real-estate frontiers, and threatened livelihoods based on traditional fishing and pearling.

These processes are a revealing proof that urbanization is inseparable from geopolitical strategies and socio-ecological transformations: Noura Al Sayeh's "Reclaim" project[4] documents thoroughly the physical and social changes incurred by land reclamation. Fatima Alzeera's work[5] on fishermen's displacement shows how these ecological disruptions cannot be dissociated from social and political marginalization. Fadi Masoud[6] highlights how land reclamation and dredging have radically reshaped Gulf shorelines by replacing fluid sea-land gradients with abrupt engineered edges. Design Earth[7] similarly show how energy infrastructures and territorial projects produce ecological externalities. Civil Architecture[8] show how urbanization severed the cultural, fishing, and agricultural practices that existed for centuries prior to the oil-led urbanization in Bahrain.

Our paper zooms on the Northern Governorate of Bahrain as a stage for these ecological and socio-political contradictions.

Cultural Ruptures

Until the mid-20th century, the Northern Governorate was characterized by fertile soils, freshwater springs and irrigation systems that sustained a thriving cultural and agricultural landscape of date palm plantations and communities dating to the Dilmun Civilization (3000 years BC).[9] In this area, the

villages of Budaiya, Diraz, and Barbar flourished around traditional fishing and pearling, craft-based economies and cultural practices that were central to Bahrain's identity.[10] After the discovery of oil in the 1930s, unplanned urbanization and land reclamation eroded the historical relationship between this area and its waterfront. Haphazard private compounds fragmented the agricultural grid. Resorts restricted access to the water. Artificial islands replaced traditional fishing grounds. Cultural sites such as burial mounds, temples, palm plantations and fishing ports became fragments isolated by contemporary urbanization: private fences, highways, and compounds.

Ecological and Climatic pressures

The Northern Governorate encapsulates the ecological vulnerabilities of Bahrain. Once a territory with economies and agglomerations proportional to its resources, it is now an area under demographic and ecological pressure. Shallow marine ecosystems have been dredged and replaced with artificial shorelines to pave for development, fisheries have declined, aquifers that were once central to the Northern Governorate's settlement patterns are now depleted and heavily saline. Beyond the destruction of shallow marine ecosystems, urbanization has also resulted with degraded soils, reduced biodiversity, and more frequent heat islands due to low-density development and limited green cover. This vulnerability is exacerbated by poor accessibility, where car-oriented infrastructure such as the Budaiya Highway marks a rupture in human and non-human accessibility. With the absence of vegetation and public transport, roads become physical and ecological barriers between inland and coastal zones, promoting energy-intensive mobility patterns that also act as economical barriers between villages and vital infrastructures.

Socio-Political Marginalization

In addition to its ecological and cultural ruptures, the Northern Governorate is also stage to socio-political fragmentation. The region has, for a long time, been associated with marginalized groups living under social and spatial exclusion. The sectarian discord underlying the relationship between these groups and the State was a direct cause of uneven development frameworks and governance. Such frameworks diverted in past decades' investment from the area, overlooking critical demographic needs and important historic sites. This is visible in the current conditions of the villages: historic cores are neglected, millennia old landmarks are abandoned, and communities have poor to no access to social infrastructure and essential services like public transport, education and healthcare.

With these eco-socio-political conundrums as mapped in Figure 8, the Northern Governorate calls for the need for rethinking design interventions as a matter of ecological adaptation that spur climate readiness, social equity and urban liveability, through participatory and incremental processes that can replace top-down state-driven governance and projects. This complex setting shaped the framework of research for the joint design studio that was given at the American University of Beirut's School of Architecture and Design in Spring 2025.

TERRITORIAL IMAGINARIES

"We need to view the fragility of the planet and its resources as an opportunity for speculative design innovations rather than a form of technical legitimation for promoting conventional solutions." Mohsen Mostafavi[11]

The Territorial Imaginaries lab[12] examines eco-political conundrums amidst climate repercussions and their implications on the built environment. As an interdisciplinary research and teaching lab, it approaches the urgency of the climate crisis through readings and design speculations linking issues of politics, ecology, landscape, and architecture. It tackles the notion of territory not from the natural sense,

as an intact environment comprising natural systems and forces, but as a socio-political construct that imprints the impacts of large-scale forces on the natural and built environments.

Territory is thus contemplated, not as a distant and detached field, but as an immediacy and continuum encompassing the systems and layers within which architecture and design overlap.[13] The research further expands this notion to look at the spatial outcomes of economic flows, ecological degradation, and resource extraction, moving from macro to micro scales of understanding.

Seen from the lens of cartography, the territory is actualized through the act of mapping that inscribes its underlying systems of governance, planning, and political boundaries.[14] Cartography and mapping further have the power to visualize and reveal the abstract distinctions that exist between the territory's overarching economic, ecological, and social structures and the land they implicate. Mapping's agency thus "lies in neither reproduction nor imposition but rather in uncovering realities previously unseen or unimagined, even across seemingly exhausted grounds."[15] It is thus centred in this lab as a critical practice, and as both a design and research tool that help investigate and narrate the otherwise abstract realities of the territory.

Organized as a combined seminar and design studio, the lab engages students in their MENA context, probing how geopolitical dynamics shape territories and connect to ecological conundrums. The aim is to foreground climate, ecology, and resource issues in architectural education, empowering students to utilize their disciplinary tools of visualization and systems thinking to imagine alternative futures. Each year the lab focuses on a new "episode" that highlights an eco-political conundrum; In past episodes, the lab examined the energy/water conundrum in Lebanon, and the offsite ecological implications of natural gas extraction on water ecologies, a result of political dissonances that prioritize lucrative economic development over addressing the climate urgency. It further investigated the shifting dynamics of economy and political power in the Bekaa and Litani areas, afforded by a corrupted energy / water cycle of extraction and production, and their repercussions on the natural and built environments.

In its third episode in spring 2025, the lab explored the ecological and climatic implications of nation-building in the oil-producing kingdoms of the Arabian Gulf, specifically focusing on Bahrain. Through an undergraduate Architecture and Landscape studio, and a graduate Urban design studio,[16] the lab examined how large coastal developments affect natural ecosystems and cultural practices, and how through design, alternative coastal visions can be proposed instead to prioritize people and climate.

The resulting work, shown here, from this interdisciplinary lab proposes designs that can mediate between political agendas, climatic processes, people's needs and material realities of place to enhance urban liveability in the face of extreme weather and resource scarcity.

Figure 2. Bahrain Northern coast and student projects

Studio pedagogy

In both the undergraduate Architecture, Landscape, and graduate Urban Design studios, the lab adopted a scenario-based design approach, using speculative time-forward scenarios to generate new design visions for the northern coast, as illustrated in Figure 2. Students invented alternative future narratives to frame their work, acknowledging the shifting climatic, political, and economic conditions, and the necessity to address time as a dynamic factor. Visualization tools were central: mapping, diagrams, axonometric, timelines, superpositions, and other visual methods helped students represent the collected complex territorial data, focusing specifically on layers of geopolitics, ecology, climate, and culture. Drawing further served as the agent to generate and communicate their speculative ideas in narrative form. Tools such as GIS, Adobe suite image and vector software, aerial photographs and historic maps, were used in intersection with model making, and hand drawing.

At the core of the methodology were three approaches or "levels of understanding".

- **Systems Thinking:** involving a holistic analysis of landscapes, built fabric, and ecological processes as interconnected systems. Systems thinking, as discussed by Helen Furjan,[17] incorporates "holistic interrelationships and addresses context, feedback and dynamics", expanding the understanding of architecture as synonymous to and an inherent extension of ecology. Systems thinking further allows the understanding the design process as an organizational framework, referencing James Corner,[18] and as a "pliant" system that responds and adapts to changing fluxes and dynamics, and that strategically intersects architecture, landscape, urban design, and ecology.
- **Multi-Scalar approach**: involving the simultaneous and/or the sequential work across scales, from the regional/macro of understanding (coastlines, watersheds) down to the local/micro scale of interventions (sites, buildings).
- **Time-based Design**: understanding each project as an evolution through time, while considering phased scenarios that respond to climate uncertainties (sea-level rise, shifting demographics).

The studio phasing moved sequentially starting from initial large-scale framing and macro analysis that incorporated key "entry points" – geopolitics, ecology, climate, culture – to frame and identify key constraints and opportunities, such as endangered mangrove areas, vulnerable neighbourhoods, or economic drivers. The work then progressed towards proposing future transformative scenarios with detailed programming of landscape, architecture, and production. The work proceeded to develop design projects that integrate with and activate the territory at multiple scales and in different time-

based scenarios. Projects integrated scale and time by revealing how the intervention unfolds in stages (for example, temporary floodable parks, permanent greenways). Finally, the work evolved into implementation strategies that are re-zoomed out to contextualize broader change. By moving iteratively from broad analysis to detailed proposals, this method ensured each project remained connected to systemic issues.

ARCHITECTURE AND URBAN DESIGN VISIONS

The studio outputs navigated between large-scale development and small-scale interventions, advancing socio-ecological equity and the dynamics of climate, ecology, and production, while highlighting key endangered resources such as water, agriculture, and cultural practices In practice, this meant every design explicitly addressed issues of liveability (comfort, access), adaptability (climate resilience), biodiversity (habitat enhancement), and equity (benefiting diverse communities) in some form. Each project presented hereafter proposes a unique lens of investigation and site narrative that builds upon the context's extracted richness and vulnerabilities and exemplify the process and intention of the teaching lab.

Threads of Manama[19]

The first project focused on the capital Manama and investigated the various layers underlying its urban development including politics, social dynamics, culture, and climate. Key observations were extracted through mappings- viewed in Figure 3 - such as the urban repartition based on classes and ethnicities, with working class communities occupying the older inner quarters and upper class inhabiting the new coastal developments. A disconnecting infrastructural ring road acts as a boundary between the new coastal developments, with low density high-rise buildings, and the older neighbourhoods with higher low-rise density. Their proposal envisioned a future where the coast becomes an opportunity to connect inner city crafts and inhabitants to coastal areas, highlighting public space, cultural practices and marine biodiversity. It further addressed issues of urban disconnection, pollution, and lack of sustainable outdoors. Utilizing weaving as a process and the simulations of coastal evolution in time, the project proposes an operative interface, where ecological systems, social life, and productive practices of fishing and textile crafts are co-activated in response to shifting climatic realities, as seen in Figure 4. The proposal incorporates programs of cultural heritage, particularly weaving and textile, into three cores: educational, production, and innovation. It includes a series of overlapping platforms and nodes that connect and extend to the urban context and incorporate public piazzas, walkways, flood sensitive zones, and active landscapes of leisure and production. Through time, the project is imagined to sustain various episodes of sea-level rise, activating higher level surfaces as lower walkways become submerged.

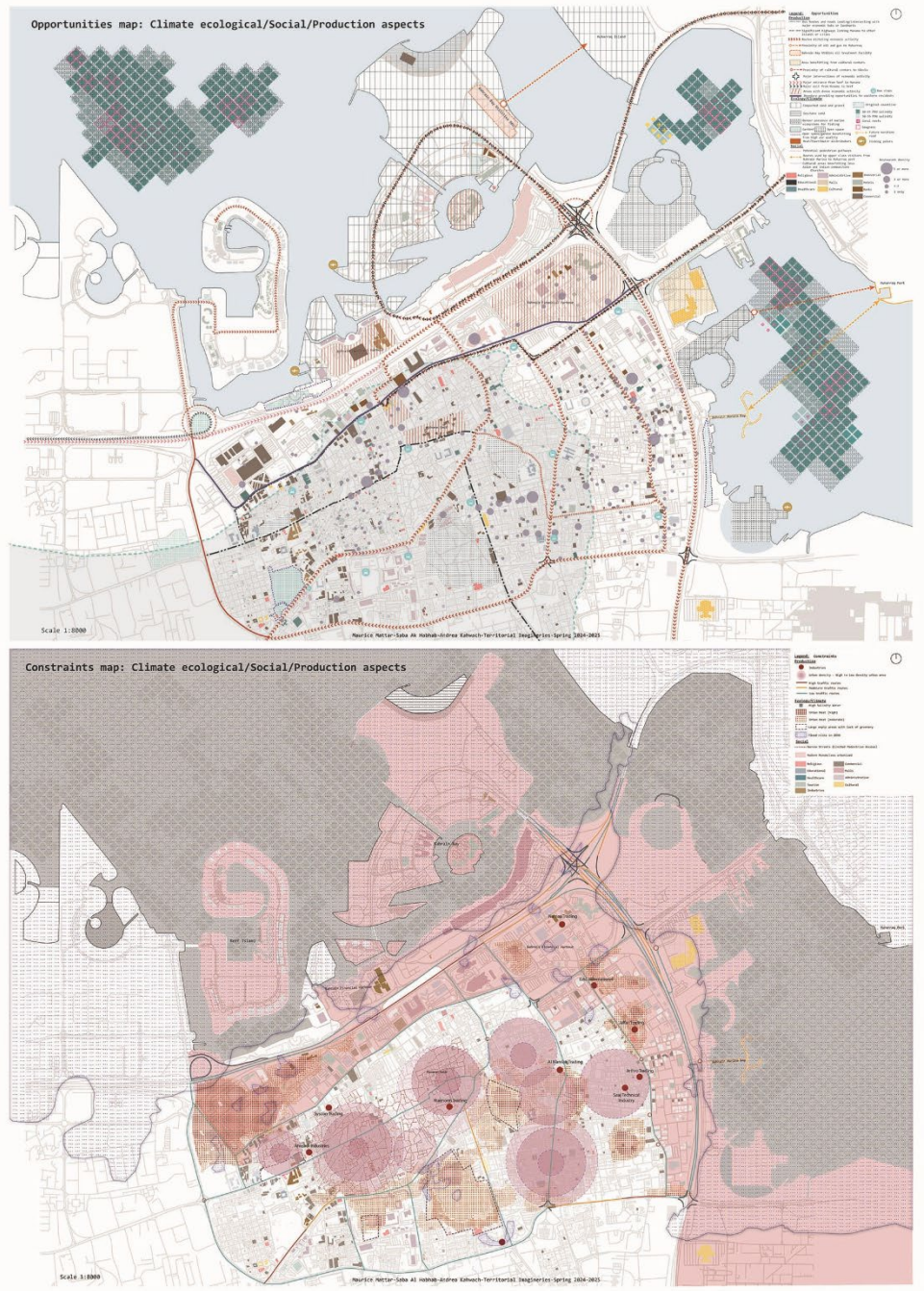

Figure 3. Constraints and Opportunities Maps for Manama

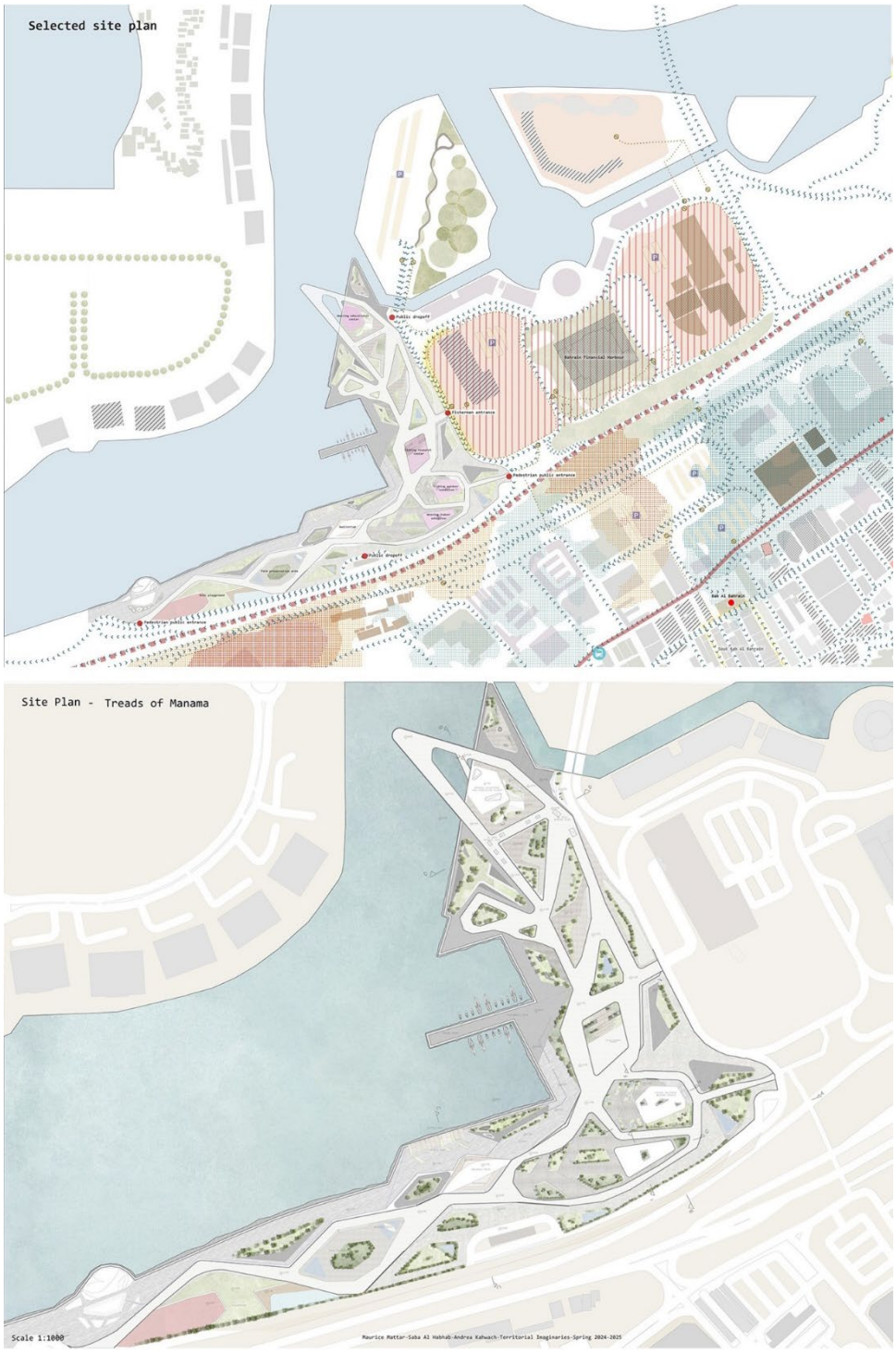

Figure 4. Threads of Manama project and context relations

Flow Fields: Designing Diraz through wind, ritual, and cultivation[20]

The second project looked at the suburb of Diraz, a stronghold of the Shi'a community, which has suffered from state control and under development, and holds cultural remnants of Ain Umm al-Sujur mosque and the Diraz Temple. In mappings, the students explored the three aspects of geopolitics, culture and climate, viewed in Figure 5. They unpacked the timeline evolution of Diraz, under political and climate forces, from the Arab Spring uprising and subsequent political unrest to the decline in its

agricultural practices amidst impacts of land reclamation projects off its coast. They further showed the infrastructural neglect and detachment due to the highway's barrier, an attitude that seem to remain in the government's future plans. Their project proposes instead a people-centred narrative for Diraz, one that reconnects its history, land, and community back to its context. Taking over areas of underused agricultural fields and vacant lots, the project proposes the integration of programs of culture and religious rituals, local crafts, with productive urban landscapes and community spaces. The design was developed as a system of unfolding topographic surfaces that incorporate shaded courtyards and pathways that maximize passive cooling, illustrated in Figures 6 & 7. Its spatial organization was structured following the study of three primary flows that inform the massing: wind, religious ritual procession, and agricultural practices. Prevailing wind directions were mapped and simulated to guide the orientation and porosity of buildings, enabling passive cooling and microclimates.

Ceremonial traditions and processions helped define areas of gathering, thresholds, and movement. Agricultural operations were also analysed to address parameters of crop rotation, agroforestry, irrigation, and distribution. The project further envisions the expansion of the area's agri-cultural identity in time through a green belt along the main highway, reconnecting various fragmented ecological and urban areas.

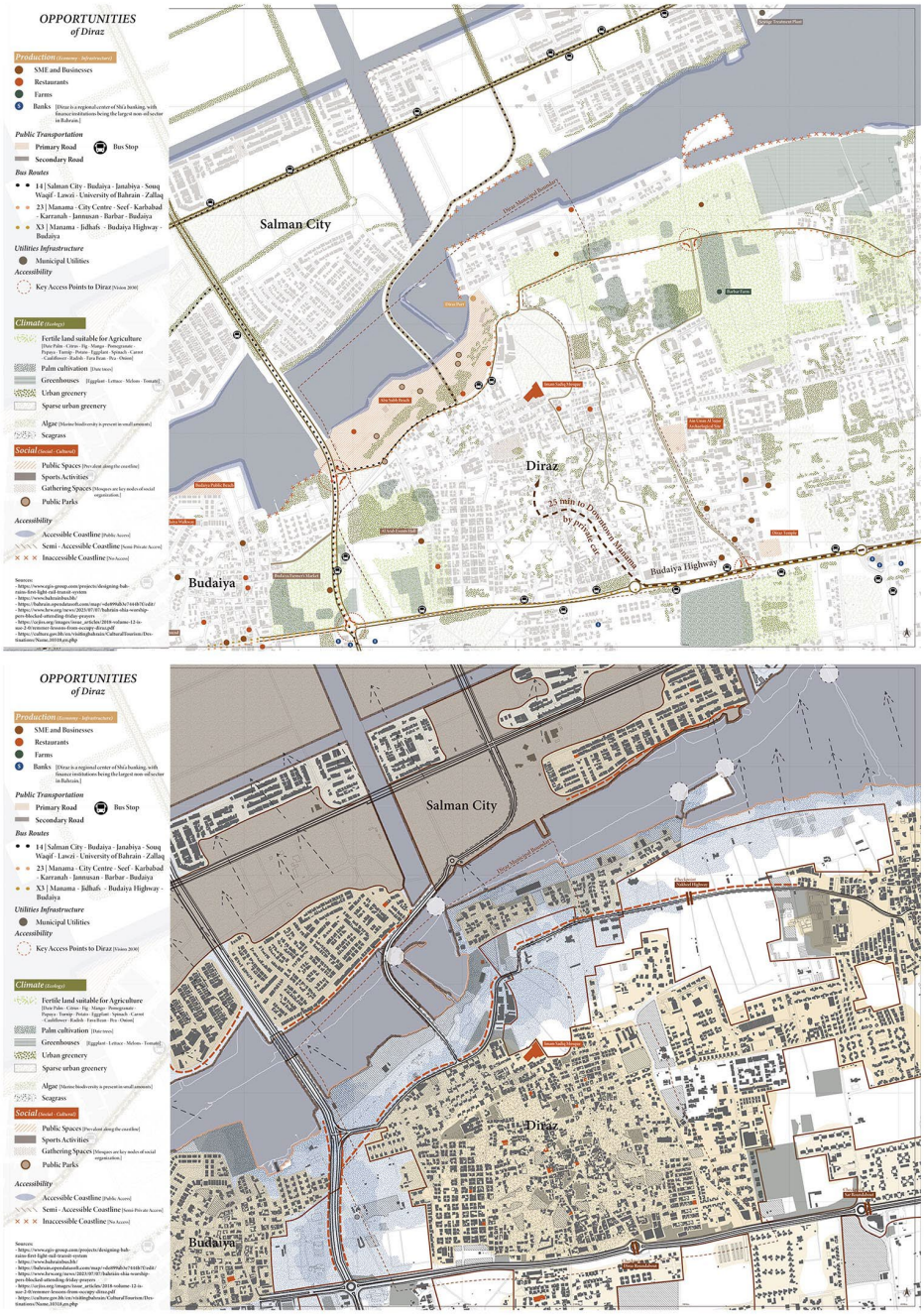

Figure 5. Constraints and Opportunities Maps for Diraz

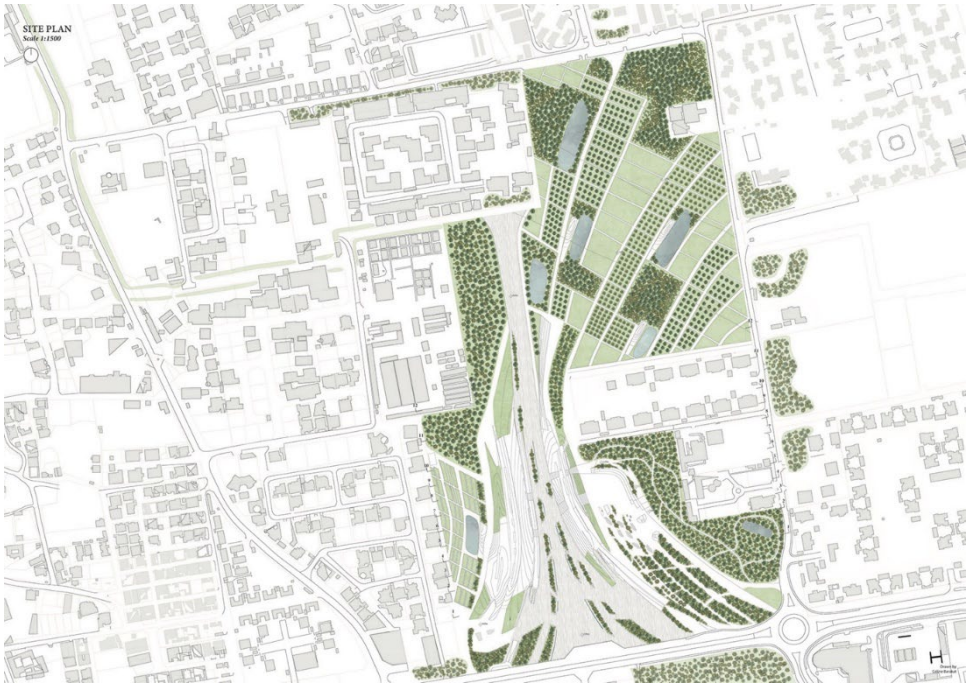

Figure 6. Masterplan of Flow Fields extending wind, rituals, and agriculture

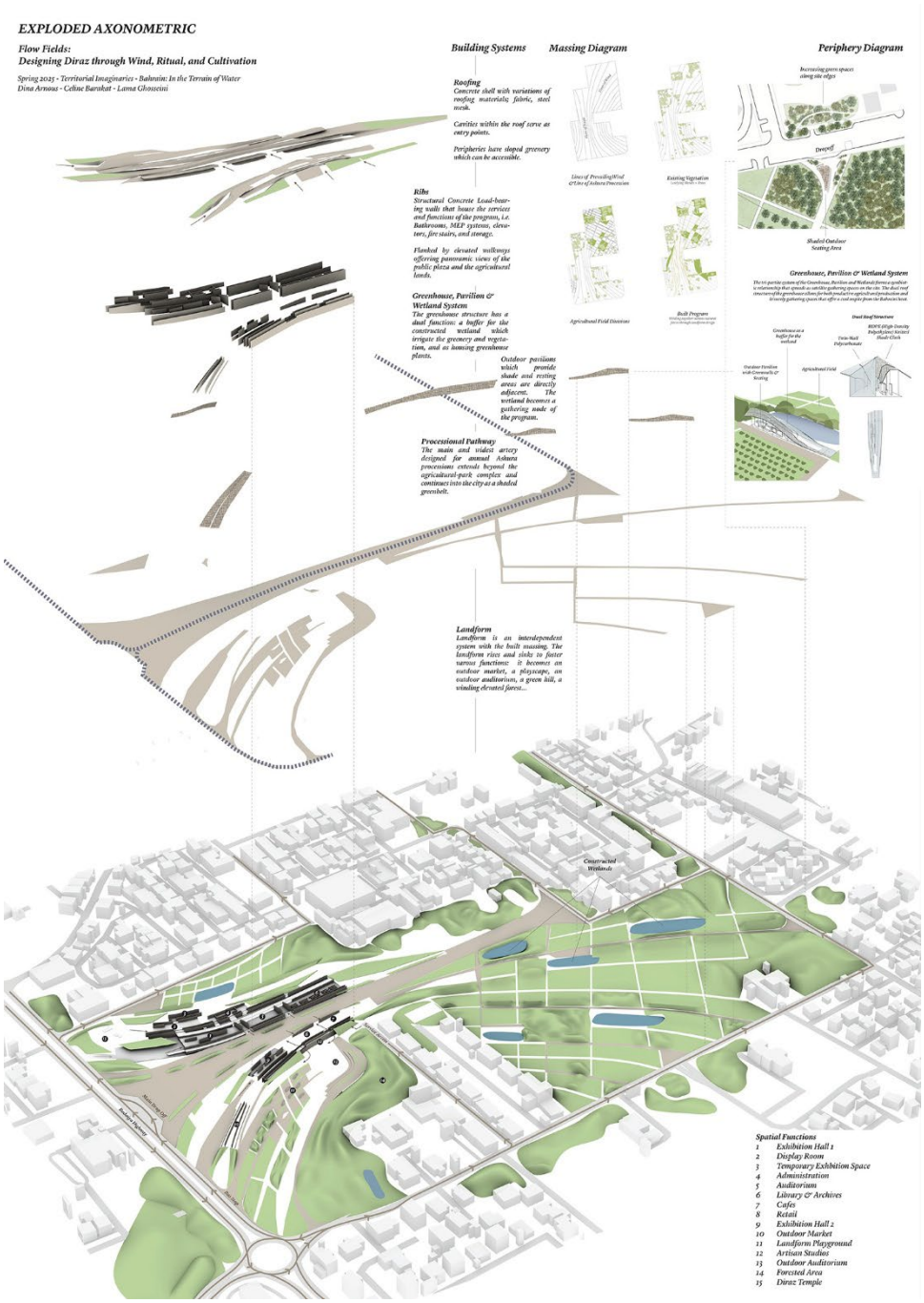

Figure 7. Exploded axonometric for Flow Fields showing systems of water and programming

Heritage-Led Regeneration of Bahrain's Northern Governorate[21]

The third project – developed in the Urban Design Studio- proposes an alternative framework for the Northern Governorate: heritage-led regeneration in the areas of Barbar and Jannusan. This approach recognized that heritage is not merely about preserving built structures only but also activating cultural and ecological systems as drivers of a heritage-led transformation, as shown in Figure 10. Rather than proposing new mega-projects, the proposal suggests reconnecting what was once whole: historic wells, coastal ports, agricultural fields and cultural landmarks. By joining these systems in a continuous network of pedestrian and bike paths, and water harvesting structures, the design seeks to reinforce both an ecological and cultural continuity- Spatial Framework shown in Figure 9.

Several strategies underlie this vision:
The proposal includes the revival of water systems including the restoration of historic canals and springs to reconnect communities to their hydrological heritage, along with the introduction of new retention ponds, fog harvesting towers and wetlands that enhances the water security of the area.
A heritage trail links archeological sites, historic villages and agricultural lands, through shaded pedestrian and cycling paths. This trail positions heritage as a lived dimension in its locales, overlapping it with soft mobility points such as bike rentals and bus stops and social infrastructure. Cooling corridors stitch back the villages cores to Budaiya highway, in a thorough re-editing of the patched urban fabric.
Inclusive economies are nurtured in a participatory governance framework, where existing buildings are retrofitted with SME hubs, traditional crafts and an economic diversification rooted in local agency rather than speculative capital, to avoid the traps of gentrification while creating new opportunities of co-production for the area's youth and marginalized groups. In such a framework, local communities participate in commissioning, design, delivery and managing revenues to reinvest them in their villages.
This approach ensures that interventions are incremental, socially grounded and maintain legitimacy over time as shown in Figure 10.

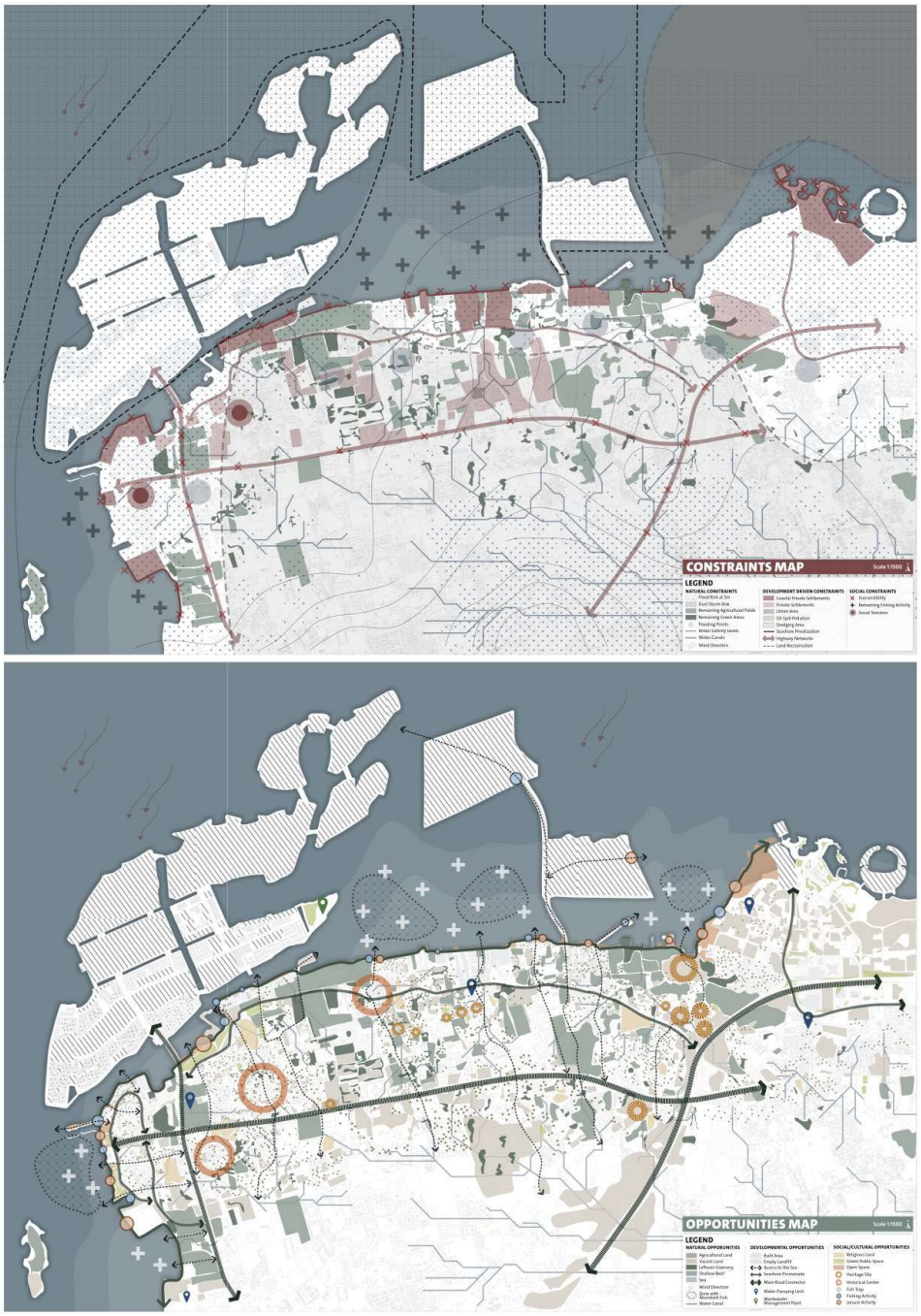

Figure 8. Constraints and Opportunities Map for the Northern Governorate

Figure 9. Spatial Framework of the Heritage Led Regeneration with a time-based transformation simulating public participation processes and water/ shade improvements over time.

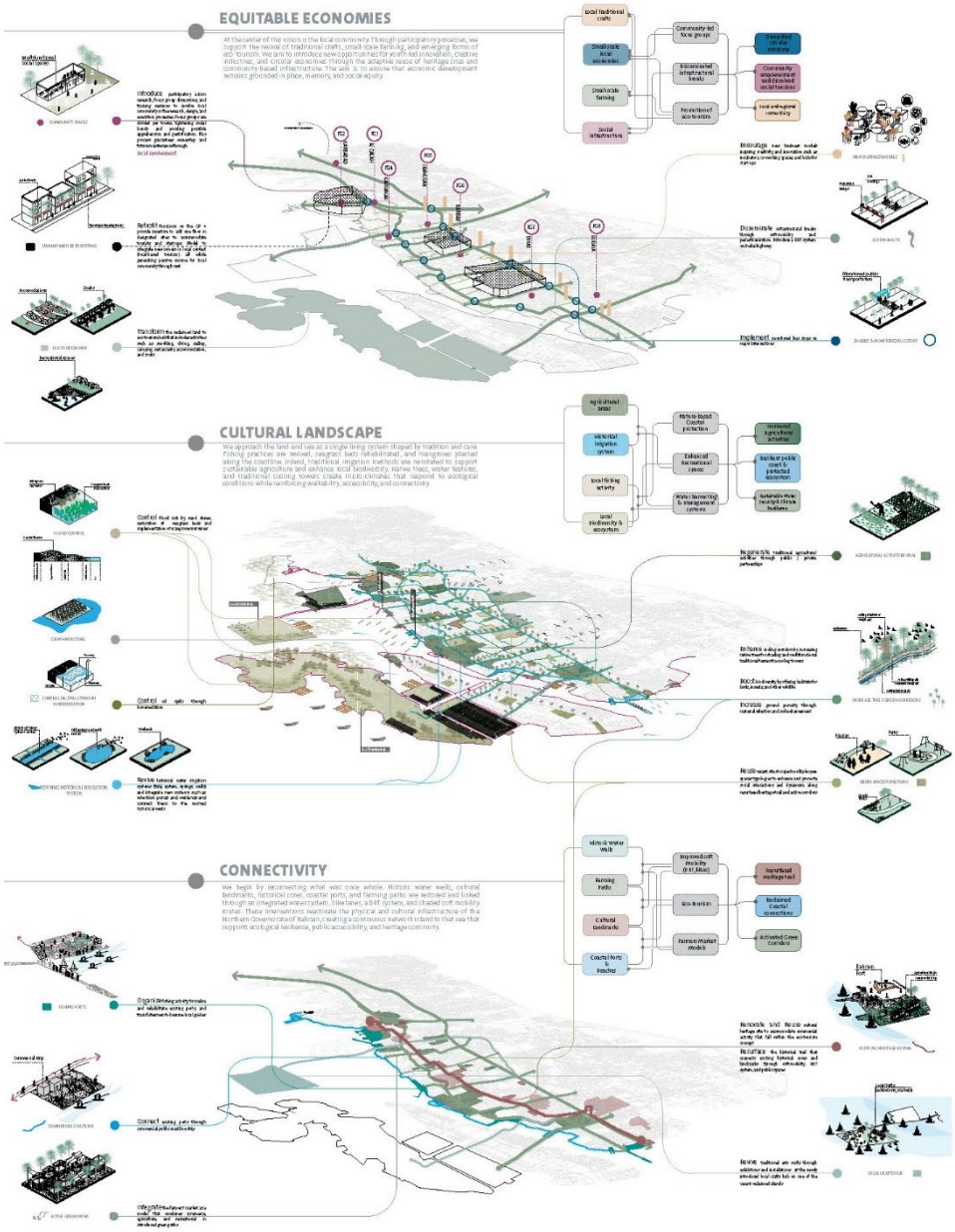

Figure 10. Multilayered strategies of the Heritage Led Regeneration in the Northern Governorate

CONCLUSION

Projects shown thus navigate between large-scale development and small-scale interventions, advancing socio-ecological equity and working with the dynamics of climate, ecology, and water. Through these speculative futures, the lab proposes spatial, economical, and ecological frameworks that enhance existing landscapes and urban localities to prioritize liveability, resource recovery, and climate adaptability. Many scholars argue that such speculative futures work is essential for building climate resilience. In other words, design fiction becomes a practical toolkit, by materializing scenarios, exposing conflicts and inviting debate on trade-offs. By using scenario-based multi-scalar design, students learned to link coastal geopolitics with everyday human experiences, and to place biodiversity, liveability, and equity at the centre of design. This mirrors a key insight of the lab: design can “mediate between political agendas, climatic processes, people’s needs and material realities of place” to enhance urban liveability.

NOTES

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[5] Fatema Alzeera, “Fishermen's Displacement: Ecological Disruption and Social Marginalization in Bahrain,” *Journal of Environmental Sociology* 23, no. 3 (2018): 402–19.
[6] Fadi Masoud, “Terra-Sorta-Firma: Land Reclamation and the Transformation of Gulf Shorelines,” *Journal of Gulf Studies* 16, no. 2 (2014): 123–39.
[7] Design Earth, *Geostories: Another Architecture for the Anthropocene* (New York: Actar Publishers, 2017).
[8] Civil Architecture, “1000 Years of Non-Urban History: Cultural Landscapes of Bahrain,” *Architecture and Society Journal* 12, no. 3 (2015): 59–74.
[9] Mohammad Noor Al-Nabi, *The History of Land Use and Development in Bahrain* (Manama: Information Affairs Authority, 2012).
[10] Al-Nabi, *The History of Land Use.*
[11] Mohsen Mostafavi, introduction to *Ecological Urbanism*, ed. Mohsen Mostafavi with Gareth Doherty (Baden, Switzerland: Lars Müller Publishers, 2010), 12–33.
[12] The Territorial Imaginaries lab was founded by the authors and has been internationally recognized – winning the 2023 ACSA/Columbia Buell Centre Course Development Prize – for its innovative pedagogy in climate + architecture.https://www.acsa-arch.org/resource/2025-course-development-prize/2023-course-development-prize-winners/
[13] Antoine Picon, "What has happened to territory?" *Architectural Design* 80.3 (2010): 94-99.
[14] Mohsen Mostafavi, introduction to Jill Desimini, *Cartographic Projections* (Cambridge, MA: Harvard Graduate School of Design, 2018), 7.
[15] James Corner, “The Agency of Mapping: Speculation, Critique and Invention,” in *The Landscape Imagination: Collected Essays of James Corner 1990–2010*, ed. Alison Bick Hirsch (New York: Princeton Architectural Press, 2014), 198–252.
[16] Undergraduate studio co-taught by Carla Aramouny and Karim Bacha, Graduate studio taught by Sandra Frem
[17] Helene Furjan, “Eco-Logics,” in *101st ACSA Annual Meeting Proceedings: New Constellations, New Ecologies* (2013), edited by Edward Mitchell and Ila Berman.
[18] James Corner, Organizational Ecologies in Going Live: From States to Systems, Pierre Belanger, New York: Princeton Architectural Press, 2015
[19] Project Threads of Manama by architecture students: Maurice Matar, Saba Al Habhab, Andrea Kahwach
[20] Project Flow Fields by architecture and landscape students: Dina Arnous, Celine Barakat, Lama Ghosseiny
[21] Project Heritage-led regeneration by urban design graduate students: Marita Chamoun, Maria Rajha, Sergio Zgheib

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SYDNEY'S KOALA BELT: A TOTEMİC ORBİTAL

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INTRODUCTION

Sydney's Biodiversity Success Story

Koalas populations are crashing in NSW & Queensland. In 2022 their federal status worsened from Vulnerable to Endangered, only 10 years after they were first listed as Vulnerable. Extinction in the wild by 2050 was flagged as possible in early 2019 at the **NSW Parliament Upper House Koala Inquiry**.[1] The inquiry found the greatest threat to Koalas survival in the wild was **habitat loss and fragmentation**.[2]

However, within this bleak horizon the genetically unique Greater Macarthur Koala population of south west Sydney is a bright spot - still chlamydia-free and expanding in number and reach. They now number possibly between 500 to 1,000 koalas, perhaps the only recovering Koala colony in NSW.[3] This population was considered locally extinct until animals were spotted again in 1986, their numbers have been growing steadily since from a remnant population of about 20 that had escaped the 1920s Koala culls, by seeking refuge within the gorges of the Holsworthy Army Base.[4]

Spatially, the Macarthur population occupies a keystone position on what we are calling Sydney's 'Koala Belt.' This belt connects Sydney's two longest rivers: the Hawkesbury-Nepean River (Deerubbin) and the Georges River (Toggerai), where they almost touch at Macarthur. This riparian ring road acts as a 'Biodiversity Super Highway' linking up small Koala populations along Sydney's periphery. Such as the now extinct populations at Pittwater and Central Coast at Broken Bay, persistent colonies along the Deerubbin at Arcadia, Kurrajong and the Blue Mountains all the way to populations south of Botany Bay. The Macarthur colony has been radiating out along this belt though mostly to the east. Since CoVID, Koalas have been spotted in Heathcote National Park and occasionally even further east in the Royal National Park. These two rivers thus effectively act as a 'Koala Belt' to connect up disparate colonies and provide paths for them to escape bushfires and re-colonize habitat. It's an avenue that acts to stop their fragmentation and thus maintain their genetic health and diversity.

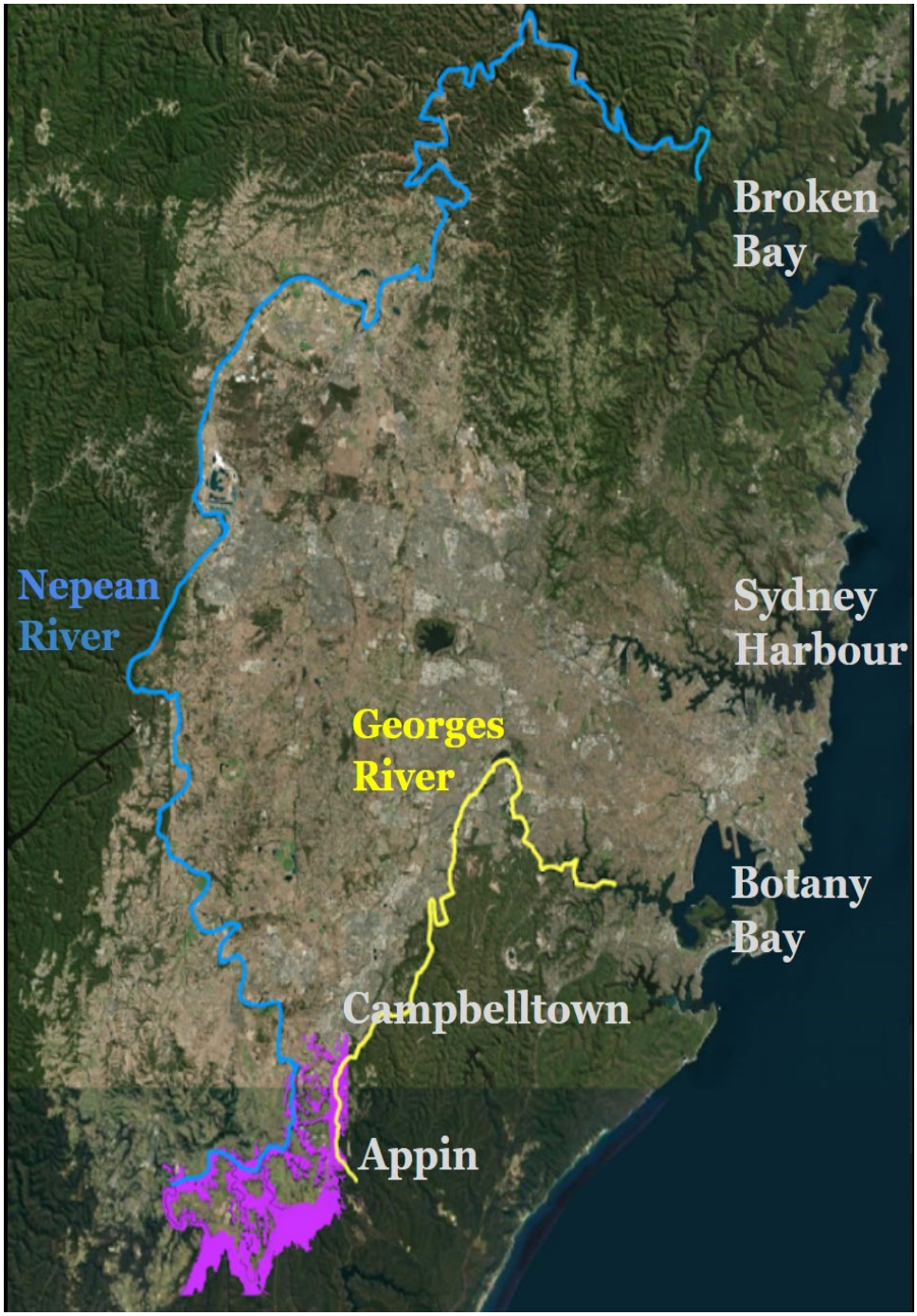

Figure 1. Sydney's Koala Belt : Georges river (yellow) connects to the Nepean river (Blue) through Macarthur's koala corridors (purple) (Deane, 2025)

Sydney's peripheral greenfield expansion, driven by a 15% human population growth over the last ten years, is driving the removal of Sydney's Koala habitat.[5] Existing Koala protections too, have become both spatially blind and de-prioritised in the face of major property developer interests. The changing nature of these habitat protections are well illustrated at Macarthur, which we will touch on here but for a greater in depth analysis of governance issues see the author's previous paper '*Sydney's Urban Sprawl, a Koala Belt and the Blue Green Grid : A Governance issue*'.[6] Learnings from these failures and successes can point to what is necessary for a Koala Belt to be a regulatory and spatial success.

Evolution of South West Sydney's Koala protections.

Koala Protection within South West Sydney and the Southern Highlands has evolved from piecemeal action to national parks and Koala corridors. The first Koala conservation push came out of the 1980s when Koalas were first spotted in 1986 in south west Sydney at Wedderburn by locals Julie Shepard, Ketih Longhurst and David Enmore.[7] This was the first sighting in the area since the 1920s when they were thought to have been shot to extinction.

Historically the south west periphery of Sydney stopped at Campbelltown, the rural and bush land beyond protected by distance - over 50 kms away from Sydney's centre - from the pressures of urban development. Large state infrastructure projects also impeded residential use. Sydney's water supply via the state heritage listed 1880s Upper Canal System runs through Macarthur as does the high-pressure Gas pipeline from Moomba in South Australia. Long wall coal mining and coal seam gas extraction also have an expansive footprint under Macarthur.

Early conservation zoning - Scenic Protection Zones - were driven by aesthetic rather than environmental considerations. However, the effect was the same - protection of large areas of rural land. This zoning kept properties in large lots, limiting development; thus wildlife connections across the landscape continued intact. Ironically the preservation of these large lots made them very attractive to larger developers like Walker and Lendlease, whose business model is to work around planning constraints and spot rezone land - ideally large lots that provide the greatest return on investment.

The 1986 rediscovery of Koalas in Wedderburn drove opposition to a developer push for small lot residential rezoning in the area, a plan that was fought and won with the help of union green bans.[8] This activism led the local chapter of the National Parks Association to advocate for the **Dharawal National Park** (6508 Ha) an adjacent area that finally came to fruition in 2012 under the Liberal O'Farrell government. The **Guula Ngurra National Park** (3358 Ha) located further south towards Canberra was declared in 2020 by the Liberal Environment Minister Matt Kean, it translates as 'Koala country' according to the Gundangara traditional owners, but was noticeable for its lack of Koala sightings.

However Matt Kean's declaration of the **Georges River Koala Reserve** (1830 Ha) in 2018 covers an area that Koalas have come back in numbers and its elongated shape hugging the Georges River heralds the importance of corridors to Koala protection.[9] This has now partly become **Warranmadhaa National Park** (962 Ha) with the promise of more under Labor Environment Minister Penny Sharpe.[10]

An idea first proposed as the '**Upper Georges River National Park**' by the National Parks Association,[11] that the author rebadged as the **Georges River Koala National Park** in early 2018 for greater political poignancy. This concept and the Two Rivers Koala National Park (aimed at securing the connection between the Georges and Nepean Rivers around Gilead) was 4000Ha were advocated for by the Georges River Koala Network (later to become Save Sydney Koalas) and both ideas were adopted as Labor promises by Shadow Environment Minister Penny Sharpe (under shadow premier John Foley) before the 2019 state election.[12] However after the Liberal party's win the Cumberland Plain Conservation Plan became the main legal instrument for 'koala protections', though its primary goal was to open rural land up for residential development. Koala protections here revolved around Koala corridors.

Presently in Macarthur we have new drivers working on Koala protections. One scientifically driven through agencies that sit outside the NSW **Department of Planning** demanding a web of wide Koala corridors. The other is driven by the Department of Planning seeking to minimize those protections and free up potential housing development. Below is an image describing those two processes via their planning instruments. The top is the green independent assessments flow trying to assert Koala protections, and the bottom is the red Department of Planning flow trying to maximize developable housing area.

Figure 2. Macarthur's regulatory evolution : Koala recommendations of the Science driven reports versus Planning department ones (Deane, 2025)

In Macarthur, in 2016 the Campbelltown Council drew up **The Campbelltown Koala Plan of Management (CKPoM)** with guidance from Koala specialists Biolink (Dr. Steve Phillips).[13] The **CKPoM** had one major landscape recommendation for Koala protections in greenfield sites - a **web of Koala corridors**. For these to be effective they had three basic requirements: to be **numerous, contiguous** and **wide** enough to act as habitat, that is 425m.

The **Greater Macarthur 2040 Interim Plan** originally promised Koala protections too, such as "sufficient corridors to support koala communities, with a minimum preferred width of 425 metres for primary corridors" - the Nepean and Georges River.[14] However the Department's **Conserving Koalas in the Wollondilly and Campbelltown Local Government Area 2019 Report** (Conserving Koalas Report 2019) rejected the need for East-West Koala corridors.[15] The **Office of the Chief Scientists and Engineers** (OCSE) would later write three reports arguing to reinstate creek corridors, and the vegetated setbacks along the Nepean River.[16] The **Koala Strategy 2022** written by the state government did not mention corridors once, but translocation 18 times.[17] Corridors oblige developers while translocation does not. The **Cumberland Plain Conservation Plan** (CPCP) was also being drafted by the Department of Planning. This regional scale Biodiversity Certification (landclearing approval) aimed at simultaneously removing state and importantly federal conservation regulatory hurdles so the land could be rezoned residential.[18] The Department left the translation of the OCSE's Advice and its effect on corridors into the CPCP to itself and a private consultancy firm **Biosis - Cumberland Plain Conservation Plan Functional Koala Corridors**. Biosis's report closely reflected the Department's earlier Conserving Koalas report; which effectively just measured the width of existing riparian bushland, noted their average measurements and made this a requirement. Ironically there was no minimum Koala corridor requirement for the creeks and rivers except for one creek - Mallaty, that did

not meet the OSCE requirement and therefore perversely is/was to be fenced off from Koalas.[19] In 2022 the NSW state and Federal listing for Koalas deteriorated after the 2019/20 bushfires from Vulnerable to Endangered. However, this degraded listing did not trigger any additional Koala protections within the CPCP or elsewhere.

Figure 3. This is a close up of the Koala Habitat in Macarthur area, shown in purple in Figure 1, it shows the East–West corridors as identified by OCSE connecting the Georges River to Nepean River (outlined in red). They are Corridors - A: Menangle Creek to Noorumba; B: Woodhouse Creek to Beulah; C: Nepean Creek to Beulah; D: Mallaty Creek to Georges River (to be fenced off from Koalas); E: Ousedale Creek to Appin North; F: Elladale Creek and Simpson Creek to the colliery. (CPCP 2022 p.29)

Koala Belt gensis

The *Koala Belt* takes two successful ideas and an emerging one and merges them, while referencing an old scheme. They are Water NSW's riparian vegetation setbacks, Sydney's coastal whale walk (noting its totemic orientation), and the Macarthur Koala corridors, while referencing the historic Green Belt of Sydney; these are the foundations of the Koala Belt.

In NSW vegetated riparian setbacks are protected under the **NSW Water Management Act**.[20] In Macarthur, like much of NSW, Koala corridors were found to occur along existing watershed creeks and rivers. The watershed framework is an optimal baseline for corridors as they ensure broadscale landscape connectivity. Water NSW's vegetated riparian setback idea came out of botanists Doug Benson and Jocelyn Howell investigations and was incorporated into the NSW Water Management Act.[21] Its main purpose was to ensure riparian structural stability along the banks of creeks and rivers, its landscape effect was to emplace wildlife corridors. Its universal and simple application of widths and assessment of corridor identification made implementation effective as a watershed protection tool.

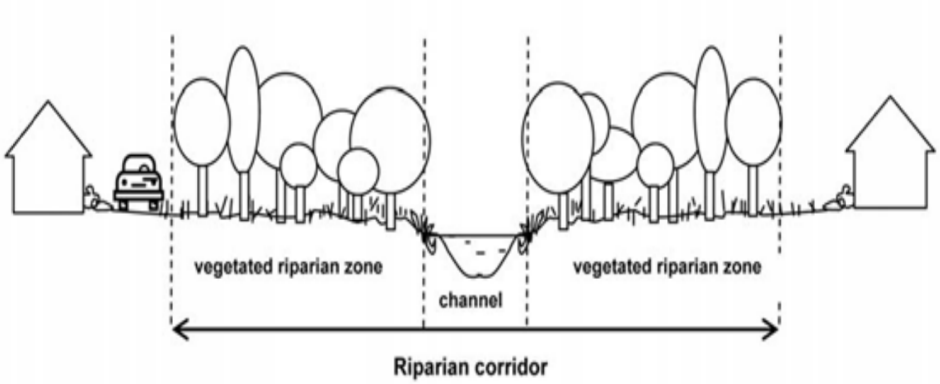

Figure 4. NSW Water Management Act : Vegetated Riparian Setbacks

Sydney's coastal **Whale Walk** from Bondi to Manly opened in 2019, and generated a narrative for a harbour path along the harbour and ocean front. While the bulk of the heavy lifting in securing foreshore land was done in 1828 with the 100ft foreshore reserve regulation and through later buy backs in the Federation Era (1890-1910), naming the walk has generated momentum to connect them. Walk advocates ex-Federal Labor Senator John Faulkner and ex-staffer Lachlan Harris have worked in a non partisan fashion to achieve this goal, with collaborators such as two Aboriginal Land Councils (La Perouse and Metropolitan), six harbour councils (City of Sydney, Mosman, North Sydney, Northern Beaches, Waverley, and Woollahra), along with eight state agencies (Place Management New South Wales, NSW National Parks and Wildlife Services, Transport for NSW, Port Authority of NSW, The Royal Botanic Garden Sydney, Sydney Opera House, Sydney Living Museums, and Taronga Zoo), and at the federal level the Sydney Harbour Federation Trust. The Koala Belt's vision is to replicate this idea in western Sydney and complete the circumnavigation of Sydney, that the Coastal walk starts creating the world's first city circumnavigation walk/ paddle of Sydney - A Koala/Whale Circuit.

The Macarthur Koala corridor requirements would ensure that the circuit meets the requirements for Koalas to inhabit and move through this riparian zone. Numerous studies as shown in the green flow of *Figure 3: Macarthur's regulatory evolution*, especially the Campbelltown Koala Plan of Management and the Chief Scientist's reports spell out what those requirements are. Koala corridors essentially have three criteria: to be numerous and contiguous, at least 400m wide, with integrity protection via conservation zoning or public ownership. A minimum vegetated setback requirement of 400m on either side of the Nepean-Hawkesbury (and 400m across a creek).

Sydney historically had a *green belt,* gazetted in 1951 under the County of Cumberland Planning Scheme inspired by London's. This *green belt* prevented urban sprawl through land use zoning and open space acquisitions. Yet while London's still persists, Sydney's soon fell after the dissolution of the Cumberland County Council in 1963, and the 'release' of thousands of hectares of farmland for housing by the Liberal Askin state government in 1965. London's urban footprint remains smaller than

Sydney's, though it houses about twice as many people.[22] A partial green wedge of sorts was planned for in the 1968 Sydney Region Outline Plan around Campbelltown through '*A linked system of open spaces ... will have its setting formed by conservation and planting of ridges, high points, Georges River and Nepean River valleys'* [23] This was enforced by a Scenic Hills zoning that prohibited residential subdivision on any lot less than 100 hectares in area. It is the watering down of these weakened legacy protections that is impacting Koalas.

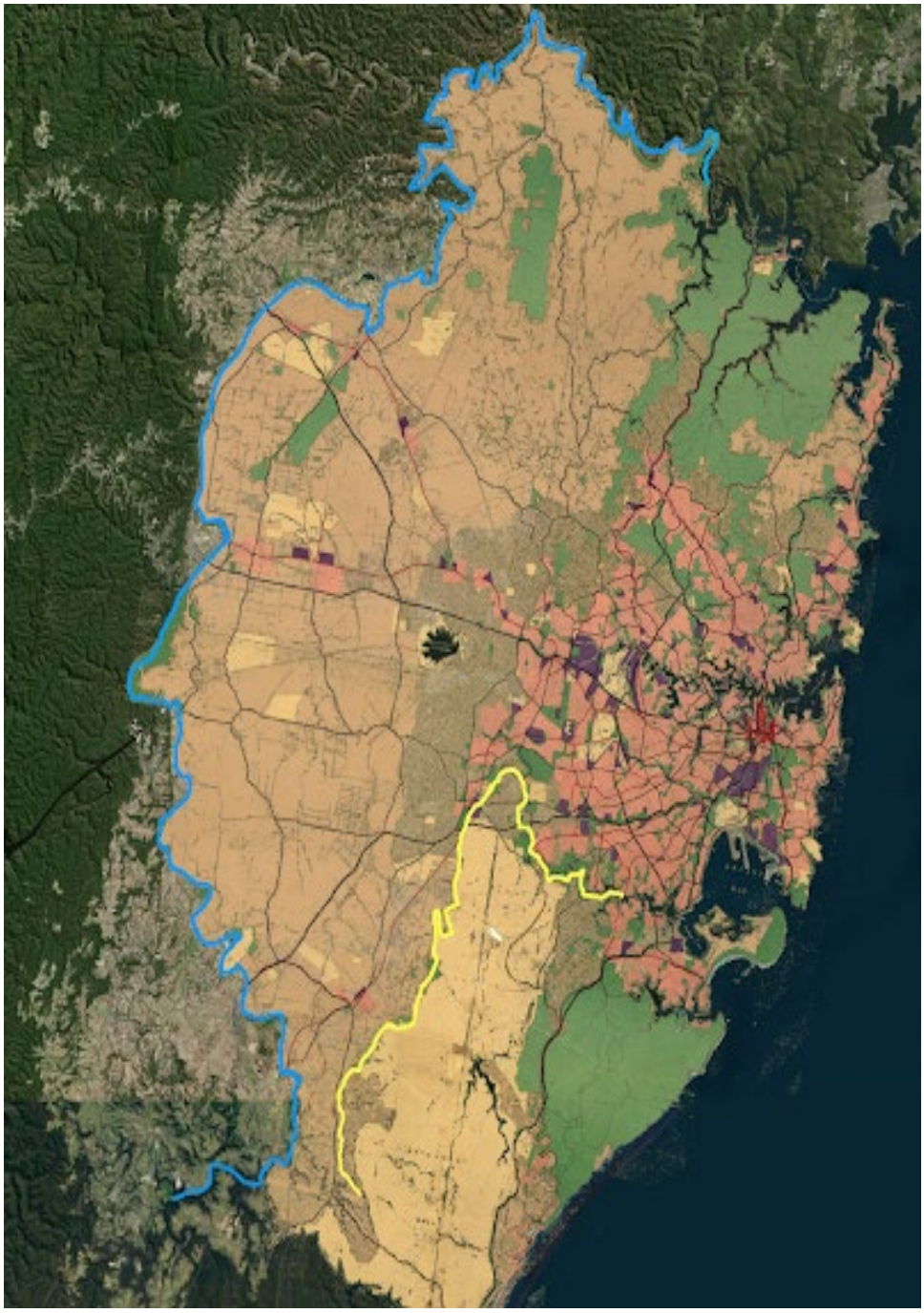

Figure 5. Above is the County of Cumberland Planning Scheme overlaid onto the Sydney Basin. The Yellow line is the Georges River and the Blue line is the Nepean River. The tan colour is the rural zone, and the green/tan is the greenbelt between the residential (pink) and the rural area. (Deane, 2025)

A river's appeal for both recreation and wildlife connectivity is already driving councils to create such pathways independently. What is missing is a comprehensive landscape masterplan for these separate ideas to plug into and a methodology proposal to guide riparian decisions connections for these disparate green corridors. That is where Sydney is in a unique position to look to its indigenous past, present and future, its Dreaming as a guide.

An indigenous Koala Belt with Totemic protection and Songline Connection.

In south west Sydney western conservation methods will not be enough to protect Koalas, thus another overlay an indigenous one should be investigated here, to expand and embed Aboriginal cosmology within the framework of a broader Koala custodianship.

Australia is in a fortunate position as a relatively wealthy country that still has cultural connections with the stories of its landscape - lorescape. In Europe and Asia their lorescape has been erased beneath the ebb and flow of territorial conquests by alternating cultures. The topography has been objectified. On the periphery of these continents remnant lore from these continual erasures may still exist in Gaelic Ireland, Sami Finland, or Shinto Japan, etc. But in Australia this lorescape substantially still exists, similar perhaps to the other later colonized landscapes of the Americas, Africa and the wider Pacific. Western Sydney is uniquely placed as it has the largest concentration of Aboriginal people in Australia, and major Local Aboriginal Land Councils, including the Dharawal, Deerubbin and Gandangara, who are also major landowners.[24] Thus an indigenous overlay is a fitting avenue to be explored.

Two concepts that appear apt for Koala conservation along a river are totem and songline relationships. The Totem attraction should be obvious, as it normally relates to an animal such as the Koala, while the other a songline dovetails in with the geographic feature that similarly snakes its way through the landscape - the river.

Koalas emblematic of Australia are perhaps already a national totem, but they also act as an umbrella species, as their struggle writ large the biodiversity crisis within Australia, and their protection incidentally protects many other species with smaller ranges. We have seen it is so often the animal that motivates conservation actions. The most recent National Park wins, deliberately used Koala in their activist title to engage the public - the Georges River Koala National Park (Warranmadhaa) and the Great Koala National Park. The US has had similar success bringing the Baldheaded Eagle back from extinction through their *Extinction and the U.S. Endangered Species Act*,[25] which elevated the animal as the protection driver, over habitat protection as done in Australia. The Australian Koala Foundation too is pushing for a *Koala Protection Act* to mimic this success. These ideas lend themselves to the Koala as a totemic driver for protection.

Songlines (or Dreaming Tracks) are the foundational maps of knowledge for Aboriginals tracing the journeys of ancestral creator-beings as they formed the land and sky. More than creation stories, they are complex navigational guides, memory archives, and legal frameworks passed down through song, story, dance, and art. Every landmark—a rock, river, or tree—acts as a mnemonic, triggering a verse that encodes practical knowledge about travel routes, resource locations, and spiritual law.[26] So what are possible guides to using these two threads for Koala conservation. So how are similar concepts being engaged currently perhaps the most analogous is the Gumbaynggirr Good Koala Country Plan.

The NSW state government and the Gumbaynggir of the Mid North Coast of NSW (near Coffs Harbour) have been investigating how to incorporate Koala protections and Aboriginal understandings and have developed the **Gumbaynggirr Good Koala Country Plan.**[27]It aims to blend Gumbaynggirr knowledge frameworks with Western scientific methods in caring for their traditional lands and koalas.

The Gumbaynggirr and the koala co-existed on shared travel pathways, seasonally travelling along grassy ridge lines between the mountains and the coast to where food was most abundant. One of these

Songlines is that of Bularri Gagu Dunggirr (Two Koala Brothers), “the people gathered and gave lots of food to the Koala brothers, who ate all of the food and became full and pleased. They then dug out 6 of their long stomach strings and cast them over to the land, creating a bridge for the people to return to their homelands.” The Koala Brothers eventually connect with the Two Sisters songline who created the sea.

The plan draws upon the cultural wisdom and the Gumbaynggirr seasonal calendars to guide management actions, including the use of cultural fire regimes - ‘cultural burns’. Cultural burns trigger natural events such as flowering, improving soil quality, removing invasive species, reducing fuel loads to limit or prevent intense bushfires, stimulating seed germination, influencing the weather, and maintaining access to travel routes and sources of food and water. While the Gumbaynggirr Good Koala Country Plan is more a management program for land that is protected. They have actively used the Koala to advocate for the Great Koala National Park. [28]

The closest in geographic terms would perhaps be the **Birrarung River Council** that has leveraged an indigenous connection to a river that runs through another major Australian city - Melbourne. The Birrarung - the river and its environs are a living, breathing entity that follows Wurundjeri songlines and forms a central part of the Dreaming of the Wurundjeri.[29] The Sacred Kingfisher is the totem as it perches high above the river, patiently watching over everything that happens on its banks and waters. Just as the council which includes representatives from the Wurundjeri Woi-wurrung and Bunurong watches over the river too. However the original idea came from activists the Yarra Riverkeeper Association, who advocated for a Birrarung Council that became a statutory body legislated under the Yarra River Protection Act 2017 (Wilip-gin Birrarung murron) aimed at protecting and improving the Yarra River (Birrarung). The council provides independent advice to the Victorian government and advocates for the Yarra River as a ‘Living Entity’. While this hasn't changed River outcomes dramatically yet, it has changed the discussion away from a management viewpoint to a custodial one. In Sydney we are seeing similar though more tentative developments along similar paths at Parramatta and the Cooks river.

There is a vision to ‘transform the **Parramatta River** and its tributaries into living waterways’. The Parramatta river was the home of the Burramattagal the name derives from their totem the eel - Burra, combined with matta, a word to describe a place and gal, the word for man.[30] Fish was their main food source where women were primarily responsible for providing the clan with fish.[31] The modern aim is to activate a walkway along its shores - the Wangal Walk,[32] And make the river swimmable again. *Murama River Rangers* and Riverkeeper Groups are the main advocates identifying areas of priority conservation and bank restoration.

The **Cooks River** a smaller river in Sydney, is of note as it has created the Wurridjal Festival around what is likely its totem - the Mullet, to mark the start of a season (March) when thousands of mullet – known as ‘wurridjal’ enter the Cooks River during their pre-spawning migration along the east coast of Australia. There are both volunteer and council organizations involved in its protection. The depth of engagement is deepening in 2016, the Council run Cooks River Alliance commissioned the *Aboriginal History Along the Cooks River* by Dr. Paul Irish.[33] Jennifer Newman, a Wiradjuri woman, was an executive member of the community-run Cooks River Valley Association, which regenerates the banks of the river and advocates for acquisition.

We are obviously still at the stage of pulling these ideas together and on our Koala Belt there are the **Georges Riverkeepers**, a Council organization co-ordinating action for pollution monitoring and so forth, and the **Hawkesbury/Nepean Riverkeepers**, a university driven organization that is actively looking at tying in a conservation and indigenous overlay. So it is from an analysis of these examples that next steps will be drawn. What should not be forgotten here is that modern Australia's Koala Dreaming starts in this area too, in 1798 John Price first “discovered” the koala, near Pheasants Nest

just south of Wilton on the Nepean, and the word ‘Koala’ too likely comes from a Dharug word ‘Koolah.’ The depth of a Koala totem along these rivers is yet to be determined, but there are rock carvings of the Koala which are rare besides the Hawkesbury at Blackfellows Head.

Figure 6. Koala Aboriginal rock carving, Blackfellow's Head, Westleigh (Hawkins, Ralph c1970)

CONCLUSİON

Sydney's Koala Belt, anchored by the Georges and Nepean Rivers, presents a critical opportunity to redefine urban planning through a lens of ecological and cultural stewardship. Despite grim state-wide trends, the resilient Macarthur Koala population demonstrates the potential for recovery when habitat fragmentation is addressed. Historically, piecemeal protections and a diluted green belt have failed to curb urban sprawl driven by developer interests. However, the emerging concept of a Koala Belt, integrating robust ecological corridors (at least 400m wide) with Indigenous totemic and songline concepts, offers a more holistic and enduring solution.

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UTILIZING AI AND INTELLIGENT INFRASTRUCTURE FOR SUSTAINABLE HERITAGE MANAGEMENT AND SMART TRANSFORMATION OF HOUTONG, TAIWAN

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INTRODUCTION

In recent years, sustainable development has gradually become a global consensus. Within the tourism industry, the challenge lies in how to balance economic growth and local revitalization with ecological conservation and cultural preservation. As climate change intensifies, urbanization accelerates, and visitor numbers continue to rise, many tourist destinations are facing issues such as insufficient environmental carrying capacity, resource depletion, and the erosion of community culture. These tensions highlight the urgent need to integrate "smart tourism" with "ecological management" in future tourism development.[1]

Figure 1. Houtong's Geographical Context Map. (Source:Created by the author.)

The Houtong area in New Taipei City, Taiwan, provides a representative case. Once a thriving coal-mining settlement, Houtong declined in the late 20th century and later transformed into a well-known tourist attraction branded as the "Cat Village." Today, Houtong draws large numbers of domestic and international visitors, becoming one of northern Taiwan's most popular destinations. However, while tourism brings economic vitality, it also exerts pressure on the local ecosystem. Problems such as

declining vegetation cover, disturbed stream water quality due to recreational use, and environmental sanitation issues linked to the over-concentration of stray cats illustrate the fragile balance between tourism growth and ecological resilience. This situation reflects a lack of systematic ecological monitoring and visitor flow management, gradually leading to the emergence of overtourism.

Previous studies on Houtong and its neighboring Jiufen have mainly focused on cultural heritage preservation, community-building, and tourism marketing strategies. While these efforts have contributed to shaping a distinctive local identity, relatively few studies have addressed the quantitative analysis of "ecological carrying capacity" and "visitor behavior management." Meanwhile, advances in Artificial Intelligence (AI) and big data analytics present new opportunities for local governance. AI can serve as a "predictive engine" by integrating NDVI (Normalized Difference Vegetation Index), climate data, and real-time sensor inputs to monitor environmental change trends.[2] At the same time, AI-based visitor hotspot analysis and simulation can help identify potential conflict zones in advance and provide optimized management strategies. Such data-driven governance compensates for the limitations of traditional, experience-based planning, enabling more precise and forward-looking management.

Building on this context, this study takes Houtong as a case site and aims to propose an "AI-oriented sustainable tourism management model." The research objectives include three main aspects: (1) to integrate NDVI and climate data to investigate recent ecological trends in Houtong; (2) to employ Kepler.gl, Overpass Turbo, and visitor flow simulation tools to visualize the interactions between tourist activity and ecologically sensitive areas; and (3) to develop an AI-driven simulation and management framework that proposes strategies for balancing visitor distribution and ecological protection. By integrating interdisciplinary methods, this research seeks not only to address the needs of local tourism development but also to serve as a reference for other cultural-ecological settlements in Taiwan.

LITERATURE REVIEW

1. Sustainable Tourism, Carrying Capacity, and the Push–Pull Theory

Sustainable tourism emphasizes balancing economic benefits, social needs, and ecological protection. Since the UNWTO introduced its framework, scholars have increasingly highlighted the importance of "carrying capacity,"[3] which recognizes that natural and socio-cultural systems have thresholds. Exceeding these limits can lead to ecological degradation, resident discontent, and a decline in tourism quality. The problem of overtourism has become evident worldwide: Venice struggles with cruise tourism, Barcelona faces protests over overcrowding, and parts of Bali were closed due to environmental damage.

Tourist flows are also shaped by motivation. According to the **Push–Pull Theory,**[4] travel behavior arises from internal "push" factors—such as escaping daily routines or seeking leisure—and external "pull" factors, such as landscapes or cultural symbols. In Houtong, visitors are drawn by the "Cat Village" identity and mountain-town atmosphere (pull) while also motivated by urban stress relief (push). When flows driven by these forces exceed local carrying capacity, overtourism emerges. Taiwanese studies similarly note that mountain settlements often face land overuse and congestion once transportation improves. Integrating carrying capacity with motivation analysis and technological tools is therefore crucial for sustainable tourism governance.

2. Smart Tourism and Artificial Intelligence Applications

With the rise of digital technologies, tourism has entered the "smart tourism" era. Its core lies in using ICT, IoT, AI, and big data to enhance experiences, improve efficiency, and support sustainability. Practical cases illustrate this potential: Barcelona uses sensors to monitor visitor distribution, while Kyoto employs big data to inform tourists about peak times and alternatives.[5]

AI applications in tourism generally fall into three categories: predictive analytics (forecasting visitor flows through machine learning and external variables), real-time monitoring (tracking flows and environmental stress via sensors and recognition systems), and optimization strategies (simulating scenarios to balance visitor distribution and ecological protection). Yet scholars caution that focusing solely on efficiency may neglect local culture and ecological sensitivity. Embedding smart tourism in local contexts is essential to avoid reducing it to a purely data-driven exercise.

3. NDVI and Environmental Monitoring

The Normalized Difference Vegetation Index (NDVI) is one of the most widely used remote sensing indicators for ecological monitoring. By measuring differences in red and near-infrared reflectance, NDVI reflects vegetation coverage and health. Since the 1970s, it has been applied in forestry, land-use studies, and climate research. NDVI time-series analyses reveal long-term vegetation change and detect anomalies such as drought or urban expansion.

With platforms like Google Earth Engine, NDVI data can be rapidly accessed and integrated with climate datasets and GIS.[6] In tourism research, NDVI has been applied to assess links between visitor activity and ecosystem health, such as comparing vegetation cover in natural parks with tourist distribution. For Houtong, NDVI can capture vegetation dynamics in the mountainous environment and be cross-referenced with visitor flow data, providing a quantitative basis for evaluating tourism's ecological impacts.

Synthesis

This review identifies three research gaps. First, while sustainable tourism emphasizes carrying capacity, few studies combine it with motivation theories such as the Push–Pull framework. Second, although AI applications in smart tourism are advancing, their integration with ecological governance remains limited. Third, NDVI has proven effective in environmental monitoring, but applications in settlement-based tourism contexts in Taiwan are scarce. This study seeks to address these gaps by integrating Push–Pull theory, AI technologies, and NDVI monitoring into a framework for balancing tourism management and environmental sustainability.

METHODOLOGY

This study takes Houtong, located in Ruifang District, New Taipei City, as a case study. Using the Google Earth Engine (GEE) platform, it integrates remote sensing imagery, climate data, and visitor flow simulations to explore the relationship between tourism activities and ecological sustainability. The methodology consists of three major components:

1. Study Area and Data Collection

Houtong, once a coal-mining settlement, has transformed into a popular tourist destination known as the "Cat Village." The area is mountainous, ecologically sensitive, and highly representative of cultural-ecological settlements in Taiwan.

A. **Remote sensing and NDVI data**: Sentinel-2 and MODIS imagery (2010–2025) obtained through GEE, used to calculate NDVI values and analyze vegetation coverage and temporal changes.[7]

B. **Climate data**: Global precipitation and temperature datasets (e.g., CHIRPS, ERA5) accessed via GEE, correlated with NDVI trends.[8]

C. **Tourism flow data**: Facility and node information (e.g., train station, cafés, cultural facilities) extracted using Overpass Turbo, with weighted visitor flows visualized through Kepler.gl.

2. Analytical Framework

A. **Natural Sciences Analysis (NDVI and Climate Correlation)**

I. Conduct NDVI time-series analysis to identify vegetation change trends.

II. Correlate NDVI results with precipitation and temperature data to assess ecological vulnerability and climate impacts.

B. **Social Sciences Analysis (Tourism Flow Simulation and Push–Pull Theory)**

I. Apply the **Push–Pull Theory** by translating destination pull factors into spatial nodes with assigned weights based on facility type.

II. Use Kepler.gl to construct weighted flow models and heat maps, overlaying them with NDVI and climate-sensitive areas to examine pressures caused by tourism activity.

3. Validation and Limitations

The results are cross-validated with government tourism statistics and findings from previous studies to ensure reliability. Limitations include the insufficient resolution of satellite imagery for capturing micro-level vegetation changes, potential errors in GEE climate datasets, and the lack of real-time field ecological measurements.

CASE STUDY / ANALYSIS

This study applies the proposed methodology to Houtong, analyzing the relationship between tourism activities and ecological sustainability from two perspectives: natural sciences and humanities. The results reveal the interaction between vegetation change, climate variability, and visitor flows.

1. Natural Sciences Analysis: NDVI and Climate Trends

Annual Precipitation (2010–2024)

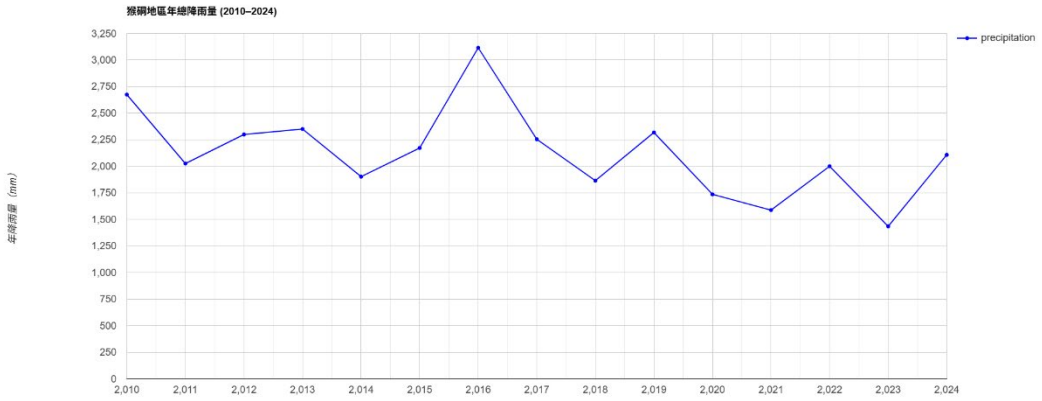

*Figure 2. Houtong **Annual Precipitation**. (Source:Created by the Google Earth Engine.)*

Annual precipitation in Houtong demonstrates significant fluctuations. In 2010, rainfall was around 2600 mm but dropped to about 2000 mm in 2011. [9]The highest peak occurred in 2016, exceeding 3100 mm, while 2023 recorded the lowest value at approximately 1400 mm. Although Houtong is situated in a typically humid mountain region, precipitation patterns have become increasingly unstable, with more pronounced contrasts between wet and dry years.

NDVI Annual Average (2010–2024)

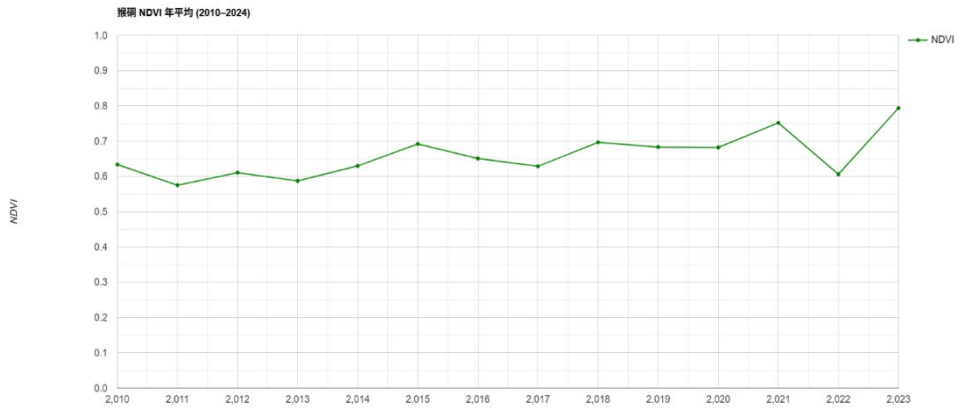

*Figure 3. Houtong **NDVI Annual Average**. (Source:Created by the Google Earth Engine.)*

NDVI trends show initial decline followed by gradual recovery. Values decreased from 0.62 in 2010 to 0.57 in 2011, indicating early vegetation stress. They rebounded in 2015 (0.69) and reached 0.75 in 2021, reflecting strong ecological resilience. However, NDVI dropped again to 0.60 in 2022, coinciding with a drought year, before rebounding sharply to 0.79 in 2023, the highest value during the study period. This suggests that vegetation in Houtong has adaptive capacity but remains vulnerable to climatic variability.

Land Surface Temperature (2010–2024)

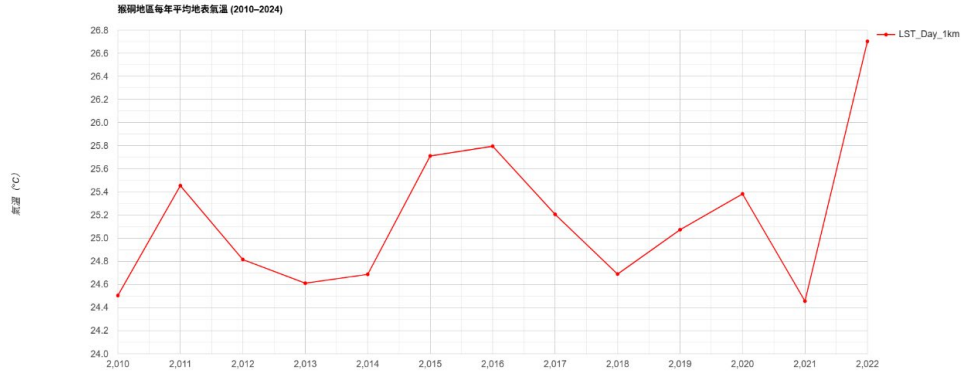

Figure 4. Annual average surface temperature. (Source:Created by the Google Earth Engine.)

Average land surface temperature (LST) ranged from 24.5°C to 26.8°C. Temperatures remained relatively stable from 2010 to 2014, then rose rapidly to 25.8°C in 2015–2016. After fluctuations between 2017 and 2021, the temperature peaked at 26.8°C in 2022, representing an extreme heat event. These changes correlate with NDVI patterns, as years with elevated temperatures often correspond to vegetation stress.

Correlation Analysis between NDVI and Climate

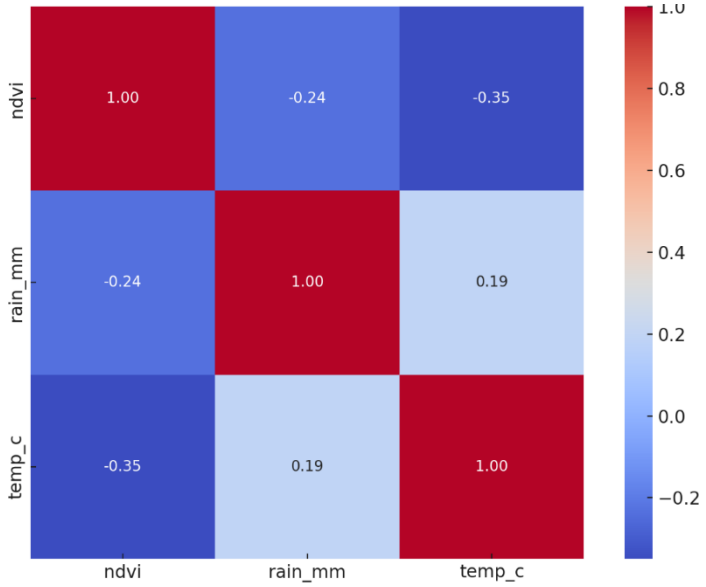

Figure 5. Correlation Matrix between NDVI, Precipitation, and Temperature (Source:Created by the author.)

Part A – Statistical Relationships: NDVI shows a weak negative correlation with precipitation (r = –0.24) and a moderate negative correlation with temperature (r = –0.35), suggesting that excessive rainfall may not enhance vegetation growth, while high temperatures exert stronger suppressive effects. Precipitation and temperature are only weakly correlated (r = 0.19), indicating unstable climatic interactions in the region.

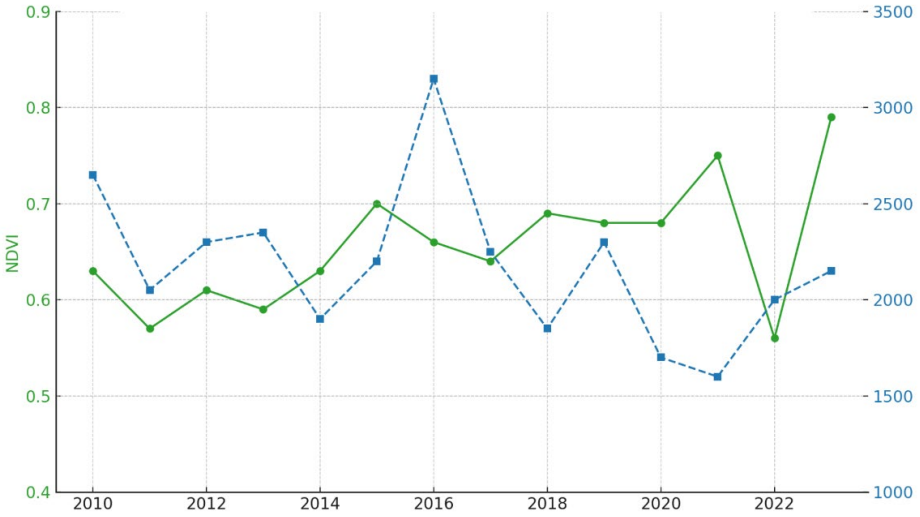

Figure 6. NDVI and Precipitation Time-Series in Houtong (2010–2024) (Source:Created by the author.)

Part B – Temporal Dynamics: NDVI generally improved in years with moderate rainfall (e.g., 2015, 2021), while extreme rainfall (2016) and drought conditions (2022) corresponded with NDVI declines. Despite this, vegetation demonstrated resilience, rebounding sharply in 2023 to its highest recorded

value (0.79). Overall, NDVI in Houtong is more sensitive to extreme heat and climatic extremes than to average rainfall fluctuations.

Summary: Vegetation dynamics in Houtong are strongly influenced by climate variability, particularly high temperatures and extreme rainfall events. While NDVI demonstrates recovery capacity, ongoing climate extremes introduce heightened ecological uncertainty.

2. Humanities Analysis: Tourism Flow Simulation and Push–Pull Theory

1. Tourist Trend Analysis (2001–2024)

年	年間				1日平均	
	上車	下車	上下車	来源	上車	上下車
2001	72,681	60,934	133,615	[34]	[註 1]206	[註 1]379
2002	58,362	55,515	113,877	[37]	160	312
2003	56,264	52,165	108,429	[38]	154	297
2004	51,204	46,913	98,117	[39]	140	268
2005	48,743	46,276	95,019	[40]	134	260
2006	49,934	45,776	95,710		137	262
2007	42,274	41,444	83,718	[41]	116	229
2008	48,024	45,943	93,967		131	257
2009	50,328	48,806	99,134		138	272
2010	142,591	136,775	279,366	[42]	391	765
2011	230,699	221,684	452,383	[43]	632	1,239
2012	235,782	237,165	472,947	[44]	644	1,292
2013	291,768	282,827	574,595	[45]	799	1,574
2014	343,005	332,687	675,692	[46]	940	1,851
2015	295,312	283,845	579,157	[47]	809	1,587
2016	292,935	281,768	574,703	[48]	800	1,570
2017	283,531	273,271	556,802	[49]	777	1,525
2018	290,095	281,119	571,214	[50]	795	1,565
2019	290,670	287,384	578,054	[51]	796	1,584
2020	176,764	171,694	348,458	[52]	483	952
2021	123,844	119,958	243,802	[53]	339	668
2022	139,556	132,221	271,777	[54]	382	745
2023	314,973	288,616	603,589	[55]	863	1,654
2024	283,867	280,731	564,598	[56]	776	1,543

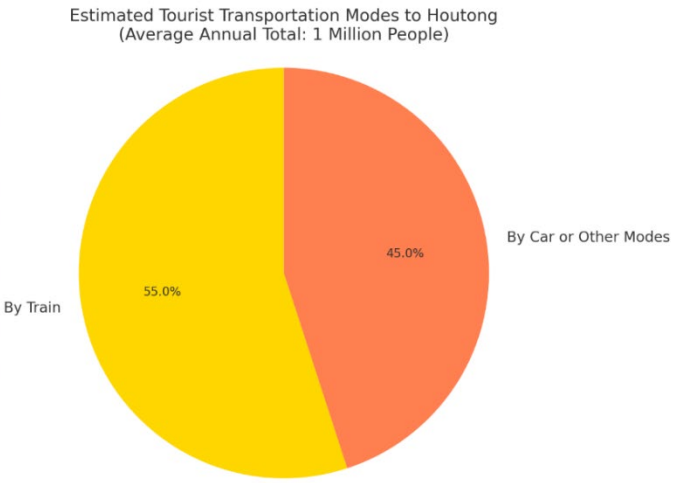

Figure 7. Crowd Flow Simulation (2001–2024) (Source:Created by the author.)

Tourism development in Houtong can be divided into three phases:

- **Before the Cat Village**: Prior to 2010, Houtong attracted fewer than 100,000 visitors annually and remained a quiet post-mining settlement with limited tourism activity.
- **The Rise of the Cat Village**: Since 2010, the emergence of the Cat Village identity and cultural tourism has driven visitor numbers to stabilize at around 1 million per year. According to Taiwan Railways data, Houtong Station now serves approximately 550,000 passengers annually, accounting for about 55% of total visitors.[10] The remainder arrive via private vehicles, tour buses, scooters, bicycles, or hiking trails.
- **Pandemic Impact and Recovery**: During the COVID-19 pandemic (2020–2021), visitor numbers dropped sharply to between 240,000 and 340,000. Since 2023, however, tourism has steadily recovered, reflecting resilience and renewed interest.

These trends highlight both the central role of rail-based transportation and the symbolic “Cat Village” branding in attracting visitors, as well as the vulnerability of local tourism to external shocks such as the pandemic.

2. Tourism Hotspot Distribution

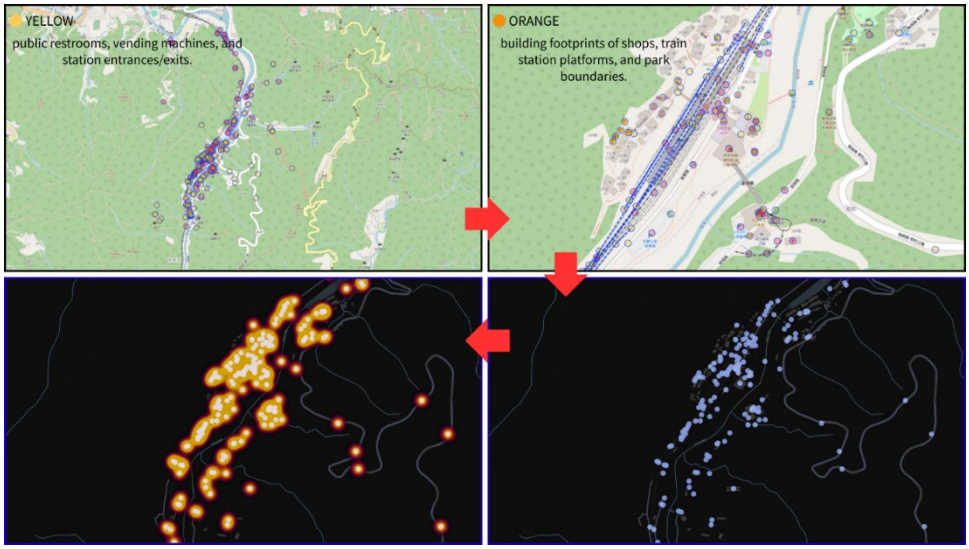

Figure 8. Crowd Flow Simulation (Source:Created by the author.)

Using Overpass Turbo, facilities within a 1.5 km radius of Houtong were extracted, and weighted visitor flows were modeled in Kepler.gl. The results show that visitor activity is highly concentrated around Houtong train station and the Cat Village core, forming a single dominant hotspot. Cafés and dining spaces form secondary clusters, while cultural facilities and hiking trails attract comparatively fewer visitors, indicating a highly uneven spatial distribution of tourism.

3. Interpretation through Push–Pull Theory

According to the **Push–Pull Theory** , visitor flows in Houtong are shaped by a combination of push and pull factors:

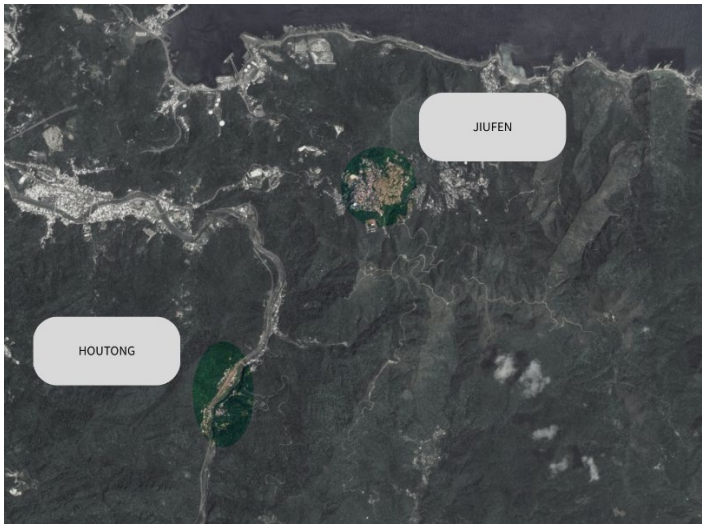

Figure 9. Jiufen Geographical Location (Source:Created by the author)

• **Pull factors**: The accessibility of Houtong Station and the symbolic Cat Village identity serve as the primary attractions. Moreover, the proximity of Jiufen—an internationally renowned tourism hotspot with historic streets, teahouses, cultural architecture, and nostalgic atmosphere—creates a strong pull

factor with a spillover effect. Many domestic and international tourists extend their trips from Jiufen to Houtong, positioning it as a secondary node within the regional tourism network.

• **Push factors**: Most visitors are motivated by short-term escapes from urban life and the pursuit of leisure or healing experiences. These motivations result in generally short stays, high crowd density, and limited spatial dispersion.

• **Impacts**: The most congested visitor areas overlap with zones of NDVI decline, indicating that tourism activity directly contributes to ecological stress.[11]

PROPOSED STRATEGIES

To balance tourism development and ecological sustainability in Houtong, this study proposes integrated strategies from both the natural sciences and social sciences perspectives:

1. Natural Sciences Perspective

1. Environmental Sensor Installation

Deploy sensors in high-traffic, geologically risky, and ecologically sensitive areas. These include rainfall sensors to detect abnormal weather, slope monitors for landslide risks, and AI-powered wildlife cameras to observe animal activity and human–wildlife interactions.

2. Improving NDVI Accuracy

Cross-validate satellite-based NDVI with field surveys, such as sample plots and vegetation cover checks. This reduces distortions caused by clouds, humidity, or terrain, thereby improving the reliability of long-term ecological monitoring.

3. AI Integration Models

Integrate NDVI, climate, and tourist flow data into AI models to monitor long-term ecological trends, simulate peak-season impacts, and support dynamic carrying capacity management—ultimately enabling smarter, data-driven decisions for sustainable tourism planning.

2. Social Sciences Perspective

1. Xiaocukeng Trail as a Redistribution Node

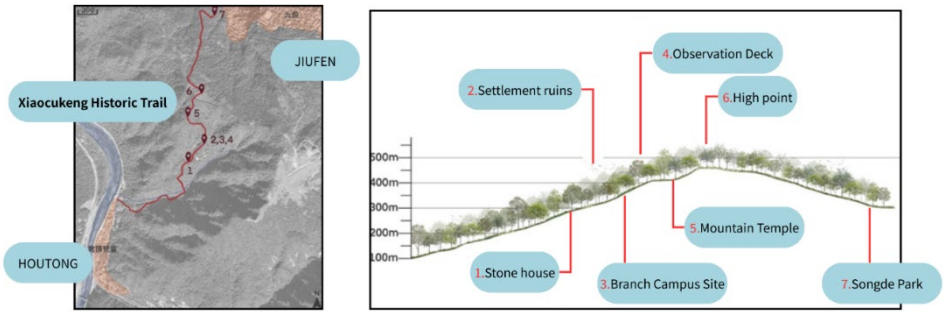

Figure 10. Xiaocukeng Geographical Location (Source:Created by the author)

Position the Xiaocukeng Trail as an intermediate target zone linking Jiufen and Houtong. By enhancing trail design, landscape features, and interpretive facilities, the trail encourages visitors to pause and explore, extending their stay while dispersing flows beyond Jiufen's core.

2. Tourist Flow Redistribution Model

Starting from Jiufen, develop a connected network of eco-trails and historic sites—including the Miner's Museum and Ruisan Mining Ruins—to redirect part of the visitor flow into Houtong's deeper areas. This helps relieve crowding in Jiufen, promotes longer visitor stays, and revitalizes underused cultural and ecological resources.

CONCLUSION

This study examined Houtong as a case study to explore the tensions and potential reconciliations between tourism development and ecological sustainability, framed from both natural sciences and social sciences perspectives. The research motivation arises from Houtong's unique trajectory: once a declining coal-mining settlement, it has reemerged as a tourist destination through the symbolic branding of the "Cat Village." This transformation highlights the complex interplay of cultural symbolism, regional linkages, and ecological pressure, raising the broader question of how sustainable governance can be achieved under the twin challenges of climate change and overtourism.

From the natural sciences perspective, NDVI and climate data retrieved via the GEE platform revealed that Houtong's vegetation demonstrates resilience but is highly sensitive to extreme heat and rainfall variability. Correlation analyses show that excessive rainfall does not necessarily foster vegetation growth and may even trigger soil erosion or short-term ecological stress, while high temperatures exert a strong suppressive effect on vegetation health. These findings underscore the vulnerability of Houtong's ecosystems in an era of climate extremes, highlighting the urgent need for continuous ecological monitoring.[12]

From the social sciences perspective, visitor flow simulations and Push–Pull Theory analyses show that tourism in Houtong is defined by short stays, high density, and a single-core pattern. The primary pull factors include the accessibility of Houtong Station and the symbolic identity of the Cat Village, while Jiufen exerts a powerful regional pull that positions Houtong as a secondary node within the tourism network. However, this concentrated visitor pattern results in substantial overlap between NDVI decline zones and tourism hotspots, confirming that tourism activities are directly linked to ecological stress.

Taken together, these findings indicate that Houtong's role within the regional tourism system is promising yet constrained by two critical challenges: concentrated visitor flows and ecological fragility. To address these issues, this study proposes targeted strategies. From the natural sciences perspective, these include installing environmental sensors, enhancing NDVI accuracy through field validation, and integrating NDVI, climate, and visitor flow datasets into AI models for dynamic carrying capacity management. From the social sciences perspective, the Xiaocukeng Trail is positioned as a key linkage between Jiufen and Houtong, designed to disperse flows through trail-based attractions and interpretive features, while a flow redistribution model directs visitors into deeper sites such as the Miner's Museum and the Ruisan Mining Ruins, fostering a multi-core development pattern.

The contributions of this research lie in providing a cross-disciplinary framework that integrates remote sensing, AI-based simulations, and tourism theory,[13] thereby uncovering the ecological–tourism interactions and translating them into actionable strategies for regional governance. Future research should incorporate on-site surveys and community participation to further refine and ground these strategies in practice. Ultimately, Houtong can be repositioned as a sustainable tourism hub that balances cultural value, ecological resilience, and community agency—serving not only to mitigate the impacts of overtourism but also as a model case of coexistence between local heritage and natural systems in Taiwan.

NOTES

[1] Graham M. S. Dann, “Anomie, Ego-Enhancement and Tourism,” *Annals of Tourism Research* 4, no. 4 (October 1977): 186–187.
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[3] United Nations World Tourism Organization (UNWTO), *Tourism and Sustainability: A Statistical Insight* (Madrid: UNWTO, 2019), 33.
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HARNESSING THE BENEFITS OF ORGANIC FIBRES IN REGENERATIVE GREENING

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INTRODUCTION

Climate change has a significant impact on cities worldwide. Urban areas face increasingly intense heatwaves, deteriorating air quality, rising flood risks, and growing pressure on infrastructure and public health systems. In this context, urban greenery is a key strategy for promoting ecological, social, and economic sustainability.[1] Ecologically, green spaces improve air quality, capture carbon, regulate temperatures, and support biodiversity by providing habitats for pollinators and other species. Socially, access to nature enhances well-being, reduces stress, encourages physical activity, and strengthens community cohesion and equity. Economically, urban greenery increases property values, reduces infrastructure costs through nature-based solutions, and creates new opportunities for employment and innovation.

Currently, many urban greening solutions rely heavily on non-renewable materials that are transported over long distances.[2] This practice conflicts with sustainability goals and highlights the need to shift toward local, renewable, and recycled materials. The expansion of urban greenery increases the demand for sustainable and locally sourced materials, such as organic substrates, recycled components, and plastic-free alternatives. This shift supports circular economy principles and helps reduce environmental impact.

European Union strategies, including the Biodiversity Strategy 2030,[3] the Circular Economy Action Plan,[4] the Strategy for Sustainable and Circular Textiles,[5] and the EU Plastics Strategy,[6] provide a strong policy framework for this transition. These initiatives guide cities and businesses toward greener and more resilient built environments, encouraging the development of new materials, practices, and partnerships that meet future regulatory and market expectations.

Companies are encouraged to develop their operations and build new networks to meet the demands of future business environments. EU strategies and regulatory frameworks strongly shape the growing importance of urban greenery and sustainable, locally sourced materials. These policies establish clear targets for urban planning and material use, creating both pressure and opportunities for companies to develop solutions that support ecological urban development and circular economy models.

The EU Plastics Strategy[7] aims to reduce plastic pollution and promote the use of alternative materials, thereby directly supporting the transition toward plastic-free solutions in green construction and urban design. Regulatory changes, including eco-design requirements, extended producer responsibility, and measures to limit microplastics, require companies to reassess their material choices and supply chains. At the same time, EU funding instruments and growing demand for ecological solutions open new

avenues for innovation and business development. These initiatives support a regenerative thinking[8] approach that actively restores and strengthens nature's systems. It goes beyond the frameworks of circular economy and sustainable development by creating conditions that support life in its ecological, social, and economic dimensions. Regenerativity incorporates systemic thinking that recognises the interconnectedness of environmental and financial systems. It is inherently long-term in orientation, prioritising resilience and adaptive capacity over short-term gains.

BACKGROUND LITERATURE

Although the use of recycled materials in green building has been widely studied,[9] these studies often lack an understanding of the entire production chain's functionality.[10] To improve the supply chain, it is vital to understand the experiences and perceptions of different actors and their systemic roles. In this case study, we analyse actors' experiences in the textile circular economy, focusing on the collection and use of organic fibres such as wool and cotton in regenerative green construction, particularly in urban greening. These perspectives highlight the challenges and uncertainties of utilising organic textile fibres in construction that may be based on incorrect assumptions about consumer and production chain expectations.

Circular economy and material revalorisation

The common challenge in conventional construction is that speed and economic returns matter more than material reuse.[11] The circular economy offers a compelling response to the waste-intensive logic of traditional construction. It promotes the reintegration of used materials into productive cycles, reducing dependency on virgin resources and lowering environmental footprints. In urban greenery, this philosophy is being applied to everything from structural timber reuse to recycled concrete aggregates.[12] Organic waste fibres represent a high-potential resource stream for smaller-scale construction such as urban greenery.[13] Repurposing textile waste not only mitigates disposal impacts but also reduces reliance on mined or fossil-based inputs.[14]

Lifecycle assessment (LCA) provides a comprehensive framework for evaluating the environmental impacts of textiles and apparel from raw material extraction through end-of-life disposal.[15] Advanced recycling and circular economy strategies—when assessed through LCA—can significantly reduce dependency on virgin fibres and mitigate environmental burdens such as greenhouse gas emissions, water usage, and landfill accumulation.[16] However, these sustainability advantages often remain under-recognised in procurement decisions due to the absence of standardised certifications or lifecycle-based eco-labels. Without formal Environmental Product Declarations (EPDs) and traceable metrics, even environmentally superior materials struggle to gain acceptance in mainstream construction markets.[17]

The SERVQUAL model in circular B2B supply chains

Originally developed to measure service quality in the financial sector and consumer contexts, the SERVQUAL model evaluates perceptions across five dimensions: reliability, assurance, tangibles, empathy, and responsiveness.[18] Its application to B2B supply chains, especially those in green and circular contexts, offers valuable insights into stakeholder satisfaction and friction. In construction, where material reliability and inter-organisational trust are paramount, the SERVQUAL model is a diagnostic tool. The growing complexity of sustainability regulations and market disruptions in construction supply chains demands new tools for managing procurement risks and highlighting that trust, risk transparency, and alignment of sustainability expectations are central to supplier–buyer relationships.[19] While they do not apply SERVQUAL directly, Pacheco and Clausen[20] developed a framework that addresses comparable service quality dimensions, providing valuable insights into how construction companies can systematically evaluate supplier performance within circular and

sustainable procurement goals. Similarly, adapting service quality models such as SERVQUAL can help identify expectation gaps, like delivery reliability and sustainability assurance, that often hinder the adoption of green logistics and procurement solutions.[21]

In the context of fibre-based media, reliability refers to the consistency of material quality.[22] Assurance involves, e.g. third-party testing and regulatory recognition,[23] while empathy covers the supplier's ability to accommodate specific client needs, such as reasonable pricing structures. The mismatch between operators in different supply chain stages is often driven by innovation, small-scale production, and regulatory compliance, influenced by buyers' cost expectations rooted in conventional procurement norms.[24] Even when developers express preferences for sustainability, purchasing decisions are typically driven by upfront cost, leading to slow adoption of green alternatives despite their lifecycle benefits.[25] Responsiveness captures agility in meeting shifting regulatory, environmental, or supply constraints. These dimensions are critical for assessing performance and trust in a fragmented supply chain that relies on waste streams.

DATA AND METHODS

The data for this explorative study were collected within the project MUOKS – Regenerative growth through design: Organic waste fibres and side streams as a growth base for nature-based solutions, coordinated by the Institute of Design and Fine Arts at LAB University of Applied Sciences. Experts for semi-structured interviews were selected through purposive sampling, based on their roles and expertise within different segments of the supply chain identified in earlier development work conducted under the MUOKS project. Given the small scale of the textile recycling and urban greening sectors in Finland, only four interviews were conducted, representing the textile waste recycling, nonwoven mat manufacturing, landscape design, and vegetated solutions sectors.

The interviews were designed to capture organisational and personal perspectives, drawing on the participants' professional experience and domain-specific knowledge. They focused on the current structure and functioning of the supply chain, highlighting how materials and processes are organised today, and on potential changes related to the transition toward organic materials, including both opportunities and barriers. Technical, regulatory, and systemic factors influencing the adoption of recycled and organic materials were also discussed, along with prospects and development needs within the field. A thematic analysis was applied to identify recurring patterns, perspectives, and potential areas for innovation across the different expert domains.

The interview data were analysed using a qualitative, exploratory approach through the SERVQUAL model to structure findings. In particular, we focused on the gaps and constraints between actors' perceptions. This model, initially designed for service quality, was adapted to analyse B2B supply chains, examining dimensions such as reliability, assurance, empathy, and responsiveness. The analysis process followed a thematic approach, categorising the interview data into three main findings, or "gaps," that highlight the misaligned priorities and challenges within the supply chain. These gaps are defined in the next chapter.

FINDINGS

The interviews with actors in the textile collection, sorting, logistics, and utilisation chain reveal critical disconnections and misaligned priorities. The core challenge lies in bridging the gap between a supply-driven, cost-conscious upstream and a demand-driven, value-oriented downstream in the urban greenery. The key gaps loosely based on the SERVQUAL in the green supply management are summarised in Figure 1 and defined in the following sections.

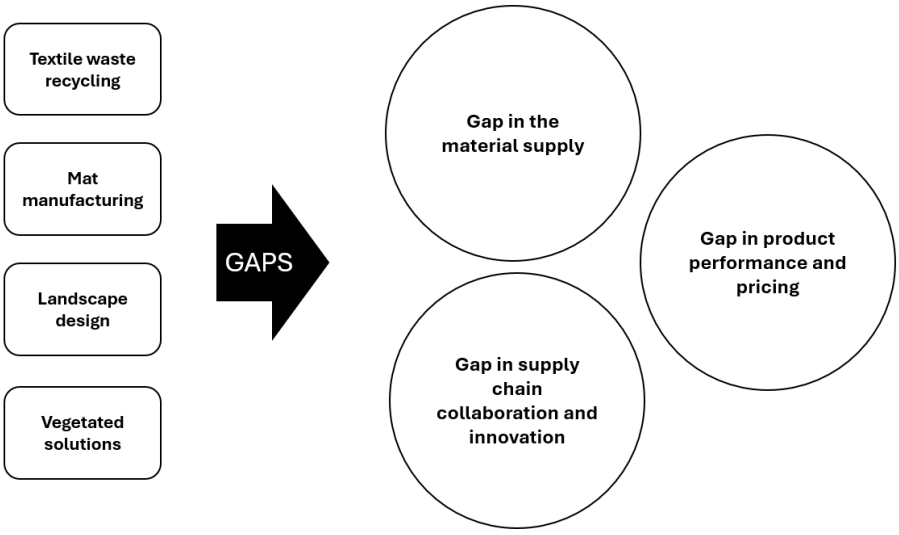

Figure 1. Key gaps in green supply management revealed by the SERVQUAL analysis

Gap in the material supply

One of the challenges within the urban greenery in Finland is the significant gap between the amount of textile and organic waste available and the volume of processed, usable raw material. The interviews revealed that a substantial quantity of raw wool, for instance, is discarded. According to a mat manufacturer, Finland generates a lot of fibre waste. Still, a lack of processing infrastructure in the country means that much remains unused for new products. Vegetated solutions provider supported this, stating "even here in Finland, huge amounts of fibre are produced, so maybe what we'd need is a whole production facility that could use this recycled fibre to make something like water retention mats".

Logistics and processing limitations compound this issue. Collecting and sorting textile waste is resource-intensive and expensive because the material must be tidy, dry, and free from hard elements like buttons and zippers to avoid damaging machinery. The process is labour-heavy and costly. The interviewed textile waste operator described the collection and sorting process as "very resource-intensive work" and noted that the costs involved make it a challenging waste stream to manage.

The upstream actors, in this case, the textile waste operator and mat manufacturer, are focused on efficiency and cost-effectiveness. Their perspective is driven by traditional business models, where profitability is based on minimising costs and maximising output. They doubt that the organic nature or domestic origin of textile fibres adds value that customers would be willing to pay for. This aligns with a broader trend in the conventional construction industry, where speed and economic returns often precede material reuse.

The upstream actors are also worried about the pending EU-level producer responsibility legislation. Without clear regulations on who pays for what, it's challenging to invest in new infrastructure with confidence. Textile waste operator complained that "since it hasn't been decided yet and nobody knows how this will be handled, we're basically left hanging all the time, so to speak."

Gap in product performance and pricing

A second key finding relates to the conflict between the environmental benefits of recycled materials and market demands for cost-effectiveness and proven performance. The interviewed landscape designer highlighted that despite a strong desire to use sustainable options, project decisions often come

down to cost. He noted that "euros unfortunately decide a lot". This creates a barrier for newer, often more expensive, recycled products.
The perceived performance of organic materials also presents a challenge. Mat manufacturer questioned the long-term effectiveness of biodegradable products in applications like water retention mats, stating that the water retention properties might degrade over time: "If the idea is that the water retention product breaks down over time, then basically the whole point of water retention breaks down with it". Landscape designer, on the other hand, saw this as a positive, noting that a slow degradation process can act as a natural nutrient source for plants, reducing the need for chemical fertilisers. However, he acknowledged that "of course, this is something that should be looked into and monitored, and there should be proper scientific research so that it's based on facts."
Verifiable product data, like Environmental Product Declarations (EPDs), is also a key factor. A vegetated solutions provider emphasised that EPDs are crucial for making informed decisions, as they quantify a product's environmental impact. However, generating these EPDs is an expensive and "hellishly heavy process," putting smaller players at a disadvantage. He explained that without a verified EPD from their supplier, they must use generic data, which does not fully capture the environmental value of their recycled products.
The lack of standardisation, certifications, and formal quality control creates a significant gap in trust and assurance within the supply chain. To be effective as a growing medium, recycled textile fibres must meet specific quality expectations, such as organic content and lack of contaminants. However, without standardised certifications, it is not easy to verify the sustainability claims of the materials. This lack of a formal framework makes it hard for even environmentally superior materials to gain approval in the mainstream market. Downstream actors face procurement risks as they cannot fully trust the properties of the material or long-term performance. This is a challenge within the urban greenery, where short-term, project-based relationships hinder the trust and collaboration needed for systemic change. The interview findings suggest that upstream actors' focus on cost-efficiency may compromise the reliability of material quality, making it difficult for downstream players to have confidence in the product.

Gap in supply chain collaboration and innovation

The interviews reveal a lack of integrated collaboration across the supply chain, from waste collection to end-use. While individual actors are highly motivated and innovative, their efforts are often siloed. The landscape designer advocated for a "holistic city planning" approach where all stakeholders, including architects, builders, and material producers, work together from the start. He recalled projects where on-site materials like vegetation and soil are salvaged and reused.
However, this level of collaboration is not the norm, although the textile waste operator described their role as "matchmakers" across the supply chain. However, he noted that many of the planned initiatives, like a new domestic production facility, are stuck in the planning phase due to a lack of coordinated effort and funding. Woollen socks are a good example of this gap in collaboration. According to a mat manufacturer, woollen socks would be an ideal raw material for their production due to the fibre quality. Still, textile waste operators do not collect them for recycling because they are classified as underwear, causing a hygiene-related issue in waste collection. This highlights how a simple lack of communication between the waste management and manufacturing sectors can prevent a perfect circular economy solution from taking hold. While all actors recognise the growing importance of urban greening and the need for new solutions due to evolving legislation, the industry is slow to adapt. The interviews expose a disconnect in communication and a lack of mutual understanding between the different segments of the supply chain.

The fragmented nature of textile recycling for construction materials, along with its contractual and short-term nature, challenges collaborative development. Producers make incorrect assumptions about what their customers value, and vice versa. This lack of communication prevents the co-development of scalable solutions and viable business models. As a result, the industry misses opportunities to align economic, environmental, and social goals, which are necessary for long-term competitiveness in a changing market. The reliance on isolated innovations rather than integrated, end-to-end solutions hinders the systemic change required for a truly regenerative economy.

CONCLUSION

This study, conducted as part of a project that tested the use of organic materials in urban greening, brings forth significant differences in perspectives among actors across the supply chain. The material supply gap highlights the disconnect between the availability of the textile waste (resource) and its economic viability as a raw material. While the concept of a "green supply chain" is broadly accepted[26], the empirical findings show that the upstream actors' focus on traditional cost-effectiveness and their reliance on a pending regulatory framework hinder investment in the necessary infrastructure. This illustrates that without clear economic drivers and policy signals, a supply chain will default to its most profitable, often linear, model.

The gap in product performance and pricing demonstrates a chasm between the environmental value of recycled materials and the market's current valuation of them. Downstream actors, despite a strong desire for sustainable options, are constrained by cost and the lack of verifiable data. The absence of standardised certifications undermines trust and assurance, which are core dimensions of the SERVQUAL model. This finding aligns with more exhaustive research on green supply chain management, which emphasises the need for transparent information sharing to build confidence among partners.[27]

Finally, the systemic gap in collaboration and innovation shows that although individual actors are highly motivated, their efforts might be siloed, preventing the co-creation of scalable solutions. By bringing stakeholders together to discuss and share their views on green supply chain may foster the mutual understanding and trust required to move from fragmented, short-term project-based relationships to a truly integrated, regenerative ecosystem. For example, the shared interests may foster developing new solutions and viable models, particularly in response to the evolving legislative landscape.

The findings emphasise the need for a holistic, end-to-end approach that integrates the economic, environmental, and social dimensions of sustainability. This approach should move beyond harm reduction toward regenerative solutions that actively restore ecosystems and enhance societal well-being. Bridging the gap between production and application requires innovative business models that create value across the supply chain.

The research was carried out within a project that also piloted the collection and processing of organic materials into a growing substrate. This combination of research and practical experimentation demonstrates how cross-sectoral collaboration could support the development of circular and regenerative solutions. Inconsistencies in regulatory implementation and the lack of market-driven innovations further underline the need for new pilot initiatives and real-world testing. In addition to research, more practical experiments are needed to co-develop scalable solutions and to support systemic change throughout the supply chain.

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ENHANCING THERMAL COMFORT IN CONTEMPORARY HOUSING THROUGH WINDOW OPENING BEHAVIOUR: CASE STUDY OF VIETNAMESE TUBE HOUSES

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INTRODUCTION

People spend over 80% of their time indoors, mainly in homes, bedrooms, living rooms, and study areas.[1] This underscores the crucial role of indoor air quality and thermal comfort in improving occupant well-being and productivity.[2] It is projected that by 2050, around 70% of the world's population will live in cities, leading to a rise in urban building density.[3] A key consequence of urbanisation is the Urban Heat Island (UHI) effect, characterised by elevated temperatures in urban areas due to the absorption and radiation of heat by dense built structures, high population densities, and the scarcity of green spaces. As opposed to rural areas, urban environments generally have less natural ventilation and lower indoor cooling potential.[4] This means that, particularly in hot climates, occupants will increasingly depend on air conditioning to maintain acceptable indoor conditions.

Vietnam is a developing country in Southeast Asia, where rapid urbanisation has caused an uneven and sometimes unsustainable rise in the construction of residential buildings in large cities.[5] In Vietnam's urban regions, the most common housing type is tube houses (also known as street houses), accounting for a significant 94.1% of all urban dwellings.[6] Despite its importance in promoting Vietnam's smart city development, some barriers pose challenges to adopting new sustainable strategies for this housing type. These include demands for multifunctional spaces, diverse user groups, poor architectural design, and unsustainable construction practices. The result is poor microclimate conditions, leading most residents to depend on air conditioning to sustain thermal comfort.[7] This dependency not only adversely impacts the health of users over time but also contributes to an escalation in overall energy consumption.

By examining a typical modern alley tube house in Ho Chi Minh City, Vietnam, the research investigates the potential of window opening behaviour to enhance thermal comfort and optimise natural ventilation. This study utilises the building simulation tool IES-VE to evaluate the indoor comfort of the current tube house under various window opening schemes, in accordance with ASHRAE Standard 55. The findings provide a practical perspective for architects, urban planners, and policymakers to adopt energy-efficient design strategies and promote sustainable behaviours suitable for tropical climates, thereby helping to mitigate climate change impacts.

LITERATURE REVIEW

Urban Vietnamese tube houses

Following the year 1986, tube houses emerged as the predominant architectural style in Vietnamese urban areas due to their cost-effective construction, which supported the rapid pace of urbanisation. The defining features of traditional tube houses include a long and narrow layout, typically comprising one or two storeys, as well as internal voids designed to improve natural light and promote airflow throughout the interior spaces.[8] However, contemporary tube houses (figure 1) have undergone a transformation towards shorter lengths with more storeys – a development attributable to the densely populated urban environment, adversely affecting the quality of indoor daylight and natural ventilation.[9] Contemporary tube houses are employed solely for residential purposes or are utilised in a mixed-use capacity that incorporates both living spaces and commercial activities. These houses usually measure between three and four metres in width and roughly fifteen to twenty metres in length. They are highly dense structures, commonly consisting of three to five storeys, with each floor averaging 3.5 metres in height. Quyen. H categorised contemporary tube houses into two types based on their locations: the first type is situated on main roads (with at least 1 or 2 lanes), while the second type is found in narrow alleys.[10] With outdoor access restricted to only one side, these tube houses have fewer opportunities for natural ventilation, especially in the back rooms away from windows, which often depend on air conditioning for thermal comfort. The main tube house envelope materials include:[11]

- External walls: one layer (100-150mm) or two layers (200-250mm) of clay plaster brick without insulation;
- Roof: reinforced flat concrete or metal frames with tiles and an insulation layer. The flat concrete roof is mainly used on buildings higher than three storeys;
- Windows: Single-glazed transparent windows made of wood or aluminium frames

Figure 1. Modern tube houses in Vietnam. Image source: French Press Agency - AFP Cost.

Previous studies have highlighted the strong reliance of Vietnamese tube houses on mechanical cooling. Phan Anh Nguyen et al. surveyed 153 households across different climatic regions and found that air-conditioners and water heaters accounted for the majority of residential energy use, with 90% of homes relying on air conditioning for thermal comfort and none depending solely on natural ventilation methods.[12] Similarly, Vinh Tien Le et al. (2017) examined 60 urban households on Vietnam's south-central coast, reporting that electricity accounted for 74.4% of total energy consumption, with cooling as the primary end-use. Air-conditioners were used by 82% of households, mainly installed in enclosed master bedrooms, while only 18% relied on natural ventilation due to cost concerns.[13] Together, these findings emphasise the widespread dependence on air conditioning as the main approach for thermal comfort in tube houses, highlighting the urgent need for sustainable alternatives that improve passive ventilation and reduce energy use dependency.

Window open behavior and adaptive thermal method

In hot climate regions, natural ventilation serves as an effective passive design strategy aimed at reducing energy consumption while enhancing occupants' thermal comfort. With the growing focus on lowering energy use for heating and cooling, natural ventilation becomes a cost-efficient passive option applicable during both the construction and operational phases of a building.[14] Occupant behaviour, particularly regarding window operation, greatly affects the effectiveness of natural ventilation and indoor thermal comfort conditions.[15] Window-opening behaviour is influenced by multiple factors, including outdoor and indoor temperatures, wind speed, relative humidity, sunshine duration, solar radiation, and levels of environmental pollution.[16]

There are two widely used thermal comfort predicting models, namely the rational model and the adaptive model.[17] The rational model was established by Fanger in 1970, combining six conventional factors: metabolic rate, occupant's clothing insulation, air temperature, mean radiant temperature, air speed, and humidity, to predict the thermal comfort of groups of users in controlled or air-conditioned environments. However, some research suggests that the thermal comfort range according to the Fanger could have been wider if occupants had more control over the space temperature, such as in naturally ventilated buildings.[18] For more than three decades, the adaptive thermal comfort model has provided a foundational approach for naturally ventilated spaces, with successive extensions developed to address diverse climatic context.[19] The adaptive model was first incorporated into the ASHRAE 55 standard in 2004, which includes three interrelated aspects: psychological, physiological, and behavioural. Specifically, some occupants' behaviours to adapt to thermal comfort include changing clothes, opening or closing windows, moving to different rooms, adjusting activity levels, and using fans or air-conditioning.[20]

In the Vietnamese context, Dang P.N. proposed a thermal comfort scale for buildings, which was later formalized as the national standard TCXDVN 306:2004, specifying microclimate parameters for the occupied zones of residential and public buildings. Table 1 shows that in the hot season, the thermal sensation scale for Vietnamese people defines a comfort range between **25.5°C and 29.5°C** at 80% relative humidity and low air velocity (0.3–0.5 m/s). The lower limit of comfort is about 25.5°C, while full comfort extends up to 29.5°C; temperatures above 31.5°C are perceived as hot.[21] This indicates an adaptation of Vietnamese occupants to warm, humid conditions, with higher comfort thresholds compared to international standards such as ASHRAE 55. Another relevant study surveyed 40 participants to identify the thermal comfort zones of Vietnamese people.[22] From this research, 90% of participants reported a comfortable thermal range between 24°C and 29°C. Another survey involving 472 students in Ho Chi Minh City, Vietnam, assessed thermal comfort in classrooms and found that the neutral temperature is 29.4°C.[23]

Thermal state	Thermal sensation	Air temperature °C (with RH = 80% and v = 0.3–0.5m/s)	
		Cold season	**Hot season**
Cold	- Cold	≤ 19.8	
	- Slightly cold		
Comfort (neutral)	- Lower limit	21.5	25.5
	- Fully comfortable	24.5	29.5
	- Upper limit	29.0	
Hot	- Slightly hot		
	- Hot		≥ 31,5

Table 1. Thermal sensation scale of Vietnamese people.

RESEARCH METHODOLOGY

Building performance simulation has grown increasingly essential for evaluating indoor environments under various conditions, providing greater efficiency than experimental methods.[24] This study uses IES-VE to assess thermal comfort in a typical Vietnamese tube house with different window operation schedules. The research aims to 1) evaluate the viability of relying on natural ventilation without air conditioning, and 2) investigate how window and door opening behaviour can enhance comfort in modern tube houses.

Research method

This study evaluates six window opening schemes to assess their impact on indoor thermal comfort in a naturally ventilated building. Options 1 and 2 represent control extremes with windows fully open or fully closed which serve as control extremes, aiming to clearly illustrate the influence of window operation on indoor thermal conditions. While Options 3, 4 and 5 simulate realistic behaviors such as nocturnal ventilation, closure during peak outdoor temperatures (11:00–16:00), and closed at night for reasons of security and privacy. Option 6 employs a temperature-driven control strategy, whereby windows open only when the indoor air temperature exceeds 29°C—an upper threshold identified from previous occupant surveys as the acceptable limit for thermal comfort in this context. Details are summarized in Table 2, with operative temperature—defined by ASHRAE Standard 55—used as the key comfort indicator for bedrooms, kitchen, and living room.

Option	Opening control	Period applied
1	Full-day open	Whole year
2	Full-day close	Whole year
3	Open from 18:00 to 6:00 (next day) Closed from 6:00 to 18:00	Whole year
4	Fully open but closed from 11:00 to 16:00	Whole year
5	Open from 6:00 to 21:00 Closed from 21:00 to 6:00 (next day)	Whole year
6	Open only when room temperatures are higher than 29°C	Whole year

Table 2. Exterior window opening scenarios.

Case study building information

The case study dwelling exemplifies the modern alley tube house commonly seen in Vietnam. Its spatial layout follows a typical pattern, featuring a living room and kitchen on the ground floor and two bedrooms with shared toilets on each subsequent level. The front bedrooms have greater outdoor exposure, while light wells are strategically incorporated within the staircase core to enhance daylight and ventilation. Completed in 2018, the building occupies a 12 m × 4 m plot, oriented northwest, with a construction density of 100%. It has four storeys (total height of 16 m, with 4 m per floor) and is accessed via a two m-wide alley. While the front façade remains open, the other sides are blocked by neighbouring structures with heights ranging from 8 to 18 m. The basic functional layouts are illustrated in Figure 2, along with the overall section, emphasising the natural ventilation strategy. In this design, bedrooms mainly depend on single-sided ventilation, complemented by stack ventilation through a ventilated lightwell to dissipate the heat accumulated inside the building.

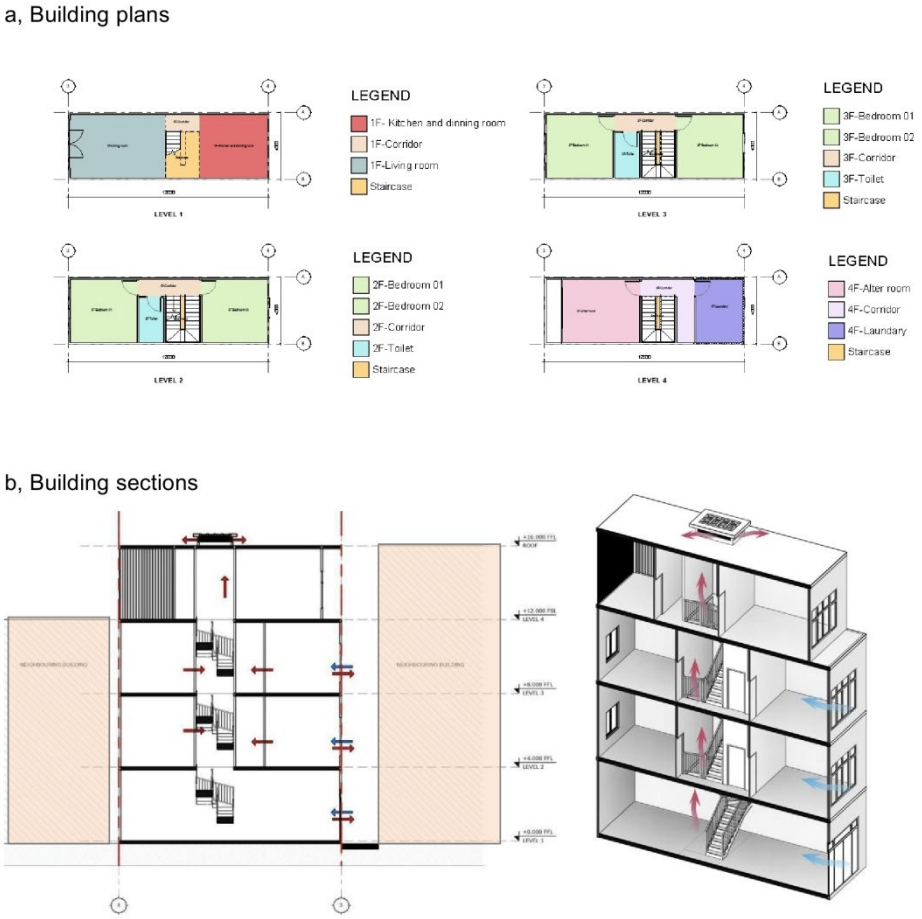


Figure 2. Building plans and sections.

Input information for simulation process

Weather data

Ho Chi Minh City has a weather pattern characteristic of a tropical climate with high temperatures and high humidity throughout the year. The hottest period is in late April and early May. There are two main seasons: the rainy season (from May to October) and the dry season (from November to April).[25] The average temperature is around 27°C with high humidity. In general, from March to July, the average temperatures are higher than 29°C, with the highest value reaching nearly 31°C in April. The average temperatures in February and from August to November are close to 28°C. January and December have the lowest average temperatures, below 27°C. The data for this research were collected daily over a period of one year, from 1st January to 31st December 2023, through the simulation process.

Building information

Typical modern tube houses in Ho Chi Minh City follow similar principles for envelope materials. Generally, these buildings are constructed from concrete, bricks, and glazing or wooden doors and windows. There are four types of openings: exterior bedroom windows, interior bedroom doors, exterior main entrance door, and roof louvre openings. Figure 3 shows the different opening types in the building. In detail, the percentage opening of the front and rear windows is set at 70% because of 30% protective horizontal louvres integrated into the windows for safety issues. The number of people in the building includes five individuals from three generations living together, which is a typical number in

Vietnamese households. This paper focuses on the spaces frequently used by occupants: living room, kitchen, and bedrooms. The bedroom doors and main entrance door are usually kept closed during lunchtime (from 11:00 to 14:00) and at night (from 21:00 to 06:00 the next day), a practice driven by owners' preference for privacy at resting hours.

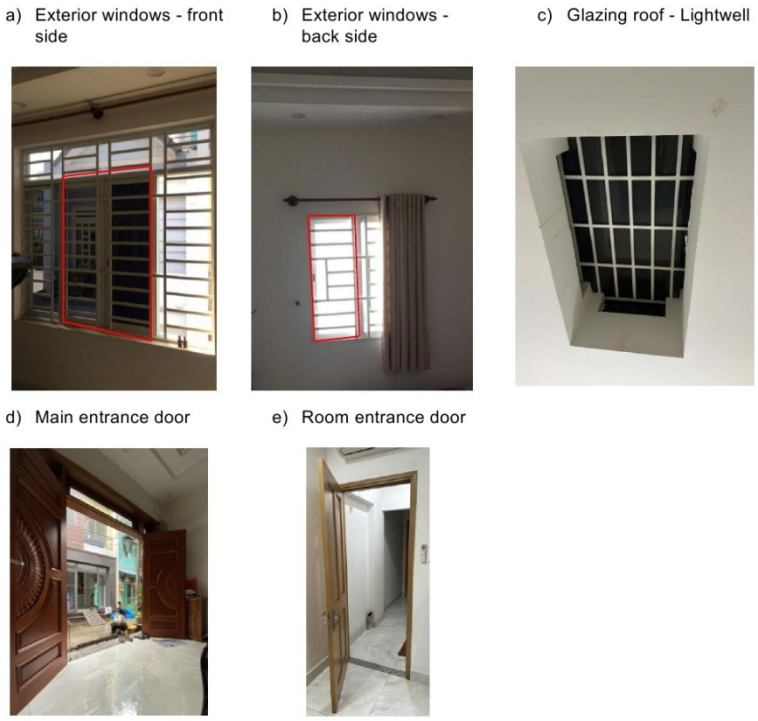


Figure 3. Exterior opening types with protective elements.

RESULTS AND ANALYSIS

Operative temperatures and thermal comfort ranges (ASHRAE 55)

Within the ASHRAE Standard 55 adaptive comfort framework, the prevailing mean outdoor air temperature $\overline{tpm(out)}$ is derived from a weighted running mean of daily mean temperatures rather than a simple arithmetic average. This formulation accounts for the temporal dynamics of human thermal adaptation, wherein recent climatic conditions exert a stronger influence on occupants' comfort responses than those experienced further in the past. By progressively diminishing the weight of earlier days, the method integrates both short-term variability and long-term climatic trends, thereby offering a more robust representation of outdoor conditions for assessing indoor thermal comfort in naturally ventilated environments. Equation 1 expresses how the prevailing mean outdoor air temperature is calculated. [26]

$$\overline{tpm(out)} = (1-\alpha)te(n-1) + \alpha trm(n-1) \quad (1)$$

where:

- te(n−1): yesterday's mean outdoor air temperature
- trm(n−1): running mean temperature for the day before the day in question
- α: weighting factor (typically between 0.6 and 0.9), determining how quickly the running mean responds to temperature changes

The thermal comfort ranges in this research are based on the recommendation of ASHRAE 55 with the 80% acceptability range. Equation 02 is used to define these 80% ranges based on the values of prevailing mean outdoor temperatures.

- Lower limit (80%): $Tlower = 0.31 \times \overline{tpm(out)} + 14.3$ (°C) (2)
- Upper limit (80%): $Tupper = 0.31 \times \overline{tpm(out)} + 21.3$ (°C)

In this research, the α value is set at 0.9, which is recommended for humid tropical climates where the variation in day-to-day temperature is not significant. The prevailing mean outdoor temperatures are calculated using equation (1), with the mean outdoor temperatures and running mean temperatures over 365 days derived from the simulated results. Figure 4 illustrates the prevailing mean temperatures throughout the year. It is clear that the $\overline{tpm(out)}$ ranges from 24°C to below 33°C, while most of the time the values are above 25°C.

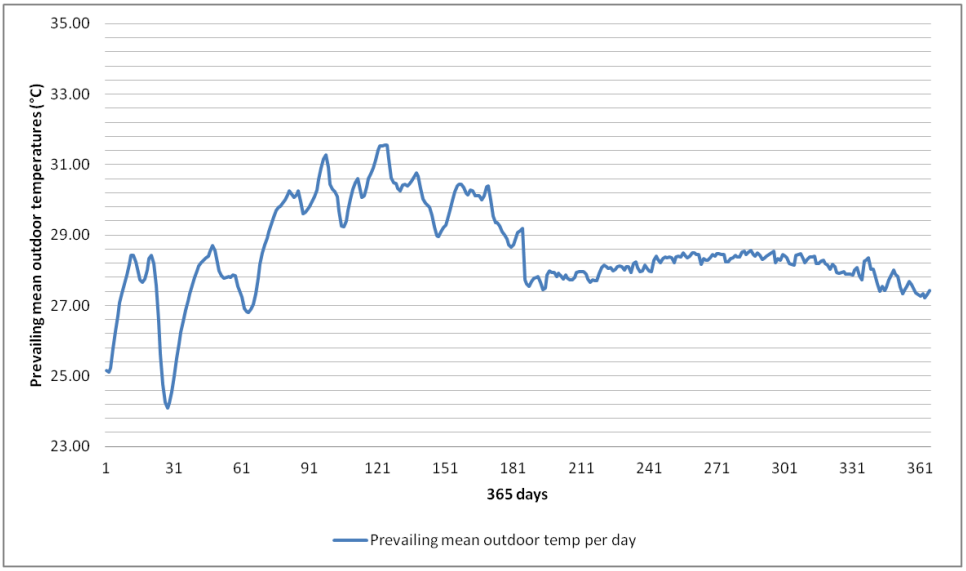


Figure 4. Prevailing mean outdoor temperatures in a year.

The year-long simulation results indicate that the operative temperature range within the 80% thermal comfort acceptability band is from 21.77 to 31.08°C. This range is consistent with neutral temperatures reported in previous studies from Vietnam, reinforcing the reliability of the model. The findings emphasize the relatively wide comfort tolerance of occupants in hot–humid climates, reflecting both climatic adaptation and alignment with existing regional field evidence

Our analysis shows the following results. Regarding 2F-Bedroom 01 (Figure 5), the proportion of acceptable thermal comfort days across six window-opening schemes was 70%, 37%, 74%, 76%, 56%, and 59%. Schemes 1, 3, and 4 (night-time ventilation) achieved the best results (>70%), while Scheme 2 (windows closed day and night) performed worst, with over 60% of days outside the comfort range. Scheme 4 was most effective, reaching nearly 80%. The trend was similar in 2F-Bedroom 02 (Figure 6), with 67%, 47%, 72%, 75%, 58%, and 61% of acceptable days. Performance was slightly better than Bedroom 01, likely due to reduced solar gains at the rear of the building. In 3F-Bedroom 01 (Figure 7), acceptable days ranged from 16% (Scheme 2) to 60% (Scheme 4), while in 3F-Bedroom 02 (Figure 8), the range was 32–64%. Overall, Level 3 bedrooms performed worse than Level 2, mainly because of greater solar exposure. Nevertheless, Scheme 4 consistently delivered the best results, while Scheme 2 remained the least effective. On Level 1, both the kitchen and living room (Figures 9-10) exceeded 75% of acceptable days under all schemes. Differences between the best and worst cases were small (<10% in the living room and approximately 10% in the kitchen), indicating that these spaces are less sensitive

to window operation and provide the highest thermal comfort compared with upper floors. Overall, findings emphasise the central role of occupant-controlled window operation, particularly night-time ventilation, in improving thermal comfort in naturally ventilated tube houses. Options 1, 3, and 4 were consistently showing better results, whereas scenarios with closed windows resulted in unacceptably poor conditions. Importantly, thermal performance varied significantly by floor level, with upper bedrooms most vulnerable to overheating, underscoring the need for design interventions that mitigate solar gains while maximising natural ventilation potential.

CONCLUSION

This study highlights the important role of window-opening strategies in enhancing thermal comfort in Vietnamese tube houses. Nighttime ventilation, particularly when combined with window closure during peak hours (Options 1, 3, and 4), lowered operative temperatures by up to 4 °C, while continuous closure at night (Options 2 and 5) led to heat build-up and the worst comfort outcomes. Additionally, nighttime ventilation proved most effective during cooler months, whereas during the hottest period (March–July), natural ventilation alone was insufficient and needed supplementary measures like standing or ceiling fans. Design limitations, such as enclosed layouts, further hindered airflow efficiency, which could be improved by adding atriums, light wells, and balconies. Although natural ventilation provides significant benefits, contextual obstacles like safety, noise, and pollution restrict window-opening behaviour. Future designs of tube houses should incorporate architectural solutions to promote effective nighttime ventilation and lessen dependence on mechanical cooling.

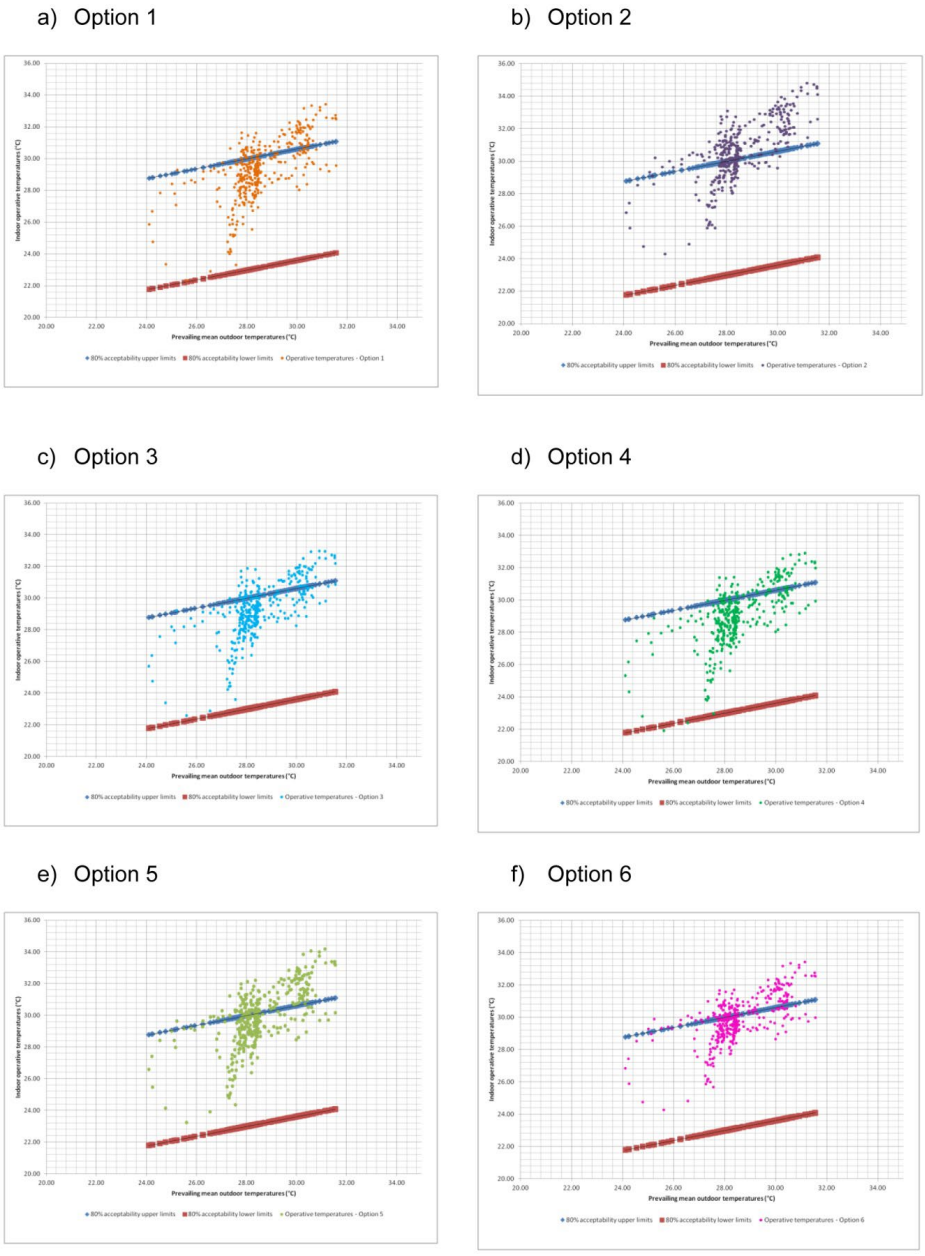
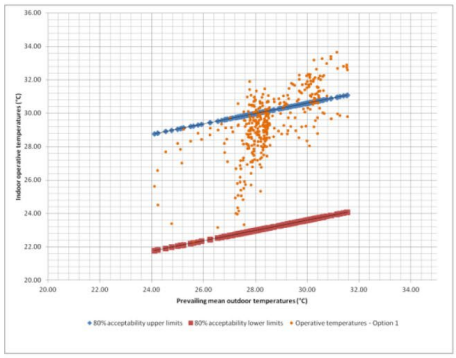
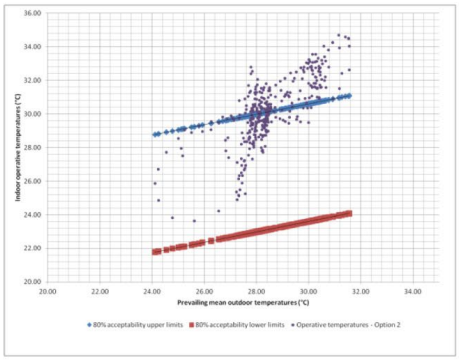


Figure 5. The 80% acceptable operative temperature ranges in 2F-bedroom 01.

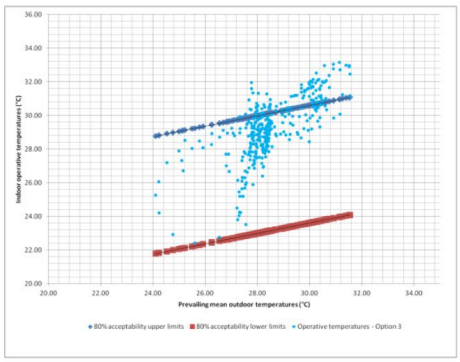
a) Option 1



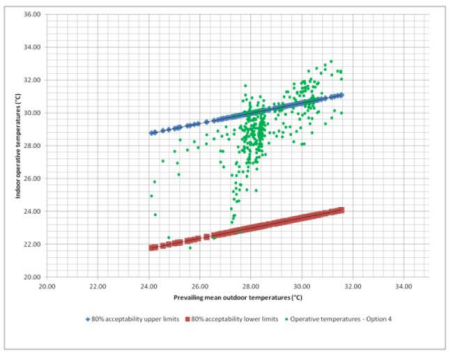
b) Option 2



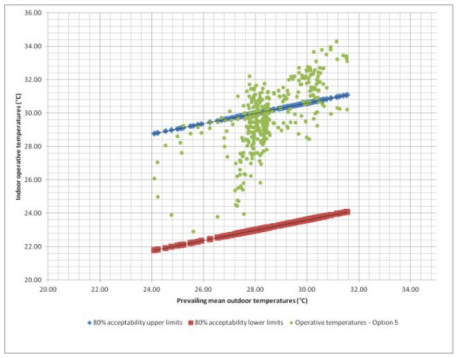
c) Option 3



d) Option 4



e) Option 5



f) Option 6

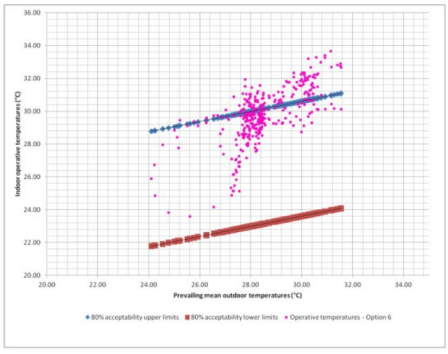


Figure 6. The 80% acceptable operative temperature ranges in 2F-bedroom 02.

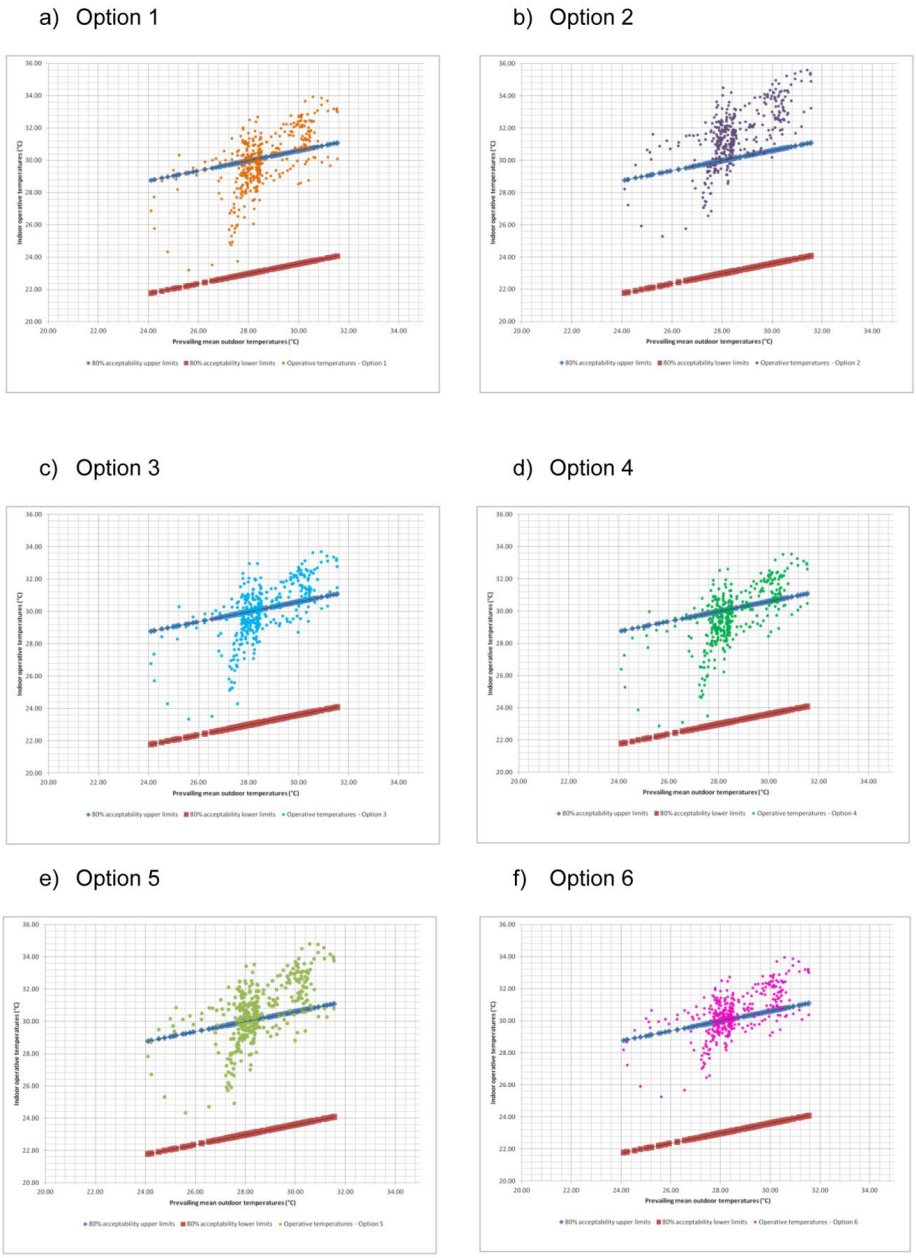
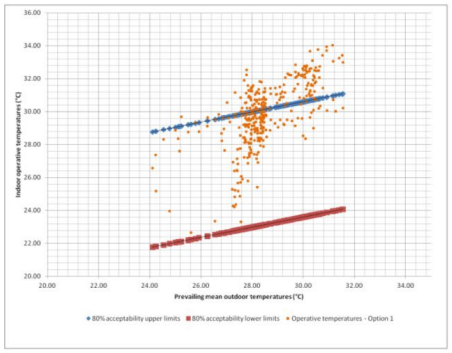


Figure 7. The 80% acceptable operative temperature ranges in 3F-bedroom 01.

a) Option 1



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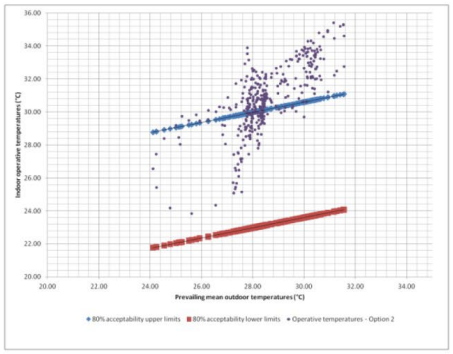

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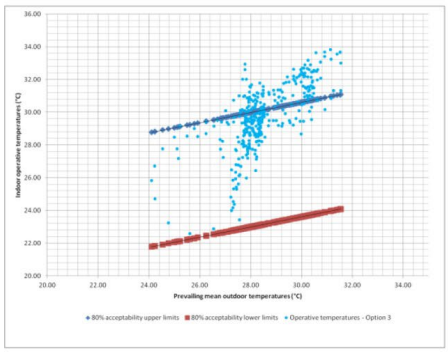

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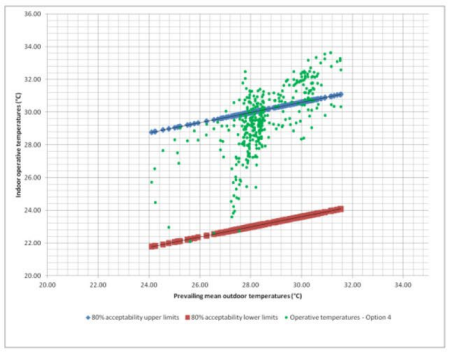

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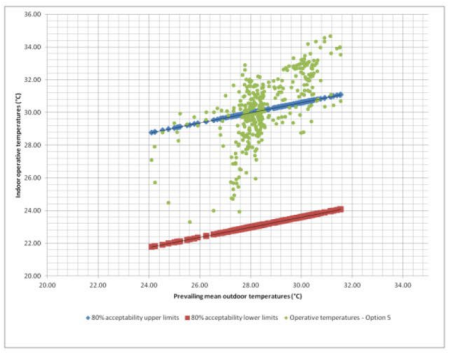

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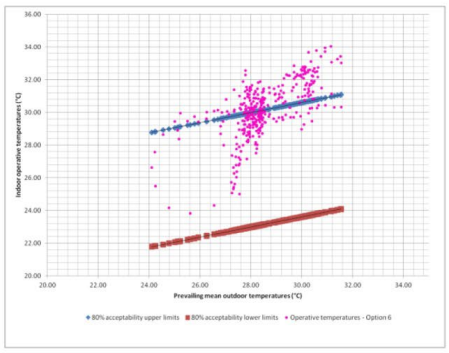
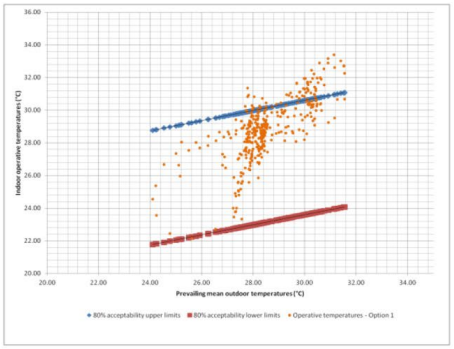


Figure 8. The 80% acceptable operative temperature ranges in 3F-bedroom 02.

a) Option 1



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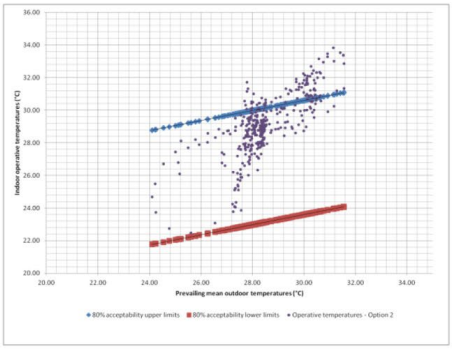

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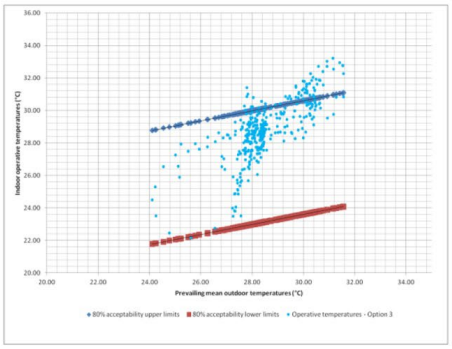

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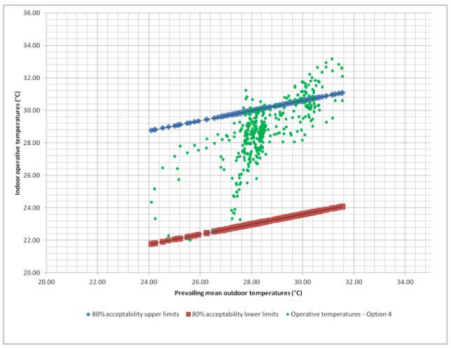

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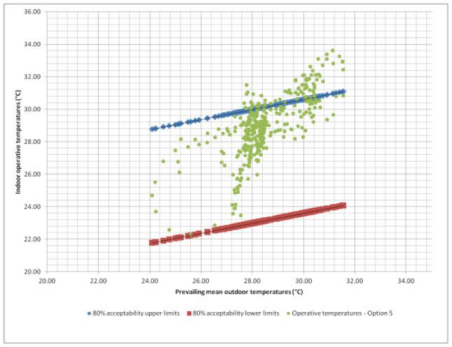

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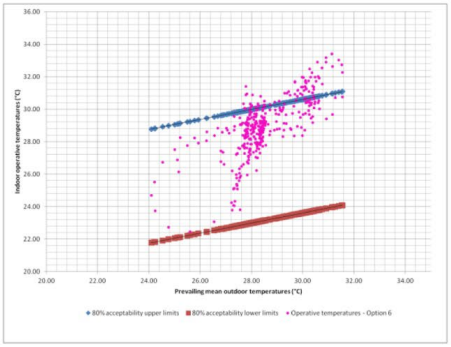
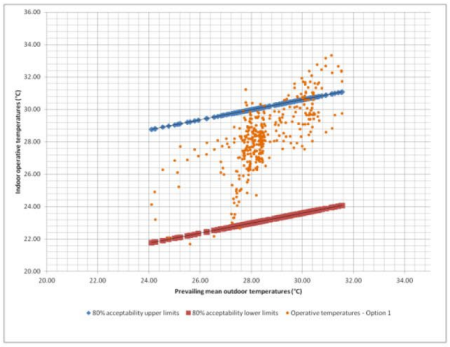


Figure 9. The 80% acceptable operative temperature ranges in 1F-kitchen..

a) Option 1



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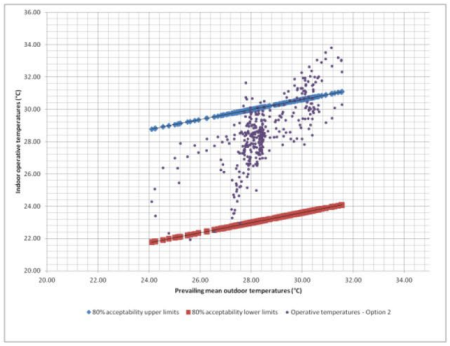

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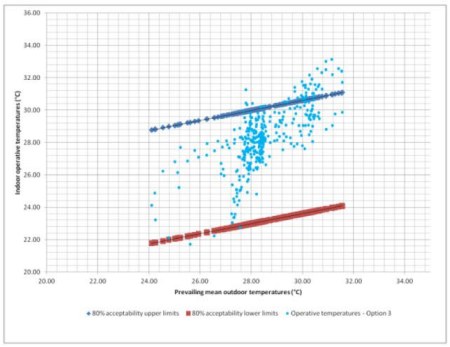

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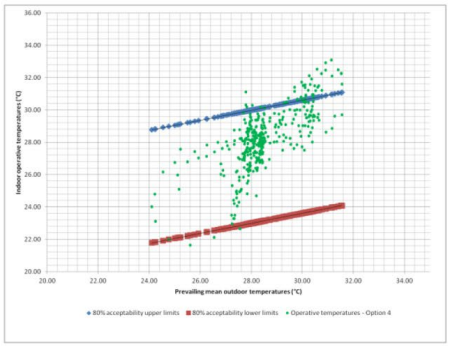

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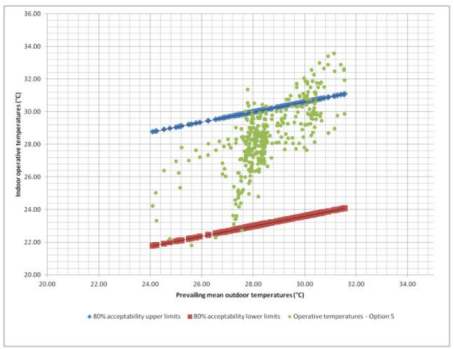

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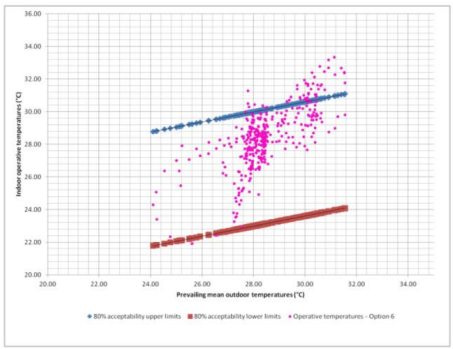

Figure 10. The 80% acceptable operative temperature ranges in 1F-living room.

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SINGAPORE PTE. LTD.: THE NATION'S NATIONAL GALLERY

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LOOKING BACK, LOOKING FORWARD

Ideas of livable are explored through notions of reclamation and limits that pertain to Singapore's physical size, resources, short history and especially the city's ability to reinvent. The Singapore story from colonial administration to sixty years of independence is recounted through the National Gallery, that comprises of the former City Hall, 1929 and Supreme Court, 1939. The Gallery is located within the Civic District, bordering the Marina Bay financial area that is built on fully reclaimed land and encompasses the city's financial heart, cultural sites and entertainment quarters. Discussions concerning repurposing began in 2005 and the Gallery was inaugurated and opened to the public in 2015 as part of Singapore's Millennial celebrations.

The conversion of these government and judiciary buildings into a public Gallery reveals leadership attitudes concerning cultural manifestoes, land use and economic policies that also correspond to the gradual transition from hard to soft power. Here, architecture and ideology are allowed to simultaneously perform as microcosms of the city that explore questions of identity, conservation, heritage and adaptability through overlooked interventions that celebrate nuanced, layered and fragmented qualities. This requires reevaluating existing predominantly highly stratified top-down governing establishments to incorporate bottom-up strategies that harvest the potential of people and their contributions.

These ideas of non-hierarchical structures are further reimagined through Manfredo Tafuri and Walter Benjamin's discourse regarding montage, dialectics and the juxtaposition of material finds and intellectual dialogues that enable user specific creative interpretations. The arguments in Colin Rowe and Fred Koetter's *Collage City* (1978) are revisited to critique existing and traditional methods of urban development and, readings of architecture and enclosures as static entities. Multidisciplinary ideas of bricolage and polyvocality are deployed as catalysts to facilitate additional user-led, transitionary methods of habitation and use to address new attitudes toward living that respond to an evolving demographic, a maturing civil society and uncertain geopolitical challenges. Here, the Gallery is further articulated as a metaphor that alludes to Singapore's past, present and future as the architecture is absorbed by the city through the dissolution of physical and conceptual boundaries. These ideas, manifested tangibly and intangibly, reflect Singapore's ability to circumvent existing limits, enabling new and original meanings of livable to be reclaimed, and defined by the people.

SINGAPORE PTE. LTD.: A QUESTION OF TANGIBLE LIMITS

Like the way land is efficiently reclaimed, discussions of Singapore's ability to circumvent issues pertinent to a small and young country include the use of cultural manifestoes. The Gallery serves as the most recent and ambitious example of how the island's desirable architectural assets are augmented and multiplied through reclaiming, repurposing and reinvigorating monuments. The Civic District that the former City Hall and Supreme Court are located within is part of Sir Stamford Raffles 1822 town plan from which modern Singapore grew.[1] To this day, the pair of buildings overlook the country's first open public recreation space, an expansive lawn known as the Padang where the colonial elites as well as non-Europeans used to gather, and where Singapore's first National Day Parade was held on 9 August 1966.[2] Prior to land reclamation, these buildings that are now best viewed from the Padang also served as front pieces of the Singapore skyline. Their neoclassical facades were part of the seafront of grand colonial buildings, positioned to herald the power of the British Empire to vessels approaching the harbour or sailing past. These buildings, and especially City Hall are pivotal to Singapore's history. In World War II, the Chambers were used during the Japanese Occupation between 1942-45. Most importantly, the declaration of full internal governance occurred on its steps in 1959 prior to independence on 9 August 1965. Hence both buildings were gazetted by the Urban Redevelopment Authority (URA) as National Monuments in 1992.[3] Here, this recognition regarding built heritage meant the preservation of distinctive material aspects that include the facades, domes, rotunda, City Hall's Chamber and ceremonial front steps, Supreme Court's Chief Justice's Office, Chambers and main courtrooms.[4]

Discussions regarding the need for a world class cultural institution to display the national collection, research and showcase the largest body of nineteenth-to-twentieth-century Southeast Asian art, and accommodate international art exhibitions started in the late 1980s. The intent to transform the former City Hall and Supreme Court into a National Gallery and the recognition for the cultivation of arts and culture as integral aspects of a global city were further reinforced in the then Prime Minister's National Day Rally speech. This announced the government's plan for a vibrant makeover of the Civic District into a place 'where people want to live, work and play, where they are stimulated to be active, to be creative and to enjoy life'.[5] However, despite the seemingly strong support, the decade long project faced consideration challenges and competing proposals for historic buildings to become heritage tourism and/or commercial developments that could be justified by economic returns.[6]

The employment of adaptive reuse to preserve the nation's history was initiated through a two-stage open competition and the physical conversion had to address the requirements of a large-scale institution as well as conservation guidelines. The winning proposal by the French practice studioMilou Architecture addressed the competition brief by creating a central atrium as the new main entrance with a pair of link bridges suspended in the open space between the two existing buildings. This is roofed over by a draped canopy supported by tree-like columns. Additionally, a basement concourse runs across the entire length of the Gallery encompassing the courtyard of the former City Hall, and a new roofscape with an extensive garden and views of the skyline and main dome.[7] On top of the listed conservation features, the main lobbies of both buildings and the original profile of the courtyard of the former City Hall were restored and previously hidden spaces like the roof deck and internal courtyard of the former Supreme Court have also been designated for public enjoyment. The user experiences are enhanced in the extensive retention of original features and materials like the copper domes, teak ceilings, terrazzo finishes, Shanghai plaster and the historic floor patterns on the second floor of the former Supreme Court, as well as the marble flooring on the grand staircase of the former City Hall. Primarily, the two existing buildings are seamlessly connected at the lowest and highest levels to facilitate public access and encourage the appreciation of the architecture.

The corollary is a modern architectural icon that thoughtfully underscores its colonial heritage and the Gallery was awarded the Architectural Heritage Awards (AHA) in 2015.[8] The contrast between the neoclassical language typical of colonial public buildings of the period and the new contemporary structure results in a new landmark where the palimpsest of history is present in the 'significant historical spaces that allow important narratives of the nation's past to have a place in her present and future'.[9] Through a reactionary change-in-use that embraces Singapore's propensity for conspicuous consumption, the supplementary programmes of shopping and dining are taken on as constructive entities and critical design probes to transform the Gallery into new indices of Singaporean culture. While this display of confidence alludes to the fact that Singapore's independence and success has facilitated the critical revaluation of history on her own terms, the potential of intangible assets that are responsive to the fluid, uncertain socioeconomic and cultural conditions of a nation-state-city deserves substantial attention.[10] The affirmation of architecture's role in weaving disparate opinions, requirements and programs into existence must be put into practice. Hence the introduction of ground-up ideologies through unexpected programmatic spaces and landscapes of varying scales to counterbalance existing approaches are crucial for sustained success.

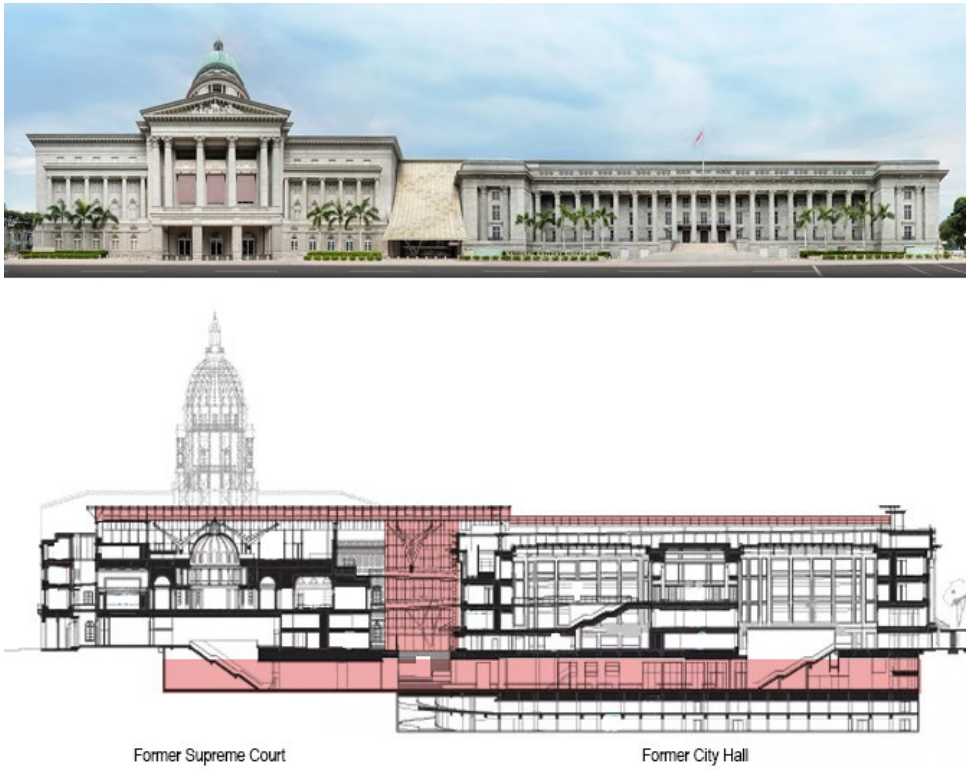

Figure 1. The winning design proposal and architectural section of the National Gallery showing the significant connecting features of entrance atrium and canopy roof, basement concourse as well as roofscape.

Figure 2. The National Gallery, 2015, Singapore.

Figure 3. The Urban Redevelopment Authority's (URA) urban planning model showing (L-R) the Civic District, as well as current and future proposals on reclaimed land.

Figure 4. Detail showing the site of the National Gallery and Padang, with the red dots indicating the natural shoreline prior to 1843.

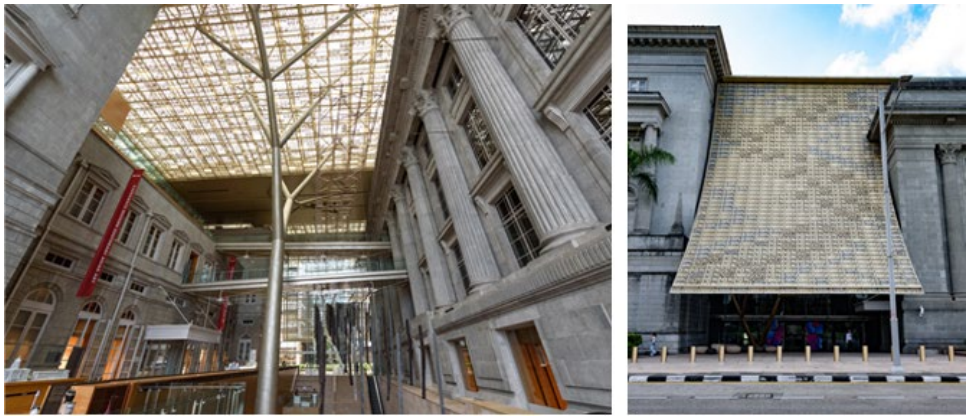

Figure 5. The main entrance space consisting of an atrium supported by tree-like columns with suspended linking bridges and a roof covering that is likened to a 'veil'.

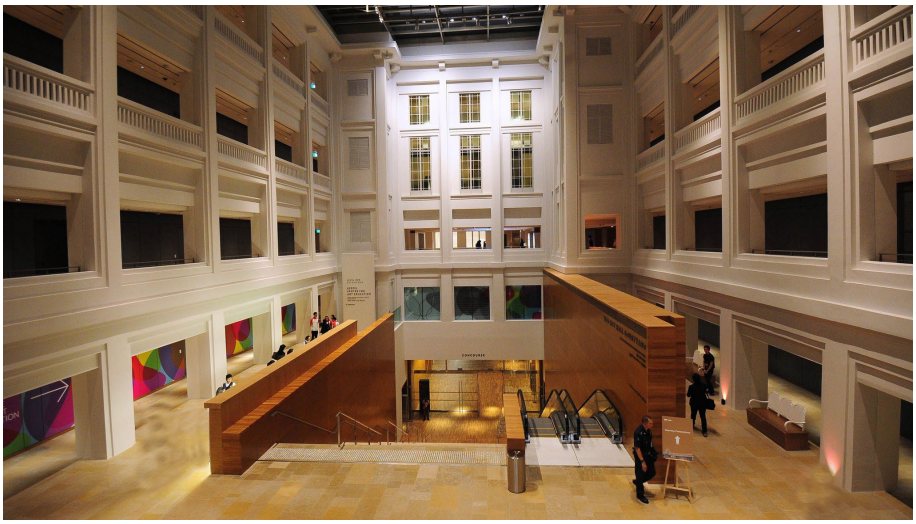

Figure 6. The basement concourse with the courtyard of the former City Hall as a main feature.

Figure 7. The new roofscape with a view towards the dome of the former Supreme Court in the distance and the disk-like roof form of the current Supreme Court on the right.

Figure 8. The former City Hall and the Padang as centre pieces of SG60 National Day celebrations.

Figure 9. The façade of the National Gallery as part of the Singapore Night Festival and as a momentous backdrop for the Formula 1 Singapore Night Race Grand Prix.

THE INTANGIBLE QUALITIES OF A BRICOLAGE CITY

The Centre for Livable Cities (CLC) was established in 2008 to explore Singapore's evolution in the last five decades to assess future solutions through existing experiences of urban development. The ambition to become a distinctive global city for the arts was progressed through a series of long-term masterplans and the gradual integration of art and cultural related buildings, spaces and activities into the city, culminating with the National Gallery.[11] he extent of land reclamation has also resulted in drastic changes to the urban context of the Civic District and the expanding cultural landscape in the reclaimed Marina Bay area houses many of the new establishments.[12] The suggestion by the CLC that 'arts and cultural institutions could also be better planned and integrated with areas in which people eat, work and play', for easy access and as part of normal routines rather than deliberately having to detour' can be read as a step towards relaxing existing zoning regulations.[13] While the tangible outcomes of Singapore's achievements in the sixty years since independence are evident, new critical and creative strategies that simultaneously counter and compliment the predominantly top-down directives are necessary in times of global uncertainty. To balance the tangible attributes of predestined and unmitigated urban development, a city that is interested in unprecedented growth also needs to duly consider the intangible contributions especially of and from her people, comprising of citizens, residents and visitors, from whom ideas of economic and cultural sustainability can be derived. At present, the punctual delineation of one version of success from all others overlooks the potential of fragments where the whole assembly constitutes of a multiplicity of disparate ideas that are continually revised, and the occurrence of the ensuing gaps are considered advantageous.

This notion of dialectics and techniques of montage foreground the role of the city dweller and enables the understanding of livable to shift through different levels of engagement. These arguments are

especially relevant to a city that is constantly in flux and here, are read against Colin Rowe and Fred Koetter's *Collage City* (1978) where overbearing order and uniformity particular to Modernist planning that negates social complexity is critiqued. The diversity and intricacies apparent in different factions of society need to be accommodated to allow for a rich and layered urban experience. Through ideas of bricolage, the concept of polemics is used to highlight the collision of interests between aspects of bricolage and bricoleur, where empirical approaches are pitched against stances of creativity.[14]

Advocacy for expanding organically where ideas concerning growth versus change and cultivation as opposed to imposition is prioritised is discussed via the 'grid of freedom'.[15] These are furthered through poetic and analytical qualities that reveal new attitudes through participatory processes and individual experiences which foreground 'the unchecked spontaneity of people'.[16] The lessons derived from these explorations serve to inspire individual interests to initiate multiple interpretations that are continuous, fragmented and juxtaposed. Fundamentally, the work serves as a critique of existing and traditional methods of urban planning as subjective and objective attributes are explored through a diverse range of techniques that include researching, constructing and organising seemingly random fragments of material in a city. These explorations revel in a multiplicity of stimuli as opposed to a single idea.[17]

Similar to recognising the creativity of the user where new understandings and meanings are further devised as dialogues to enhance the polemical and experiential qualities of a bricolage city, here, the idea of a 'questioning and incomplete' approach is fundamental to encouraging the dweller to assume authorship in the processes of contributing to an improved living environment.[18] Most importantly with each transformation, the shifts in opinions are accommodated and the multiple facets, both tangible and intangible, are juxtaposed and exploited to resist fixed meanings.[19] Additionally, the notion of an intellectual montage is employed to encourage active participation in the dynamic process of constructing and modifying the meaning of the spaces and/or experiences.[20] This approach is not exclusive nor exhaustive and the ensuing narratives pertain to material, spatial, social and cultural aspects associated with the individual.

Referencing Walter Benjamin's reading of the occurrences under the Parisian arcades as a microcosm of the city of Paris, the Gallery can be used as a model to predict and anticipate future scenarios concerning living in Singapore. This view of cultural sustainability further extends to include the creativity of the visitor where new methods of interactions serve to reveal overlooked aspects of the architecture and site. The qualities specific to the site, building and contents are not seen as absolutes but juxtaposed to create new readings and interpretations. The contradiction between inside and outside being an essential characteristic of urban planning. Hence these working methodologies are utilised to respond to evolving and uncertain challenges as the site of the Gallery is absorbed through the dissolution of physical and conceptual boundaries. The innovative approaches will be extended to simultaneously challenge existing notions of institution and ideas of economic and cultural sustainability through the creative questioning of established ideas and existing practices. The characteristics of open-endedness and adaptability are used to conjure up meaningful and individual experiences through habitation and ensured through active participation.

The Gallery as a cultural manifesto adapts and accommodates vastly different programs to acknowledge the past, present and future while critiquing existing and limited manners in which knowledge is collected, dissemination and articulated. This becomes a new site from which to imagine and enact new futures through reclaiming and returning this edifice to the Singaporean people and those who have made this city their home. These dialectical design conversations are constantly shifting to enable people to shape and articulate the meaning of this monument in this present day.

THE NATION'S NATIONAL GALLERY OF ASYNCHRONOUS EXPERIENCES

The qualities of bricolage and the creative contributions of people are further discussed in congruence with ideas of multiplicity and community. As Singapore matures, the idea that progress is simply fueled by a single economic or political agency becomes highly improbable. Consequently, the definition of 'local' through an understanding of society and how this informs growth is fundamental to discussions of circumventing limits. As individual ideas of livable adopt different meanings, the implementation of a non-hierarchical and fluid network of systems, interventions and modes that are responsive to the built environment requires a multi-character approach where active dialogue and diverse perspectives enable meaningful changes that are derived from interactions.[21] Foregrounding participatory practices addresses the notion of polyphony, which means many voices, and in design thinking refers 'to a relational activity between different actions'.[22] This is similar to notions of polyvocality where the inclusion of many and different voices are used to shift and sustain narrative change. While this does not condone the total erasure of authority, this spontaneous transformation of the built environment through the active engagement of the user should at times be allowed to take precedence over original intentions and provenance.[23] This facilitates the creation of new, multiple and individual readings where meanings are solely reliant on the users' interpretations and required to complete the work. In these discussions, the 'local' is granted authority through agency as the city continues to reinvent.

The understanding that Singapore consists of many different facets, most of which are continuously in flux is used to formulate speculative narratives through interdisciplinary approaches that embrace multiple perspectives. Hence the necessity for more flexible proto-practices that not only accommodate changes but facilitate responsive interpretations that are subjective and encouraging even, of desires that differ from government mandates. The acceptance of incompleteness and openness as positive attributes will promote permeable and inclusive definitions of livable. This approach is held in tension with the physical and manifest conditions of economic and developmental power which has contributed to the city's exponential growth as evident in the land reclamation projects, urban developments and preservation of historical buildings. The manifestation of the Gallery as asynchronous experiences through ideas of polyphony enables the public to determine new multi-faceted and transitionary ideas of habitation and use, where material boundaries are dissolved, and the multiple fragments of the nation's Gallery become part of the city. This further transcends arguments that the Gallery is treated as an object focused on recreating the material qualities while neglecting the intangible essences in the form of history and character.[24] Asynchronicity enhances the transitionary nature afforded by the new architectural thoroughfares with the deliberate interpenetration of old and new to negate boundaries.[25] These tangible and intangible considerations evidently express the country's ambitions of a burgeoning economy and aspirations towards cutting-edge culture entrenched with history as national imperatives to cultivating an emerging Singaporean identity. The ensuing studies centred on the creative user exploit the layers of meaning to shape the meaning of the work and mirror the city's ability to reinvent. While the Gallery as a material entity is reclaimed for the nation, the architecture is not inherently static, but a source to form new knowledge through its engagement with present needs and pleasures of inhabitation to portray a more porous globalised modernity.[26] These ideas serve as precedents that inform advanced discussions of livable as Singapore Pte. Ltd. depicts the city as an asynchronous archive that demonstrates how limits are circumvented, even celebrated, through the nation's capacities, ambitions, projections and influences. The idea of montage started with uniting the former City Hall and Supreme Court, creating spatial and theoretical fragments and interstitial spaces that enable new architectural readings to be derived. Pursuing the intellectual gaps and the ensuing individual meanings can become drivers for a maturing and civil society. New impetuses need to come from within the country in the processes of developing her own identity. These are temporal and transitionary as the historical past is spatiotemporally still wedded to the contemporary present and Singapore's most

important events are still unfolding in the now. Hence there is no question of limits when the intangible contributions, especially those of her people are optimised. Happy sixtieth Singapore.

ACKNOWLEDGMENTS

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Here, Singapore Pte. Ltd., through the Nation's National Gallery a decade later attempts to transcend these initial arguments.

The deepest thank you to Joanna Kwa for the exquisite photography.

NOTES

[1] Singapore was founded in 1819 when Sir Stamford Raffles established a trading outpost on the island. The former City Hall was referred to as the Municipal Building until 1951 when City status was granted by King George. The architects of the former City Hall are F. D. Meadows and Alexander Gordon, and Cavaliere Rudolfo Nolli, an Italian architect and sculptor based in Singapore was commissioned to supply the columns and granolithic stone cladding. After independence on 9 August 1965, the edifice housed various government offices, such as the Prime Minister's Office, Ministry of Foreign Affairs, Ministry of Culture, and offices of the Judiciary. It also remained the venue for swearing-in ceremonies of high government office holders. The former Supreme Court was designed by Frank D. Ward, Chief Architect of the Public Works Department. Colonial rule in Singapore ended on 16 September 1963 when the proclamation of Malaysia was announced.

[2] The word 'padang' means 'field' in Malay. This was first designated as a central area around which the British administrative district would be planned. The Padang was formalised in 1907 to meet the needs of the colonial settlement.

[3] The URA, formed in 1947 is Singapore's national land use, planning and conservation authority and is primarily responsible for planning and facilitating the physical development of Singapore. The earliest steps taken to preserve some of Singapore's important monuments and landmarks were carried out through the Preservation of Sites and Monuments Board with the first eight buildings granted legal protection as national monuments in 1973, increasing to ten conservation areas in the historic districts in 1989.

[4] Pauline Ang, *National Gallery Singapore: Art Spaces* (London: Scala Arts and Heritage in association with National Gallery, Singapore, 2016), 26.

[5] Pauline Ang, *National Gallery*, 20. Additionally, the then Prime Minister Lee Hsien Loong's speech, "National Day Rally, 2005", accessed 11 July 2025. https://www.pmo.gov.sg/Newsroom/National-Day-Rally-2005.

[6] Mercy Wong, *Urban Systems Studies* (Singapore: CLC Publications, 2017), 90.

[7] The architectural competition for the National Gallery was won by Studio Milou Architecture and completed in collaboration with CPG Consultants Pte. Ltd.. There is 12,000m2 of exhibition spaces in addition to the integration of supporting facilities like cafes, and spaces for other leisure activities.

[8] "Architectural Heritage Awards", accessed 11 July 2025. https://www.ura.gov.sg/Corporate/Get-Involved/Conserve-Built-Heritage/Architectural-Heritage-Awards. The AHA was established in 1995 to 'recognise well restored monuments and conserved buildings, and the people behind them'. Besides honouring best practices in technical restoration, AHA also features projects that 'sustain and strengthen the intangible values of heritage buildings for the community'.

[9] "Cat A_AHA 2015 Inserts_NatlGallerySpore", accessed 11 July 2025. https://www.ura.gov.sg/Corporate/Get-Involved/Conserve-Built-Heritage/Architectural-Heritage-Awards.

[10] As a small country with no hinterland, Singapore embodies a geopolitical fragility and depend heavily on her Southeast Asian neighbours for resources and supplies. This fragility requires vigilance and constant strategic responses towards issues of territoriality and territory.

[11] Mercy Wong, *Urban System Studies*, unpaginated and 106─115. Planning for the arts through documenting the chronological transformation of the urban landscape for culture and creativity between 1800─2017 included the commissioning of the Renaissance City Report in 2000. The was followed by the Renaissance City Plans in 2000, 2005 and 2008 that emphasised 'a vision for the city state to be an outstanding cultural centre in a globalised world'. 57.

[12] Colin Anderson, *DP Architects on Marina Bay, Evolution of a Civic Downtown* (California: ORO Editions, 2015), 14─15. Currently, the country's land mass has expanded by approximately a quarter since embarking on its first reclamation efforts. This is precedented by the historic reclamation project in the Telok Ayer Basin during the 1870s under Sir Stamford Raffles' colonial administration.

[13] Mercy Wong, *Urban System Studies*, 93.

[14] Colin Rowe and Fred Koetter, *Collage City* (Cambridge, Mass.: MIT Press, 1978), 101─106.

[15] Colin Rowe and Fred Koetter, *Collage City*, 100.

[16] Colin Rowe and Fred Koetter, *Collage City*, 100.

[17] Colin Rowe and Fred Koetter, *Collage City*, 92.

[18] Jonathan Hill, "Dialogical Designs," in *Dialogical Designs*, ed. Constance Lau (Milton Keynes: Lightning Source, 2016), 7.

[19] In this paper, the techniques of montage and historiographical approach reference the work of Walter Benjamin and especially *The Arcades Project* (1999). This post-humous publication is described as 'the blueprint for an

unimaginably massive and Labyrinthine architecture, a dream city in effect'. The basic essence and characteristics of the Paris arcades are effectively captured in a working system that respected the differences of the events juxtaposed within the spaces. The principles of montage are evident in the arrangement of the six chapters of the book, which are designed to operate independently and enable 'the work to be remade anew' by each reader. Howard Eiland, translator's foreword to *The Arcades Project*, by Walter Benjamin (Cambridge, Mass. and London: Belknap Press of Harvard University Press, 1999), viiii and Jonathan Hill, *Actions of Architecture* (London and New York: Routledge, 2003), 108.

[20] Manfredo Tafuri, "The Dialectics of the Avant Garde," *Oppositions* 11: A Journal for Ideas and Criticism in Architecture, v.11, (1977): 78.

[21] Simon Dentith, *Bakhtin Thought, An Introductory Reader* (London and New York: Routledge, 1995), 36–40. This idea was developed in relation to Fyodor Dostoevsky's writings and the concept of polyphony is borrowed from music and literally means multiple voices. A key feature sees 'the narrator renouncing the right to the last word and granting full and equal authority to the word of the characters'.

[22] Yeoryia Manolopoulou, *Architectures of Chance* (Surrey: Ashgate Publishing Ltd., 2013), 124.

[23] Similarly, in Roland Barthes' 'The Death of the Author' (1967), shifts that occur in the meaning of the text during the process of reading are acknowledged. While Barthes does not condone the total erasure of authorship, this spontaneous transformation of the text's meaning through the active engagement of the reader should take precedence over the author's intentions and provenance.

[24] The final architecture was addressed through observing the '3Rs' consisting of maximum retention, sensitive restoration and careful repair to ensure the accuracy, and longevity of the final product. While longevity alludes singularly to the material qualities of the building, the Architectural Heritage Legacy Award considers societal value in terms of engagement and interaction. To date, the Gallery has not received this award. The Legacy Award is open to past AHA winners with 'at least 10 years of post-award exemplary management where the longevity of the heritage building(s), both physically and socially, is sustained for present and future generations. This includes proper maintenance of the building fabric and creation of value for the wider community through continual investment, such as educational efforts, programming, and engagements'. "Architectural Heritage Awards", accessed 11 July 2025. https://www.ura.gov.sg/Corporate/Get-Involved/Conserve-Built-Heritage/Architectural-Heritage-Awards.

[25] This biased imbalance is further embedded in another common assumption that regards a work of architecture as a stable built-form and/or an enclosure, an understanding that eclipses most other means of readings.

[26] Shayari De Silva, trans., Geoffrey Bawa, *Drawing from the Archives* (Zurich, Switzerland: Lars Muller Publishers and the Geoffrey Bawa Trust, 2023), 144.

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MORE THAN MEETS AI: LOCKPORT MEMETIC ANALYSIS

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INTRODUCTION

Architecture has historically functioned as an organic, memetic process - one in which built forms evolved through iterative refinement, adaptation to human needs, and contextual responses to climate, culture, and function. Over centuries, architectural elements that proved successful - whether in material durability, spatial organization, or aesthetic resonance - became embedded within the urban DNA of cities. From Gothic to Neo-Gothic, Classical to Neoclassical, vernacular to regional adaptations, the built environment has served as a mirror of cultural memory and continuity, preserving an evolutionary lineage of architectural wisdom.

This lineage was significantly disrupted in the twentieth century with the rise of modernism. Rather than refining inherited forms through contextual evolution, modernist architecture introduced abrupt

Figure 1. Public Landing Building (200 W 8th Street), a archetypal example of Lockport's original limestone architecture and a keystone of the city's architectural DNA. (Image by Mikayla Zakutansky, 2024)

ideological shifts that bypassed time-tested adaptation. The result was profound: cities lost their spatial coherence, regional character, and intuitive human scale, giving rise to increasingly placeless urban environments.

This paper explores Lockport, Illinois, as a case study in memetic architectural evolution and interruption. It asks how built environments such as Lockport can help us understand the processes by which architectural patterns persist, fragment, and – potentially - reintegrate. Drawing from architectural surveys, historical analysis, spatial mapping, and AI-assisted pattern recognition, the study offers a framework for identifying disrupted patterns and guiding their thoughtful restoration. In doing so, it considers how cities might reestablish continuity between past and future - not through replication, but through evolutionary alignment with their own architectural DNA, supported by emerging technologies capable of reading and reimagining the patterns we have nearly forgotten.

Memetics in Architecture

The term *meme* was first introduced by evolutionary biologist Richard Dawkins in *The Selfish Gene* (1976) to describe units of cultural transmission - ideas, behaviors, and forms that replicate, mutate, and evolve through imitation and adaptation, much like genes in biological evolution.[1] Memes, in Dawkins' model, are not simply abstract concepts; they are subject to processes of selection, survival, and transformation within cultural ecosystems.

Applied to architecture, *memes* can be understood as patterns - of form, material, spatial organization, and symbolic meaning - that reproduce across time because they work. They resonate. They persist not through top-down imposition, but through their fitness: their ability to fulfill human needs, reflect collective values, and adapt to changing circumstances.[2]

This evolutionary lens has been expanded by theorists such as Christopher Alexander and Nikos Salingaros, who treat architectural forms not as static styles but as living systems of inherited knowledge.[3] Alexander's *Pattern Language* articulates how built environments evolve through the repetition and refinement of forms that support human flourishing. These patterns - doorways, courtyards, streetscapes - function as architectural memes: they spread because they succeed.[4]

Salingaros furthers this argument by applying Darwinian logic to urbanism, showing how traditional architecture evolves through a form of memetic selection, while modernist architecture often spreads through institutional force - detached from evolutionary feedback and human adaptability.[5] He warns of "parasitic memes": aesthetic ideologies that replicate not because they work, but because they are mandated or celebrated within elite discourses.[6]

Historically, cities evolved through this memetic logic. Architectural styles like Classical and Gothic were not monolithic inventions but slowly iterated languages of form. Local materials reinforced regional identity, while spatial configurations deepened a sense of collective memory. What emerged was an architectural DNA - an adaptive grammar shaped by centuries of lived feedback loops.[7]

But in the 20th century, that transmission chain was broken. Modernism introduced a kind of memetic disinheritance, replacing inherited forms with imposed aesthetics, and severing the intergenerational dialogue that had once guided urban evolution.[8]

MODERNISM AND THE SEVERING OF ARCHITECTURAL MEMORY

Modernism marks a turning point in architectural evolution - a moment not merely of stylistic innovation, but of memetic disinheritance. It disrupted the organic transmission of built form, replacing adaptive, place-rooted patterns with abstract ideologies that often-bypassed cultural memory and contextual understanding.

The rise of the International Style exemplified this shift. Architects such as Le Corbusier, Mies van der Rohe, and Walter Gropius advanced a vision of architecture as universal, efficient, and detached from history. Their buildings erased references to local traditions, materials, and human-scaled ornamentation, supplanting them with abstract geometries and mechanistic ideals. What emerged was

not an evolution of existing forms, but a memetic discontinuity - a break in the symbolic transmission that had long grounded architecture in community and psyche.[9]

Unlike vernacular and pre-modern forms, which had proven their worth through generational refinement and local adaptation, modernist designs often spread through institutional endorsement and academic abstraction. These forms were not selected through cultural resonance or practical feedback loops but through their alignment with theoretical purity. In this way, modernism introduced memetic fragility - an aesthetic logic untested by evolutionary pressures and vulnerable to cultural rejection.[10]

The rejection of ornament, scale, and proportion—those deeply intuitive elements of human perception - marked more than a stylistic change. It signaled a repression of what might be called the architectural unconscious.[11] Facade rhythms, tactile materials, and symbolic detailing, which had long served as anchors of memory and meaning, were cast aside. Cities became sterile, fragmented, and psychologically untethered - built without the vernacular codes and memes that once supported belonging and coherence.[12]

Brutalism embodies this disruption in its most extreme form. Conceived with ethical intent in the postwar era, Brutalist architecture aspired to truth, honesty, and structural clarity through raw material expression. Yet as it was adopted by bureaucracies and civic institutions, its forms became increasingly disconnected from place, scale, and social context. Rather than evolving through local feedback or cultural embedding, Brutalism often manifested as top-down imposition. Its massive concrete geometries, though ideologically consistent, frequently failed to elicit connection. The result was not resonance but alienation - an architecture of memetic amnesia, estranged from the very environments it sought to serve.[13]

In bypassing the adaptive logic that once guided architectural transmission, modernism broke with centuries of symbolic continuity. What was lost was not just tradition, but a deeper dialogue between form, memory, and the collective imagination.[14] The task now is not to reject modernism outright, but to recognize where its disruptions severed the archetypal lineage of place - and how we might begin to mend it.[15]

METHODOLOGY

This study employs a multi-layered methodological framework to analyze the memetic evolution, disruption, and restoration potential of Lockport's historic urban fabric. By integrating architectural survey data, GIS mapping, AI-assisted pattern recognition, memetic classification, and archival research, the project aims to develop a replicable model for reinforcing memetic urbanism in historic districts.

To establish a baseline of Lockport's architectural DNA, a comprehensive district-wide field survey documented building heights, massing, storefront configurations, material usage, and stylistic patterns - capturing the city's architectural continuity and adaptive evolution. Each building was evaluated using National Register criteria (Outstanding, Notable, Contributing, or Non-Contributing), providing insight into structures that retained memetic strength versus those altered by modernist interventions. These findings were enriched through historic maps, archival documents, and photographic analysis. Historic Sanborn Fire Insurance Maps were used to track the evolution of building footprints, land use, and structural change, revealing patterns of continuity and disruption in Lockport's urban morphology.[16]

AI-based image analysis and generative design tools were employed to enhance pattern recognition and inform infill strategies. Machine learning algorithms, trained on Lockport's historic fabric, identified recurring formal logics - such as façade rhythms, window proportions, rooflines, and materials. These algorithms generated speculative design options aligned with local memetic patterns, enabling rapid, iterative visualization and fostering community engagement through democratized design tools.[17]

Figure 2. Outstanding and Notable buildings identified in the Lockport Historic District survey. These structures exemplify high architectural integrity, consistent façade rhythm, and use of historic materials like limestone and pressed brick. (Image by Mikayla Zakutansky, 2024)

GIS analysis visualized spatial zones of coherence and disruption. By mapping changes in density, height, and footprint, this approach revealed opportunities for infill and adaptive reuse, particularly in areas fragmented by non-contributing buildings or urban voids.

Figure 3. Design outputs from Dall E 3 and ChatGPT 3.5 prompts. Variants explore different interpretations of Lockport's architectural patterns, including limestone façade treatments, gable rooflines, and consistent massing.

A memetic classification system further refined the analysis, categorizing architectural elements as Persistent Memes, Disrupted Memes, or Memetic Restoration Candidates. This classification guided intervention strategies that respect historical continuity while adapting to contemporary needs. AI-generated infill proposals were evaluated within this framework to ensure they reinforced Lockport's architectural identity.

Drawing from these integrated methods, the Memetic Continuity Model was developed as a structured framework for diagnosing, classifying, and restoring urban coherence within the historic district. The model operates through a cyclical process:

1. Survey and Documentation to identify existing patterns;
2. Memetic Classification to diagnose persistence or rupture;
3. Mapping and Spatial Analysis to visualize continuity and fragmentation; and
4. Restorative Intervention Design to guide future development in alignment with Lockport's architectural DNA.[18]
5. The model treats the city not as a static artifact, but as a living, evolving system - seeking to reweave disrupted patterns through an adaptive, evolutionary logic rather than replication or pastiche.

Ultimately, this research synthesizes archival data, AI analysis, GIS mapping, and memetic classification into the Memetic Continuity Model - a practical toolkit for preservation policy, context-sensitive design, and participatory planning. The goal is not merely to protect Lockport's historic character, but to extend and evolve it as a living, dynamic reality.

Lockport's Architectural History as a Memetic Case Study

Lockport, Illinois, offers a compelling case study in memetic urbanism - illustrating how architectural patterns evolve, adapt, fragment, and potentially reconstitute over time. As a historic industrial town shaped by the Illinois & Michigan Canal, Lockport's built environment embodies a story of continuity, disruption, and the possibility of reintegration.[19] By tracing the city's architectural DNA, we gain insight into how pre-modern urbanism developed organically, how mid-century interventions fractured historical memory, and where opportunities lie for restoring lost coherence through adaptive reuse and preservation.[20]

The architectural survey of Lockport's historic district reveals a town deeply rooted in traditional commercial, industrial, and residential typologies. Buildings constructed of locally sourced limestone and brick reflect a regional material vocabulary that has endured across architectural movements. The commercial corridors, defined by two- and three-story masonry structures with recessed storefronts,

Figure 4. Mapping of Lockport's architectural classification within the historic district, showing contributing (C), non-contributing (NC), and excluded buildings. The map visualizes spatial coherence and disruptions in the memetic urban fabric, aiding in prioritization for preservation and infill strategies. (Image by Mikayla Zakutansky, 2024)

transom windows, and decorative cornices, reinforce a pedestrian-friendly streetscape rooted in human scale.[21] The city's industrial legacy is equally visible in its warehouses and canal-adjacent structures - remnants of a working landscape that helped shape the town's identity. A consistent street grid and historic lot configurations further support Lockport's navigability and spatial cohesion, representing a memetic resilience where adaptive patterns have persisted for generations.

Yet, this continuity was disrupted during the mid-20th century. Urban renewal and suburban expansion introduced a wave of non-contextual development. Key historic buildings were demolished, and in their place came auto-oriented commercial forms with large setbacks, parking lots, and materials such as concrete panels, stucco, and aluminum cladding - none of which resonated with Lockport's established visual language.[22] The prioritization of vehicular circulation over pedestrian connectivity fractured the urban fabric, creating spatial and psychological disconnection from the city's historic core.

Despite these disruptions, Lockport retains significant potential for architectural and urban restoration. From a memetic perspective, recovery does not mean replication but reintegration - reweaving lost or fragmented patterns through context-sensitive design. The city's historic building stock offers a strong foundation for adaptive reuse, with many former industrial and commercial structures flexible enough to accommodate contemporary programs.[23] Restoration of historic facades, the reintroduction of traditional storefront elements, and infill aligned with existing massing and proportion can reinforce Lockport's architectural DNA without falling into pastiche.

Reclaiming pedestrian-oriented urbanism is equally vital. Vacant lots and underutilized sites offer prime opportunities for infill that respects the city's historical scale and material logic. Reactivating public spaces - plazas, alleys, and pedestrian corridors—can reconnect fragmented districts and foster civic engagement. Adaptive reuse of larger industrial structures can support mixed-use development, creative economies, and community-facing amenities, embedding new energy within the town's historic framework.[24]

Lockport's experience affirms that memetic urbanism is not a call to freeze cities in time, but a method for ensuring that new development participates in an evolving architectural lineage.[25] By identifying key disruptions and strategically reinforcing patterns of continuity, Lockport can rebuild a historically grounded but future-facing urbanism. As post-industrial towns across the United States face similar challenges, Lockport's approach offers a replicable model - one that strengthens architectural identity while enabling sustainable, culturally resonant growth.

DISCUSSION: IMPLICATIONS FOR FUTURE URBANISM

The study of Lockport's architectural DNA - and its disruption by modernist interventions - offers crucial insights for the future of urbanism. The persistence of memetic architectural patterns, refined through generations of adaptation, shows that historic environments are not static relics but living systems capable of evolution and renewal. Understanding how these patterns emerge, endure, or deteriorate provides a foundation for guiding urban development in ways that respect continuity while addressing contemporary needs.[26]

A central implication of this research is the importance of reintegrating traditional urban forms into present-day planning. Lockport's mid-century fragmentation serves as a cautionary tale about the risks of top-down, ideology-driven design that disregards local context.[27] The imposition of modernist principles - rigid functionalism, abstract minimalism, and automobile prioritization - disrupted the city's organic evolution and human scale. This underscores the need for an urbanism rooted in place: one that evolves through lived experience, incremental adaptation, and community values rather than external imposition.[28]

Adaptive reuse is another vital strategy for restoring urban continuity. Many of Lockport's industrial-era buildings remain structurally sound and architecturally significant, offering opportunities for

transformation without erasure. Memetic urbanism does not advocate freezing the past, but rather reinterpreting and reweaving it into the fabric of the present.[29] Repurposing historic structures supports both sustainability and cultural memory - reducing waste while reinforcing the unique identity of place.[30]

Figure 5. Memetic restoration analysis. Recommendations include transom windows, storefront articulation, and restoration of original materiality—all informed by historically persistent patterns. (Image by Mikayla Zakutansky, 2024)

Policy interventions play an essential role in this process. Historic districts like Lockport often face pressure from commercial interests, speculative development, and zoning changes that threaten their cohesion. Context-sensitive zoning, design guidelines, and financial incentives - such as preservation tax credits, façade restoration grants, and expedited permitting for adaptive reuse - can encourage private investment aligned with public values.[31]

Just as important is public engagement. Cities that involve residents in shaping the future of their built environment cultivate stronger civic identity and a deeper sense of place. Educational programs, heritage tourism, and creative place-making initiatives can foster appreciation for historic architecture as a shared cultural asset.[32] When people feel connected to the narrative of their city, they become stewards of its evolution.

As communities across the U.S. wrestle with the intersection of preservation, economic growth, and sustainability, Lockport provides a valuable model.[33] Memetic urbanism offers a framework for decision-making that blends continuity with creativity, tradition with transformation. By seeing architecture as a medium of cultural transmission, planners and policymakers can foster cities that are resilient, rooted, and meaningfully connected to their past.[34]

LOCKPORT OUTCOMES: MEMETIC PATTERNS AND DISRUPTIONS

The application of the Memetic Continuity Model to Lockport's historic district revealed critical insights into the persistence, fragmentation, and restoration potential of its urban fabric.

Architectural surveys, archival research, GIS analysis, and AI-assisted pattern recognition collectively confirmed that significant portions of Lockport's historic core retain strong memetic coherence. Persistent architectural memes - including consistent two- to three-story massing, limestone construction, recessed storefronts, transom windows, and pedestrian-scaled street rhythm - remain particularly evident along State Street and near the historic canal zone.[35]

Buildings such as 200–201 W 10th Street (Public Landing Building), an Outstanding and Dominant structure exemplifying Lockport's industrial limestone tradition, and 905–907 S State Street (Above All Home Care, Inc.), a highly intact Notable building preserving its original cornices and window articulation, embody these surviving patterns. These structures demonstrate how evolutionary

refinement in materiality, proportion, and urban scale has maintained Lockport's identity across generations.[36]

Figure 6. Elevation study of historic commercial buildings in downtown Lockport, Illinois. Despite stylistic variation, the facades share proportional rhythm, consistent cornice lines, material continuity, and pedestrian-scaled storefronts—hallmarks of a strong memetic architectural lineage. (Image by Mikayla Zakutansky, 2024)

Yet, field analysis and spatial mapping also revealed zones of acute memetic disruption, particularly in areas altered by mid-century commercial expansion and auto-centric planning. Key ruptures include the demolition gap at 1003–1009 S State Street, now occupied by outdoor dining, and the introduction of visually incompatible structures such as 921 S State Street (Boy Scouts/Chamber of Commerce Building) and 1001 S State Street (Taco Heaven), both of which disrupt the established facade rhythms and material vocabulary.[37]

Figure 7. This vacant lot along State Street illustrates a key site of memetic disruption within Lockport's historic downtown. The gap undermines the visual rhythm, proportional continuity, and enclosure typical of pre-modern urban fabric. (Image by Mikayla Zakutansky, 2024)

AI-assisted analysis reinforced these findings, generating infill design proposals based on persistent memes - reintroducing traditional storefront articulation, human-scaled massing, and compatible material palettes into disrupted zones. These AI-generated scenarios demonstrate how emerging technologies can aid in the recognition and restoration of architectural DNA, offering practical, adaptive templates for reintegrating fragmented urban fabrics without resorting to historical pastiche.[38]

Memetic classification revealed that approximately 67% of the buildings within the survey area maintain either Outstanding, Notable, or Contributing status, offering a robust foundation for continuity. Areas identified as Disrupted Memes - such as key gaps along State Street and transitional blocks near 11th Street - present primary opportunities for memetic restoration.[39]

The Lockport case study thus validates the central premise of the Memetic Continuity Model: cities possess embedded patterns that, when carefully read and respected, can guide meaningful urban regeneration. Rather than imposing novelty for its own sake, Lockport's memetic patterns offer a resilient, historically grounded grammar for future growth. The challenge - and opportunity - lies not in replication, but in evolutionary reweaving, allowing historic urban logics to adapt, extend, and thrive in the contemporary landscape.[40]

Figure 8. Side-by-side comparison illustrating the use of generative AI to create contextually appropriate infill architecture. The source image on the left features a historic Late Victorian commercial block in Lockport, Illinois, characterized by brick construction, recessed storefronts, tall arched windows, and a defined cornice line. The image on the right is an AI-generated design created using the prompt:
"Create a historically accurate, three-story infill building using Late Victorian commercial architecture patterns, with detailed brickwork, arched windows, and a recessed commercial storefront. The new building should harmonize with the adjacent context but not replicate it."
This process demonstrates how AI tools can visualize memetically aligned infill while respecting local architectural DNA. (Image by Mikayla Zakutansky, 2024)

CONCLUSION

The case of Lockport demonstrates the enduring relevance of memetic urbanism in shaping resilient and meaningful places. Before the disruptions of modernist planning, the city's built environment developed through generational refinement - a living process that embedded function, beauty, and memory into the urban fabric.[41] Mid-century interventions interrupted this lineage, replacing adaptive forms with auto-centric development, discordant materials, and spatial fragmentation. Yet even amid these disruptions, the memetic foundations of Lockport's identity remain intact.[42]

This study, through architectural survey, GIS analysis, Sanborn map comparisons, and memetic classification, proposes a framework for restoring urban continuity. Preservation is not about stasis; it is about extending the logic of place through time.[43] Adaptive reuse, human-scaled infill, and reconnected public space offer strategies for revitalizing cities without erasing their memory.

Future research should explore how these principles can be adapted to other post-industrial towns facing similar fractures in continuity. Lockport's story can serve as a prototype - a reminder that even interrupted traditions can be resumed, reimagined, and reintegrated.

Ultimately, memetic urbanism invites us to see cities not as mere infrastructure, but as living expressions of cultural memory and collective becoming. Architecture is not just construction; it is the

shape of meaning in our shared lives. By preserving and evolving these forms, we ensure that our cities remain soulful, sustainable, and deeply human.

NOTES

[1] Richard Dawkins, *The Selfish Gene* (Oxford: Oxford University Press, 1976).
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[32] Hayden, The Power of Place.
[33] Mason, "Theoretical and Practical Arguments for Values-Centered Preservation."
[34] Hayden, The Power of Place.
[35] Field survey data compiled by the Center for Historic Preservation at Ball State University, conducted by Mikayla Zakutansky and Karsten Lingenfelter, Lockport Historic District, 2024.
[36] Field survey data compiled by the Center for Historic Preservation at Ball State University, conducted by Mikayla Zakutansky and Karsten Lingenfelter, Lockport Historic District, 2024.not
[37]Sanborn Fire Insurance Maps, Lockport, Illinois, 1866–1950, Library of Congress, Geography and Map Division.
[38] Author's AI-assisted design analysis using training set of Lockport historic fabric, 2024.
[39] Survey results cross-referenced with National Register criteria, Lockport, 2024
[40] Author's synthesis based on Memetic Continuity Model framework.
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SUSTAINABLE USER COMFORT USING BUILDING ENVELOPE DESIGN; FROM TRADITIONAL METHODS TO INNOVATIVE SOLUTIONS

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INTRODUCTION

As urban areas continue to grow and adapt, the demand for sustainable building practices has become increasingly urgent. A critical component of this sustainability lies within the building envelope design, which directly affects user comfort and energy efficiency. The building envelope plays a pivotal role as a climate modifier in regulating indoor environmental quality and energy performance, directly impacting user comfort and sustainability in architectural design.[1] This paper explores the evolution of building envelope strategies, tracing a continuum from traditional passive methods to contemporary innovative solutions aimed at achieving sustainable user comfort.

The analysis of this study is rooted in sustainability principles and the concept of IEQ, which includes thermal comfort, daylighting, and acoustic performance.[2] Vernacular architecture theories highlight how traditional envelope designs responded to climate and culture,[3] while modern frameworks like the Passive House standard emphasize energy efficiency through envelope optimization. The study critically analyzes case studies from diverse climatic regions and evaluates emerging technologies such as dynamic façades, phase change materials, smart glazing, and bio-adaptive envelopes in enhancing thermal comfort, natural ventilation, and daylighting while minimizing energy consumption.[4]

The research reveals that a synergistic integration of traditional knowledge and modern innovations can lead to more resilient and adaptable architectural solutions. By framing the building envelope not merely as a static boundary but as an active mediator between users and the environment, this paper proposes a design paradigm that prioritizes long-term ecological responsibility without compromising human comfort. Ultimately, the study advocates for a holistic, context-sensitive approach to building envelope design that leverages both traditional and technological advancement to create livable, energy-efficient spaces in an era of climate uncertainty.

The building envelope, comprising walls, roofs, windows, doors, and foundations, serves as the primary interface between a building's interior and external environment.[5] It regulates heat, air, light, and moisture, directly impacting indoor environmental quality (IEQ) and energy consumption.

Sustainable user comfort involves maintaining thermal, visual, and acoustic conditions that promote health and productivity with minimal energy use.[6] This paper aims to explore the intersection of traditional approaches and modern innovations in building envelope design, illustrating how they can

collectively enhance user comfort while supporting sustainable development goals in an ever-evolving built environment.

SUSTAINABLE USER COMFORT AND BUILDING ENVELOPE

Buildings account for approximately 30% of primary energy use in the residential and commercial sectors, making sustainable building envelope design critical for reducing environmental impact while ensuring occupant comfort. The building envelope is the physical barrier that mediates a structure's interaction with its environment, playing a pivotal role in user comfort and energy performance. As global emphasis on sustainability intensifies, envelope design has emerged as a key strategy for reducing carbon footprints while enhancing indoor environmental quality (IEQ). Historically, traditional building methods leveraged local materials and passive techniques to ensure comfort; today, innovative solutions incorporate advanced materials and smart systems.[7]

To create a balance between sustainability and user comfort, research on the building's envelope design, materials, and features is essential. In this context, traditional and innovative envelope design solutions should be reviewed to see how they might help meet today's environmental and user needs.

Traditional methods, often seen in vernacular architecture, achieve this through passive design and local materials. Modern innovations introduce advanced materials and technologies to meet stringent energy codes and occupant expectations. Traditional methods, while foundational, need to be integrated with innovative solutions that address challenges such as climate change and dwindling resources. For instance, contemporary directives call for nearly zero-energy buildings, necessitating high-performance solutions that enhance resilience in urban contexts.[8] Simultaneously, the need for flexible and engaging learning environments underscores the importance of well-designed spaces that foster not just comfort but also creativity and productivity.[9]

Dimension	Key Factors	Sustainable Design Considerations
Thermal Comfort	Air temperature, radiant temperature, air velocity, relative humidity, personal factors (clothing, activity level) [10]	Optimized insulation,[13] high thermal mass materials (concrete, brick, stone, water), passive solar design, climate-responsive orientation and shading, high-performance windows and doors, Phase Change Materials (PCMs).[14]
Visual Comfort	Daylighting levels, glare, color temperature of lighting	Maximized natural light through strategic window placement and size, clerestory windows, skylights, light shelves, smart glass (electrochromic) for dynamic tinting and glare control, energy-efficient LED lighting with appropriate color temperatures, dynamic shading devices.
Acoustic Comfort	Background noise levels, reverberation time, sound insulation between indoor and outdoor, and sound absorption [11]	Sound insulation techniques (mass-loaded materials like concrete/brick, insulation like fiberglass/mineral wool, resilient channels), sound absorption methods (acoustic panels, porous materials, upholstered furnishings), integration of green spaces for noise mitigation.[15]
Indoor Air Quality (IAQ)	Indoor air chemicals (VOCs, particles, odors, formaldehyde, radon, NO2), pollution sources, ventilation effectiveness[12]	Source control (avoiding/reducing indoor pollution sources), selection of low-polluting/low-VOC building materials, mechanical ventilation with heat recovery (HRV) for continuous fresh air,[16] natural ventilation strategies, biophilic design elements (indoor plants).

Table 1. Key Dimensions of User Comfort and Considerations for Sustainable Envelope Design

TRADITIONAL METHODS OF BUILDING ENVELOPE DESIGN

Vernacular architecture offers time-tested strategies for sustainable envelope design. These methods leverage local materials and passive techniques to respond to environment conditions, minimizing energy use while ensuring comfort. Traditional building methods developed in response to local climatic conditions, employing passive strategies such as:[17]

- Courtyards (with water and plant elements) and wind catchers for natural ventilation and airflow
- Thick thermal mass walls (e.g., adobe, stone) to moderate temperature fluctuations
- Shading elements to reduce solar heat gain

• Use of local materials for environmental adaptation and resource efficiency [18]

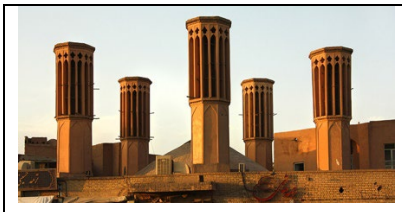			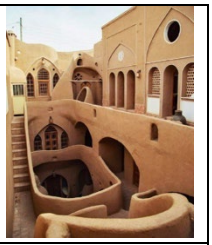
Wind catchers	Courtyard	Shading elements	Local materials

Table 2. Traditional Envelope Design Examples

These vernacular techniques illustrate valuable indigenous knowledge emphasizing harmony with nature and resource conservation. Traditional methods of building envelope design play a crucial role in achieving sustainable user comfort while reflecting cultural and climatic contexts.[19] Historically, these methods emphasized the use of local materials and natural ventilation strategies to optimize energy efficiency (Table 2).[20]

Traditional building envelope designs responded to climate and culture. Some strategies applied depending on different climate conditions are summarized below:

-Hot and arid regions; thick walls with high thermal mass such as adobe or stone absorbed daytime heat and released it at night, limiting reliance on mechanical cooling. Small, shaded openings and courtyards promoted natural ventilation and reduced solar gain.

-Cold regions; climate buildings used compact forms and insulating materials like timber to minimize thermal losses and optimize solar heat gain. Elements like overhangs, latticed windows, and shading fins were integrated for daylight control and airflow management.

-Arid regions; used adobe and rammed earth for high thermal mass, moderating indoor temperatures with minimal energy.

-Mediterranean climates; benefited from unsterilized rammed earth walls that absorbed heat by day and released it at night.

In tropical areas; natural ventilation and shading elements governed comfort without mechanical aids.

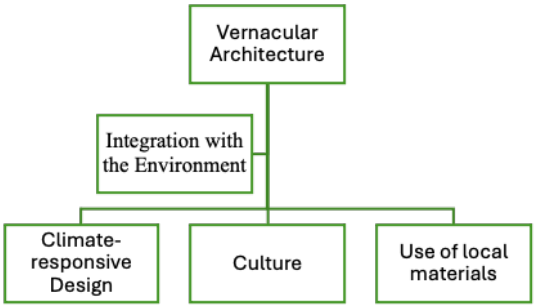

Figure 1. Traditional Architecture and Sustainability.

Traditional techniques, developed in response to local climatic conditions, demonstrate how indigenous knowledge systems effectively balanced occupant comfort with environmental constraints. However, with increasing urbanization and climate variability, there is a growing need for adaptive, high-performance envelope systems that integrate modern technologies and materials.

INNOVATIVE SOLUTIONS IN BUILDING ENVELOPE DESIGN

The evolution of building envelope design has witnessed a shift towards innovative solutions that enhance sustainability while ensuring user comfort.[21] These advancements leverage cutting-edge technologies such as artificial intelligence and leveraging advanced materials, smart technologies, and integrated systems and advanced modeling systems, which optimize design processes and improve energy efficiency.[22] This chapter explores key innovations in building envelope design, their applications, benefits, and limitations, with a focus on their role in enhancing sustainability and user comfort. Modern envelope design incorporates advanced materials and smart systems to optimize comfort and reduce energy consumption, including:[23]

-Dynamic façades that adapt to environmental changes
-Phase change materials for thermal storage and regulation[24]
-Smart glazing that controls light and heat transmission
-Bio-adaptive envelopes integrating vegetation for natural cooling

These technologies improve thermal comfort, daylighting, and air quality in a sustainable manner by enabling envelopes to function as active agents (Table 3).

Dynamic Shading	Chromogenic Facades	Solar Active Facades	Active Ventilative Facades

Table 3. Innovative Facades Examples

Advancements in envelope design incorporate technologies such as artificial intelligence, sensor networks, and real-time adaptive façades to optimize energy efficiency and user satisfaction.[25] Dynamic building envelopes adjust automatically to environmental conditions, achieving significant improvements in energy savings (18.27%) and occupant comfort (20%).[26] The integration of Geographic Information Systems with Building Information Modeling further enables sustainable urban design by refining transit and environmental strategies.[27]

These innovations highlight the shift from static passive designs toward intelligent, responsive systems that meet the complexity of modern urban environments while preserving user comfort and ecological balance.

Advanced Materials and Technologies

Innovative building envelope solutions incorporate cutting-edge materials and technologies to optimize thermal, visual, and acoustic performance while reducing environmental impact.

Smart Glazing

Smart glazing systems, including electrochromic and thermochromic glass, dynamically modulate solar heat gain and daylight, reducing lighting and cooling energy use by 20-40%. These systems enhance visual comfort by minimizing glare while maintaining natural light, aligning with occupant well-being and energy efficiency goals.[28]

High-Performance Insulation

Advanced insulation materials, such as vacuum insulation panels (VIPs) and aerogels, offer superior thermal resistance with minimal thickness. VIPs, with R-values up to 40 per inch, enable slim yet highly efficient envelopes, ideal for retrofitting historic buildings. Aerogels, used in experimental projects, provide excellent insulation while being lightweight and durable, though their high cost remains a barrier.

Double-skin facades (DSFs), can enhance energy conservation while promoting aesthetic appeal and spatial quality. These facades create a buffer zone that reduces heat loss and gain, while also providing controlled ventilation, improved thermal performance, enhanced acoustic insulation, and natural ventilation potential. [29]

High-performance glazing with low-emissivity coatings optimizes daylight penetration and minimizes solar heat, improving both energy efficiency and visual comfort.

Green Roofs and Living Walls

Green roofs and living walls provide insulation, reduce urban heat island effects, and enhance air quality. Meanwhile, green roofs and living walls dramatically enhance insulation, mitigate urban heat island effects, and improve air quality. These walls integrate vegetation into the envelope, enhancing insulation, reducing urban heat island effects, and improving air quality.[30] These systems also contribute to biodiversity and aesthetic appeal, aligning with biophilic design principles.

Kinetic Facades and Integration of Smart Technologies

Inspired by biomimicry, kinetic facades actively respond to fluctuating external conditions such as solar radiation and heat transfer variations. These dynamic skins incorporate smart technologies (sensor arrays, actuators, and responsive materials) to regulate energy flows and occupant comfort seamlessly. As energy demand grows, adopting such integrated smart systems in building envelopes becomes crucial. Their ability to adapt in real time reduces reliance on mechanical HVAC systems and supports energy-efficiency standards globally. This convergence of architecture, technology, and sustainability heralds a new frontier for building design. Innovative envelopes significantly reduce energy consumption and carbon emissions.

CASE STUDY

Comparison of Innovative Solutions

Modern case studies, including The Edge, Amsterdam and Bosco Verticale in Milan showcase advanced envelope systems.

The Edge exemplifies an innovative commercial envelope integrating electrochromic glazing that dynamically adjusts tint in response to solar intensity. Coupled with triple-layered insulation (R-30), this reduces cooling loads significantly while optimizing daylight penetration.[31] Automated operable windows are controlled via a smart building management system, enabling natural ventilation and achieving an estimated 70% reduction in energy consumption compared to conventional office buildings. The design elevates thermal comfort and daylight quality but requires sophisticated controls, leading to increased upfront costs and technical complexity.

The Bosco Verticale (The vertical forest) in Milan, with its tree-covered façade, demonstrates how living walls can lower cooling demands by 10-15% while providing acoustic benefits. Bosco Verticale features extensive living walls with over 20,000 plants installed across its façade, providing natural insulation and shading. This vegetative envelope reduces summer cooling demand by 10-15% and absorbs urban noise, enhancing acoustic comfort for occupants. The biomass enhances biodiversity and urban ecology while serving as a carbon sink.[32] Challenges include moderate to high maintenance costs

and the necessity for irrigation systems, which can limit feasibility in other urban contexts. Nevertheless, it demonstrates the ecological and aesthetic scalability potential of integrating green infrastructure within high-rise envelopes. The façade design solutions and analysis of these examples are presented in Table 2.

Feature	The Edge, Amsterdam	Bosco Verticale, Milan
Key Innovation	Electrochromic glazing, high-performance insulation	Living walls, green balconies
Thermal Strategy	Dynamic solar control, R-30 insulation	Vegetative shading, insulation
Ventilation	Automated windows, mechanical integration	Natural ventilation via vegetative envelope
Energy Impact	70% less energy than standard offices	10-15% cooling load reduction
Cost	High initial investment	Moderate to high, maintenance-irrigation needs
Scalability	High, commercial applications	Moderate, site-specific

Table 2. Comparison of Innovative Solutions in Envelope Design and Sustainable Features

Traditional Strategies Across Innovative Solution

Adobe houses exemplify sustainable vernacular envelopes adapted for extreme desert climates. While The Bullitt Center's envelope integrates innovative solutions.

Adobe houses exemplify sustainable vernacular envelopes adapted for extreme desert climates. Constructed from sun-dried clay, sand, and straw bricks, their thick walls provide significant thermal mass that stabilizes indoor temperatures amid wide diurnal swings. Small, recessed windows and shaded porches minimize unwanted solar heat gain while the breathable adobe material manages interior humidity, enhancing comfort naturally. Research on these buildings demonstrates substantially lower energy consumption compared to contemporary equivalents, underscoring the efficacy of traditional passive approaches. Such case studies offer valuable lessons for integrating climate-responsive design in modern sustainable architecture.

The Bullitt Center's envelope integrates high-performance insulation, triple- glazed windows, and automated ventilation to achieve net-zero energy. Its design prioritizes daylighting and thermal comfort, meeting the Living Building Challenge'srigorous standards, while effective, the high cost and complexity of such systems highlight the need for cost-effective solutions.[33]

The facade analysis of these two examples is described in Table 3.

Feature	ADOBE HOUSES, NEW MEXICO	BULLITT CENTER, SEATTLE
Material	Adobe (clay, sand, straw)	Steel studs, triple-glazed glass
Thermal Strategy	High thermal mass	High insulation (R-25), low U-factor (0.25)
Ventilation	Natural, via small windows	Automated operable windows
Energy Impact	Minimal mechanical use	Net-zero energy
Cost	Low, local materials	High, advanced technologies
Scalability	Limited by modern codes	High, urban applicability

Table 3. Traditional Strategies Across Innovative Solution in Envelope Design

Adobe houses leverage thick walls' thermal mass to stabilize indoor temperatures passively, using natural ventilation suited to arid climates, but construction is labor-intensive and zoning codes limit widespread adoption. The Bullitt Center employs highly insulated envelopes, triple glazing, and smart ventilation to achieve net-zero energy, pushing technological boundaries but at substantial upfront investment. These cases frame the dialogue between vernacular wisdom and cutting-edge systems in sustainability.

Benefits and challenges of Innovative Envelope Designs

Benefits of Innovative Envelope Designs

Innovative envelope solutions offer significant advantages for sustainability and user comfort:

- Energy Efficiency: Technologies like PCMs and dynamic glazing can reduce HVAC and lighting energy use by 20-50%, optimizing building performance over various climatic conditions.

– Enhanced Indoor Environmental Quality (IEQ): Dynamic systems improve thermal stability, daylight quality, and acoustic performance, contributing to the health and productivity of building occupants.

- Environmental Impact: Green roofs and low-carbon materials reduce urban heat and embodied carbon, supporting net-zero goals and embodied carbon emissions, contributing to net- zero targets.

- Adaptability: Smart systems dynamically respond to real-time environmental changes, offering spatial flexibility and efficient operation across diverse climates and occupancy patterns.

Challenges and Limitations

Despite their promise, innovative envelopes face barriers like high initial costs and complexity in retrofitting existing structures.

-High Cost: Materials such as vacuum insulated panels (VIPs) and electrochromic glass incur significant initial investments and limiting accessibility.[34]

-System Complexity: Advanced systems require specialized expertise for design, installation, and maintenance, increasing project complexity.

-Scalability Issues: Biophilic elements like living walls demand site-specific adaptation and resources, restricting replication in dense urban environments without tailored maintenance regimes.

-Durability: Long-term performance data for some innovations, such as PCMs, are limited, raising concerns about reliability

Traditional methods, while cost-effective, may not meet stringent modern regulations or urban demands. However, opportunities abound: modular envelope systems could democratize access to advanced designs, while policy incentives could revive traditional techniques in sustainable construction.

Integrating Tradition and Innovation for Flexible Solutions

As contemporary frameworks emerge to address energy consumption challenges, initiatives like the Nearly Zero Energy Building (NZEB) objective and advancements in Positive Energy Building (PEB) concepts underscore the necessity for integrating both traditional wisdom and modern technologies. These developments advocate for comprehensive strategies that not only meet energy reduction goals but also promote user comfort and resilience within urban environments.[35]

Hybrid envelopes blend vernacular and advanced strategies to balance cost, performance, and context sensitivity. Vernacular designs may also encounter legal obstacles in some systems. Among the challenges of traditional solutions is the scalability of these methods to meet the demands of modern urban environments. Adapting these techniques to larger-scale projects and ensuring compliance with contemporary building codes requires careful evaluation and innovation.

Combining traditional thermal mass with PCMs can stabilize indoor temperatures while leveraging passive solar control. Retrofitting heritage buildings with vacuum insulated panels (VIPs) preserves cultural fabric and meets stringent energy codes, exemplified by Victorian home renovations achieving 40- 50% energy savings. Moreover, biomimicry-inspired designs, such as Zimbabwe's Eastgate Centre mimicking termite mounds, utilize passive ventilation through intelligent envelope design, merging age-old natural wisdom with modern engineering. These integrations pave pathways for sustainable, resilient architecture tailored to urban density and climate change challenges.

CONCLUSION

Building envelope design is a cornerstone of sustainable user comfort, evolving from passive traditional methods to technology-driven innovations. Traditional strategies offer timeless lessons in climate-responsive design, while modern solutions provide precision and scalability. By integrating the strengths of both—thermal mass with smart materials, passive ventilation with active systems—architects can create envelopes that minimize environmental impact and maximize occupant well-being. This study advocates for a hybrid approach, urging further research into cost-effective, context-specific solutions that honor the past while embracing the future.

In conclusion, the exploration of sustainable user comfort through innovative building envelope design has underscored the imperative for a harmonious interrelationship between architectural practice and ecological sensitivity. Effective building envelopes not only enhance user comfort by regulating temperature and air quality but also serve as a platform for educational and environmental awareness. As indicated in research focused on sustainable learning environments, well-designed spaces can significantly influence the quality of the learning experience, motivating users through their aesthetic and functional attributes.[36] Furthermore, the adaptation of traditional methods alongside innovative solutions has been documented in various case studies highlighting successful implementations of Passivhaus standards in the UK, demonstrating practical pathways to achieving sustainable architecture.[37] Ultimately, fostering environments that prioritize user comfort and ecological consciousness can lead to healthier, more productive spaces, creating a foundation for a more sustainable future.

The building envelope is a cornerstone of sustainable user comfort, balancing energy efficiency with occupant well-being. Traditional methods, rooted in vernacular architecture, offer low-impact solutions, while innovative technologies push the boundaries of performance. By integrating these approaches, designers can create buildings that are sustainable, comfortable, and resilient. As climate change intensifies, further research into hybrid solutions and accessible technologies will be essential for the future of sustainable architecture.

In concluding this exploration of innovative solutions in building envelope design, it is evident that advancements in technology and materials play a pivotal role in enhancing energy efficiency and sustainability. The implementation of Building-Integrated Photovoltaics (BIPV) serves as a prime example, where thoughtfully designed modules can seamlessly blend aesthetics and functionality, providing renewable energy while adhering to architectural integrity.[38] Moreover, the European Union's commitment to the Nearly Zero Energy Building (NZEB) standard underscores the importance of integrating advanced materials and systems into construction practices to promote energy self-sufficiency.[39] As we look towards the future, continuous innovation in building envelope design will not only contribute to reducing carbon footprints but will also redefine urban landscapes, paving the way for buildings that are not only habitats but active participants in energy production and management. The intersection of technology and sustainable practices is crucial for achieving a resilient built environment.

By embracing a holistic approach that considers both environmental and human factors, we can create buildings that are not only energy-efficient but also contribute to the health and well- being of their occupants and the planet.

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BEYOND VISION: EXPLORING MULTISENSORY APPROACHES IN ARCHITECTURE

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INTRODUCTION

Architecture has long been dominated by ocularcentrism: the privileging of vision over other sensory modalities in spatial perception and design.[1] Rooted in Western philosophical traditions, particularly those of Plato and Descartes, this visual bias has shaped architectural discourse and practice, often at the expense of a richer, multisensory experience of space.[2] The concept of ocularcentrism underscores the way architecture has historically been conceived and appreciated primarily through its visual aspects, while minimizing the roles of sound, touch, and scent in shaping spatial experiences. Morton Heilig's sensory hierarchy further illustrates this imbalance, noting that vision accounts for 70% of human perception, whereas audition (20%), olfaction (5%), touch (4%), and taste (1%) play significantly smaller roles.[3]

Juhani Pallasmaa, in *An Architecture of the Seven Senses*, critiques this visual dominance, arguing that it has led to a disembodied engagement with space, where architecture is often reduced to imagery rather than an immersive, lived experience.[4] Pallasmaa advocates for an architecture that engages the full spectrum of human senses, reinforcing the idea that spatial perception relies on a complex interplay of multisensory stimuli, including, but not limited to, vision.

The challenge of this research is to identify opportunities typically hidden by visual bias in architectural design. Eschewing visual dominance in favor of a multisensory approach challenges conventional orthodoxy in search of new possibilities latent in a phenomenological and experiential design process. Foregrounding and integrating touch, sound, and scent into design considerations provides a broad range of alternative criteria for contemporary architecture that promises a deeper connection between people and their surroundings. More specifically, this research explores how sensory modalities provide new design tools applicable to an enhanced articulation of spatial perception and experience.

OCULARCENTRISM IN ARCHITECTURAL HISTORY

In Renaissance architecture, vision became the dominant means of spatial organization through the development of linear perspective. The Renaissance systematized perspective, transforming architecture into a mathematical and highly visual discipline.[5] Architects like Brunelleschi, Palladio, and Alberti emphasized the alignment of buildings, creating compositions that guided the eye through symmetry, proportion, and vanishing points.[6] This reliance on perspective reinforced architecture's role as a visual art, privileging the observer's distant gaze over a more embodied, multisensory experience.

Modernist architecture further deepened the dominance of vision by emphasizing transparency, objectivity, and spatial continuity. As Mark Wigley argues in *White Walls, Designer Dresses*, modern

architecture was carefully crafted to emphasize visual purity, where form, color, and surface were controlled primarily for the eye. The white wall became a powerful symbol of hygiene and moral clarity, conveying a sterilized vision of space that erased the complexities of daily life.[7] Consequently, architecture focused more on appearance than on sensory experience. This visual primacy extended to urban planning; *le regard surplombant* (the look from above) dictated large-scale developments, often neglecting human-scale interactions and sensory diversity.[8] As a result, modernist spaces sometimes felt detached from the lived experience of their inhabitants, reinforcing architecture as something to be seen rather than fully inhabited.

In the digital age, screen-mediated perception has reinforced ocularcentric dominance as digital modeling and photorealistic rendering software fundamentally alter the ways architecture is conceived and experienced. As architectural representation increasingly relies on digital renderings, virtual reality, and online imagery, it reduces the physical encounter with buildings to a visual spectacle. While these technologies expand architectural imagination, they also flatten spatial perception, emphasizing surface appearances over materiality, acoustics, and haptic qualities. The dominance of screens in contemporary life means that many buildings are first, and often only, encountered as images rather than physical spaces, shaping expectations and design priorities around the visual rather than the multisensory.

MULTISENSORY SPATIAL PERCEPTION

In *The Eyes of the Skin*, Pallasmaa expands his critique of visual dominance in architectural discourse and advocates for a more holistic, multisensory approach to spatial perception. Pallasmaa argues that modern architecture, with its emphasis on visual aesthetics and detached objectivity, often alienates the body from space rather than engaging it. He suggests that meaningful architectural experiences arise not just from what is seen but from how space resonates with the body, reinforcing a sense of place through multisensory immersion.[9] Echoing this view, Soltani and Kirci emphasize that perception rarely isolates a single sense but instead results from a continuous interplay between them: “Every sense we perceive calls others. We perceive the world through our sensory systems; our senses cooperate and interact continuously with our environment. Thus, we obtain the invisible dimensions of the space.”[10] This means that sensory perception is inherently layered and interconnected; what we touch influences what we see, and what we hear can alter our spatial understanding. Such integration allows architecture to be experienced as a living atmosphere rather than a static visual composition.

Neuroscientific research on embodied cognition further supports Pallasmaa’s argument by demonstrating that spatial experience is deeply tied to bodily perception. Studies in cognitive neuroscience show that the brain does not process space as a purely visual construct but integrates sensory inputs from proprioception, touch, and sound to form a comprehensive spatial understanding.[11] The hippocampus, a brain region crucial for navigation and memory, is activated not only by visual landmarks but also by sensory and motor interactions with the environment.[12] This suggests that architectural design should consider how spaces are physically experienced rather than merely how they appear, promoting designs that engage movement, materiality, and environmental stimuli to enhance cognitive and emotional connections to place.

Psychological studies further highlight the relationship between multisensory perception and cognitive function, showing that sensory-rich environments improve memory, learning, and emotional well-being. For example, environments that incorporate tactile surfaces, dynamic lighting, and varied soundscapes have been shown to enhance focus and spatial awareness.[13] This aligns with findings in environmental psychology, which indicate that biophilic spaces with multisensory engagement helped in reducing stress while improving cognitive functions in office workers.[14] These insights reinforce the need for architects to move beyond ocularcentrism and design spaces that actively engage all senses, creating richer, more meaningful spatial experiences.

MOVING BEYOND VISION

Maria del Carmen Olle Coderch, an internationally recognized photographer with over 2,000 awards and participation in 400 exhibitions since 2003, challenges conventional interpretations of space by offering a perception shaped by her visual impairment. With her vision limited to only 10%, she does not rely on traditional visual techniques but instead tracks light, refraction, and sound to navigate and capture her surroundings.[15] Her compositions move beyond structured imagery, embracing a fluid, almost painterly quality that reveals hidden details often overlooked.[16] In *Diagonal Mar Park* by Enric Miralles, located in Barcelona, where sharp angles and seemingly aesthetic elements create a visually complex experience, Ollé perceives the space differently. Rather than focusing on geometric cues, she captures the park's essence through shifting light, reflections on water, and the ambient sounds of chirping birds. As Ingold notes, "we do not see light, we do see in light", yet for those with heightened sensitivity to light, it becomes not only a medium but a subject of perception itself. In her work, light is not merely a tool for visibility; it is an active force that interacts with space, shifting atmospheres, and revealing hidden qualities of the built environment [17]

Ollé's work teaches the world an alternative way of understanding space, one that values the multi-sensory over the purely visual. She is known for "capturing surprising details, capturing fragments of nature with her gaze and expressing them through photography whose personalized technique has pictorial connotations.".[18] Her images translate sensory moments into compositions that highlight movement, textures, and the passage of time. Rather than prioritizing static, sight-driven interpretations of architecture, her work suggests a more immersive approach, where spaces are designed to be felt, heard, and experienced as dynamic, atmospheric environments. This challenge to ocularcentrism can also be seen in the work of artists Christine Sun Kim, whose practice reframes sound as a spatial and visual phenomenon, and Lygia Clark, who foregrounds touch and bodily sensation over sight.[19] Together, these practices demonstrate how architectural experience can be expanded when perception is decentered from vision.

Figure 1. Gap, Photography by Maria del Carmen Olle Coderch

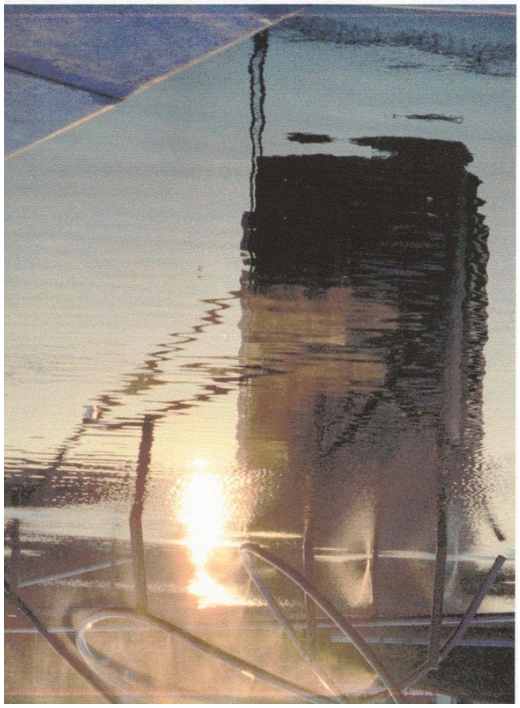

Figure 2. Hesitation, Photography by Maria del Carmen Olle Coderch

SENSORY URBANISM

The sterility of contemporary architecture and urban planning exacerbates sensory neglect. The prevalence of standardized glass towers and monotonous cityscapes has contributed to a rise in "sick building syndrome",[20] as urban dwellers spend an estimated 95% of their lives indoors.[21] Richard Sennett critiques modern urbanism as lacking a meaningful dialogue between architecture and human experience, arguing that a truly public space should allow individuals to "adopt" buildings, using them as "vehicles for social expression" rather than as passive backdrops. While the motivations have shifted, contemporary architecture still engages in a similar battle, this time, producing repetitive, non-functional buildings that serve market competition rather than human experience. As Marxist theory suggests, industrialization has led to a homogenization of the built world, where cities prioritize efficiency and capital over sensory engagement. "The consumers of physical things are alienated from making the objects they consume; they have lost physical consciousness of things by being merely passive consumers.".[22]

As Ingold notes, perception is not just about sight but about "being bodily present in the world".[23] Despite this inherent multi-sensory interaction, contemporary urban planning and architecture have largely disregarded sensory engagement. The dominance of visual aesthetics has led to environments that lack tactile and auditory richness, limiting the ways individuals, particularly those with visual impairments, interact with urban space. Studies highlight that cities must be understood not just by "reading or visualizing" but by "sensing the city through multiple sensory modalities", recognizing how movement, sound, and touch shape spatial perception.[24]

The sensory disconnect in urban environments is not an accident but a reflection of power structures embedded in spatial organization. Monica Degen, referencing Lefebvre, notes that "urban landscapes can be understood as places in which certain preferred meanings and practices are ingrained in their physical texture to maintain relations of power".[25] Considering these, a re-engagement with sensory urbanism, designing for sound, smell, and touch, can create spaces that foster inclusivity, particularly

for those with visual impairments, and challenge the alienating effects of contemporary urban development.

CASE STUDY: BARCELONA

Barcelona stands as a prime example of multisensory urbanism, exemplified by an inclusive urban fabric, allowing for rich multisensory experiences beyond vision. As Gehl emphasizes, perception is inherently tied to movement, reinforcing the importance of pedestrian-oriented urbanism.[26] Its distinctive urban fabric, rooted in a mix of medieval layouts and Cerdà's 19th-century grid, facilitates an immersive engagement with the city through soundscapes, textures, and smells. The textured pavements, La Rambla's vibrant soundscapes, and distinct olfactory environments, ranging from the salty Mediterranean air to the aroma of open-air markets, enhance its spatial legibility for those with visual impairments. Walking through Barcelona is an act of sensory mapping, where "perception is not a static process," but rather unfolds through bodily movement in space and time.[27] Lefebvre's "practico-sensory realms" further highlight the significance of these immersive urban interactions, where walking enables an embodied connection with the city [28]

Despite Barcelona's successes, contemporary urban development threatens to undermine this sensorial depth. While "fluid interactions shape spatial identity", Richard Sennett critiques modern urbanism for failing to create spaces that engage the body, reducing architecture to passive aesthetics rather than lived experience.[29] This critique resonates in Barcelona's newer developments, beginning with the preparations for the 1992 Olympic Games. Poblenou was transformed into one of the city's new centers, a process later accelerated by the 22@ plan, a public-private initiative that sought to rebrand the area as a hub of technology and innovation. While promising community services and cultural spaces, the plan relied heavily on private investment, eroding much of Poblenou's industrial heritage and sidelining local voices, which led to conflict and citizen resistance.[30] Similarly, the Olympic Village, though successful in global image-making, introduced standardized housing blocks that lack the layered textures and social diversity characteristic of the Gothic Quarter or the Eixample. This issue is evident in the rise of standardized glass façades that diminish tactile variety and sonic character. By integrating principles from Carme Ollé's work on urban experience and Pallasmaa's critique of visual dominance, contemporary architecture could foster richer sensory engagement. "The senses thus become the starting point par excellence for inhabitant expression," reinforcing the need for designers to embrace multisensory urbanism rather than continue creating sterile environments [31]

DESIGN METHODOLOGY

Truly immersive sensory experiences emerge when spaces move beyond generic design and instead cultivate isolated sensory zones that provoke, prioritize, and celebrate unique sensory encounters.

To investigate this idea, we developed a methodology inspired by the structure of a tasting menu at a Michelin-starred restaurant. These menus orchestrate a carefully choreographed journey, in which each dish builds upon the last, moving from delicate beginnings to bold climaxes and concluding with a satisfying resolution. This analogy raises a question about architecture: could spatial sequencing similarly offer a curated progression of sensory encounters, punctuated by moments of neutrality? Just as palate cleansers reset the taste buds between rich flavors, architecture can incorporate neutral, quiet spaces that momentarily minimize sensory engagement. These moments offer opportunities for reflection and preparation for the next sensory discovery. Hence, we propose a curated sequence of sensory encounters intercepted with moments of "nothingness."

In our exploration, these spaces of "nothingness" are conceptualized as existing historic buildings augmented by sensory interventions. This approach draws inspiration from Bryan Cantley's series of

parasitic drawings (figure 3), where historic structures are transformed through evocative, layered additions.

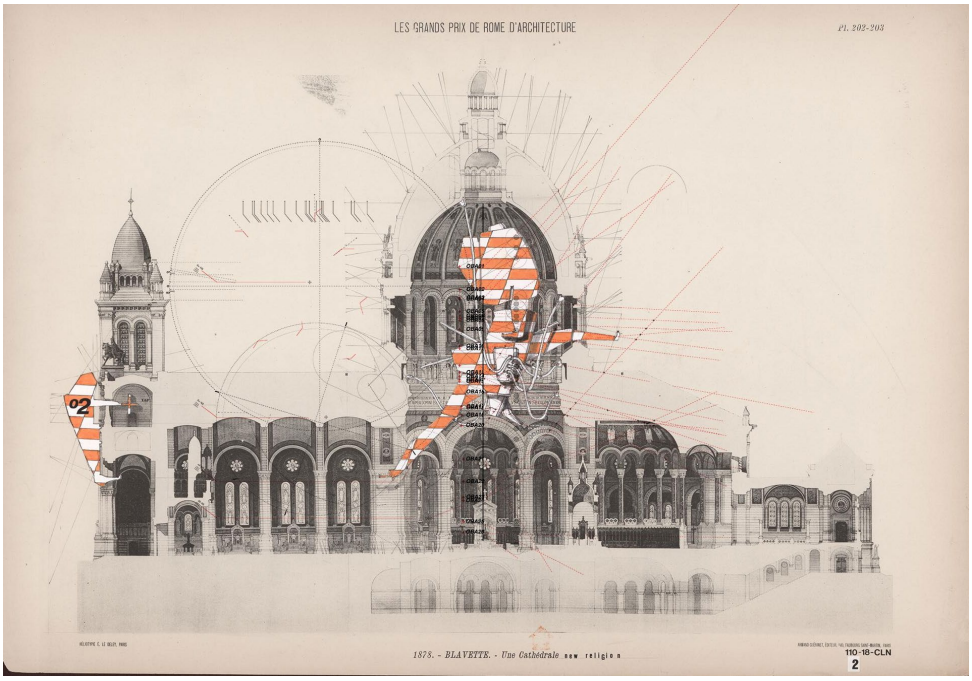

Figure 3. Palimpsestuous Relationships, His-Storical Intervention, Drawing by Bryan Cantley

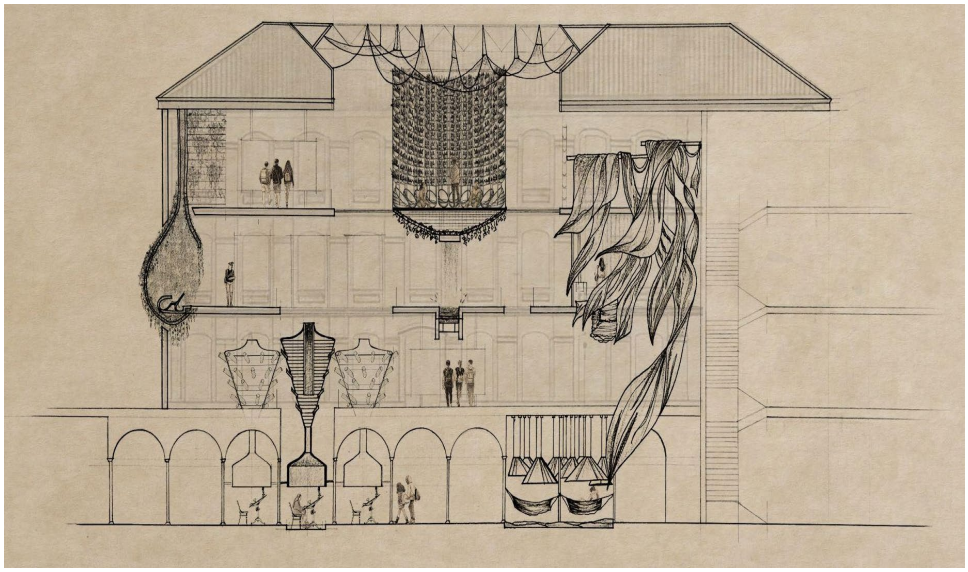

Figure 4. Senscape: Augmented Section with Parasitic Interventions

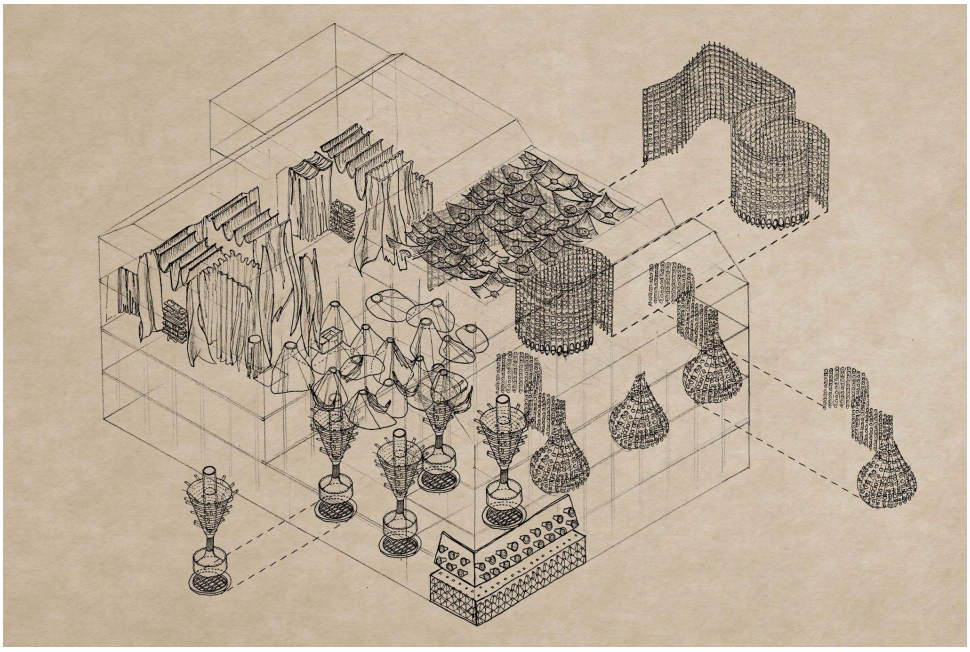

Figure 5. Senscape: Axonometric Drawing of the Augmented Building

The stillness of the interior in the historic building in Barcelona is enhanced through a strategy of parasitic key moments with subverted expectations (figures 4,5). The design prioritizes the senses of touch, sound, and smell by selecting programs within the project that naturally align with the sensory experiences and crafting moments to amplify and highlight them. The didactic sensory zones encourage users to rediscover their sensory potential, reframing their relationship with the built environment and celebrating the interplay between perception and place.

DESIGN PROPOSAL: MULTISENSORY DESIGN SCHOOL

The Multisensory Design School serves as a pioneering didactic center, shaping the next generation of architects by immersing them in a spatial experience that engages all senses, an essential step toward redefining architecture beyond its visual dominance (figure 4,5). *Senscape* provides a tactile, auditory, and olfactory learning environment that evokes a sense of nostalgia, recalling the rich sensescape of the city. The school becomes a living memory of its surroundings, ensuring that learning is not just visual but deeply felt. Designed for university students, this institution marks the beginning of a broader transformation in architectural education, emphasizing the importance of multisensory design in shaping the cities of the future.

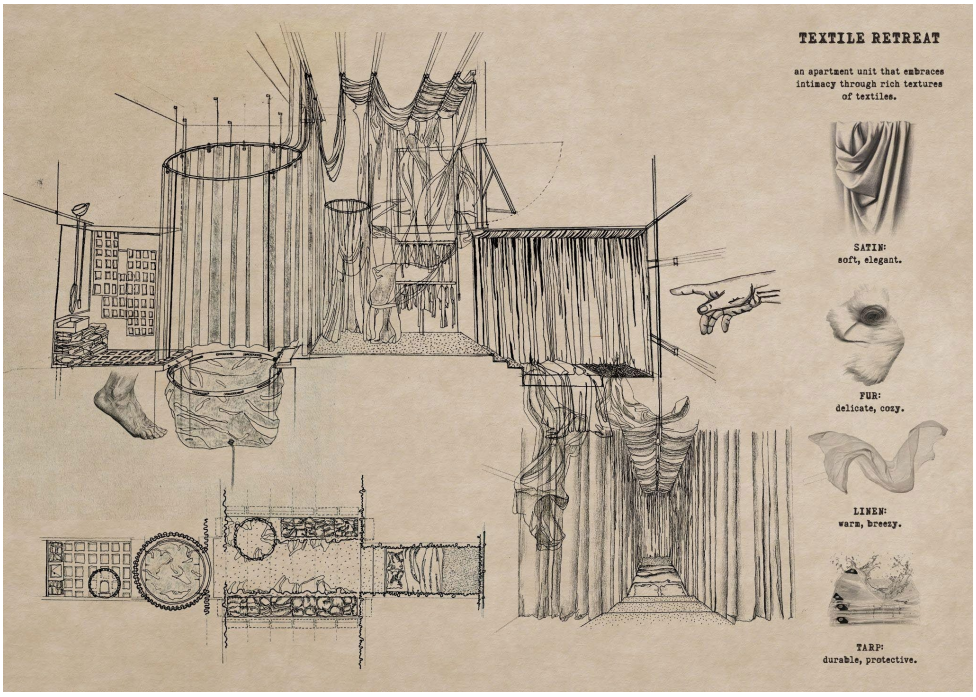

Figure 6. Textile Retreat (Touch)

While the eye perceives separation and distance, touch embodies nearness, intimacy, and affection. As shown in Figure 6, tactility is elevated through the careful use of varied textiles, each serving as a tender layer of privacy and warmth. Delicate linen drapes the beds, inviting restful slumber; satin cloaks the wardrobe, whispering of intimacy; and a tarp mimics the bathtub, grounding the sense of touch. These fabrics become a second skin, inviting the visitors to immerse themselves in a harmonious interplay of light, shadow, and texture.

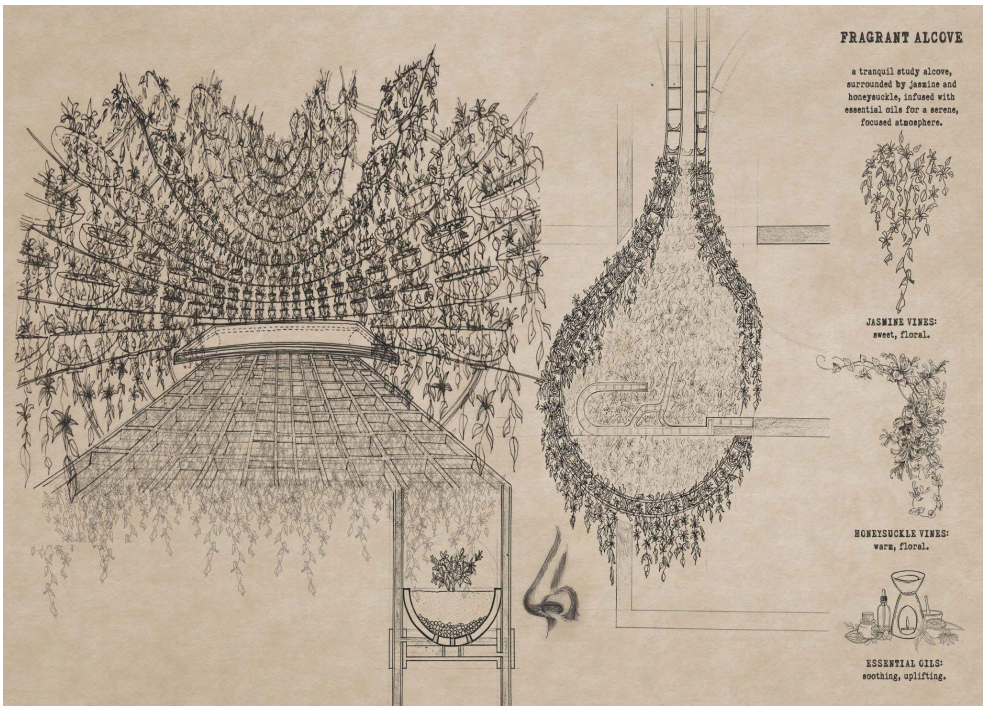

Figure 7. Fragrant Alcove (Smell)

The Fragrant Alcove (figure 7) is designed as a focused study space, extending outward from the facade like balconies that invite filtered sunlight and aromatic enrichment. As you enter, the scents of jasmine and honeysuckle vines gently surround you, filling the air with their calming presence. Pipes channel the essential oils, further enhancing the experience and nurturing both focus and relaxation.

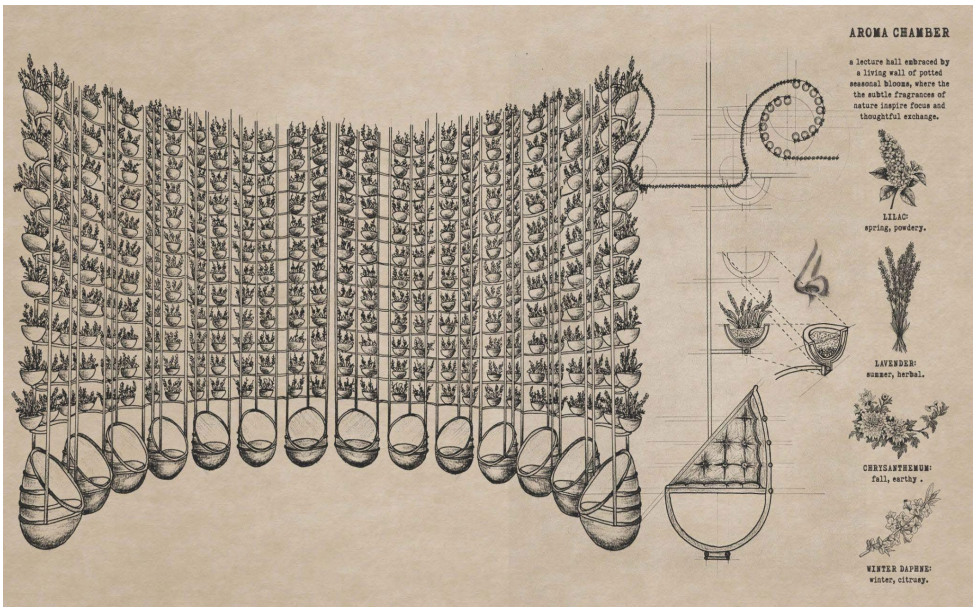

Figure 8. Aroma Chamber (Smell)

An extension of the fragrant alcove, the Aroma Chamber (figure 8) provides a space for exchanging ideas and learning. The potted plants in the lecture hall serve as both greenery and furniture, allowing you to "plant yourself" in nature. Seasonal shrubs and flowers bloom throughout the year—lilacs in spring, lavender in summer, chrysanthemums in fall, and winter daphne in winter—offering a constantly evolving olfactory experience.

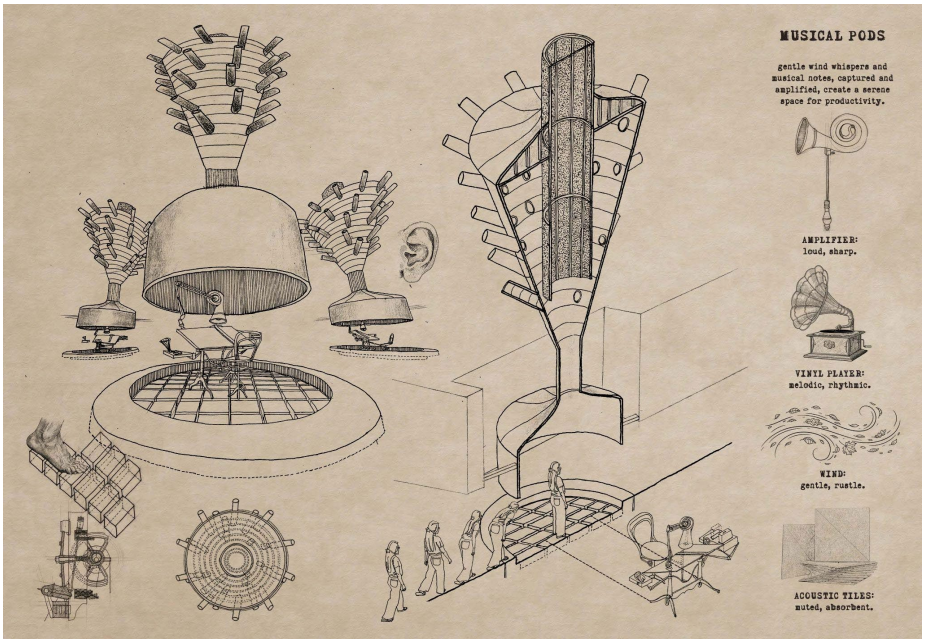

Figure 9. Musical Pods (Sound)

The Musical Pods (figure 9) capture the natural sounds of the wind, softening and transforming them into a calming presence through acoustic filters. These gentle sounds flow seamlessly into the workspace, creating a serene atmosphere for focus. The drafting furniture occupies an area covered by an acoustic canopy that users duck under to enter. Inside the pods, the pathway is designed with kinetic pavers, each producing a unique sound with every step. Musical instruments integrated into the furniture enhance the ambiance, seamlessly blending movement and sound to create a harmonious, productive experience.

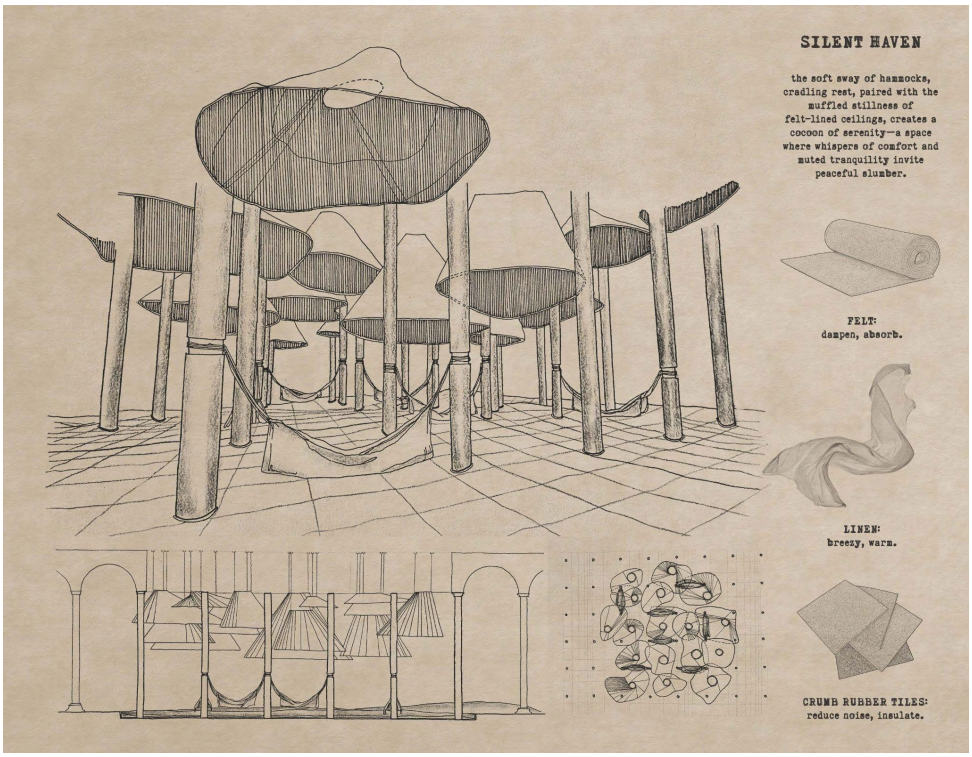

Figure 10. Silent Haven (Sound)

Nestled in the basement among a forest of columns, the Silent Haven provides seclusion and respite. Fabrics from the textile retreat extend into hammocks, tied securely to the columns, creating cozy resting spots. The ceiling features felt acoustic canopies that dampen sound, while the rubber flooring absorbs the noise of footsteps. Designed for isolation and relaxation, the space offers a peaceful escape where stillness and comfort come together.

CONCLUSION

This proposal marks the beginning of an underappreciated opportunity in architecture, where multisensory experiences become central to the design process. By addressing the limitations of vision-centric architecture and incorporating touch, sound, and scent, we open up new possibilities for immersive spatial engagement. This reimagining expands architecture's role in sensory interaction, allowing spaces to resonate more deeply with their inhabitants. The proposed design school embodies this shift, where sensory learning becomes a tangible and active experience, reinforcing the concept of multisensory architecture as both a philosophical and practical tool for shaping future urban landscapes. Through this approach, we aim to bridge the gap between abstract design and the lived, embodied experiences of those who occupy these spaces.

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FLOATING ARCHITECTURE IN TURKEY: HISTORICAL CONTINUITY AND CONTEMPORARY PERSPECTIVES

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INTRODUCTION

This study aims to examine the evolution of floating architecture in Turkey by tracing its development from the Ottoman Empire to the present. Historically, the concept of constructing buildings on water is not a new phenomenon in Istanbul or, more broadly, in the *Bosphorus* region. On the contrary, it has developed over centuries, shaped by the city's long-standing relationship with water. Since the Ottoman period, various structures have been built along the shoreline, including diving and observation towers, sunbathing terraces, sea baths, and floating houses.[1] Evliya Çelebi's 17th-century work *Seyahatname* reveals that sea baths, a notable example of these coastal structures, date back to this period.[2]

This study traces the historical transformation of coastal and leisure practices through architectural and spatial forms, situating them within broader cultural and social frameworks. Beginning with the emergence of sea baths between the seventeenth and nineteenth centuries, the research highlights how the regulation of privacy and mechanisms of social control informed early coastal use. The discussion then turns to the development of towers as collective observation structures, examining diving towers that appeared in the early twentieth century as instruments of both surveillance and recreation. Attention is subsequently directed to the rise of sunbathing terraces during the mid-nineteenth to twentieth century, which reveal the spatialization of modern leisure practices and their alignment with evolving notions of health, exposure, and public life. Finally, the paper explores the modern period of floating architecture from 1935 to 1970, emphasizing the shift from early Republican experiments to modular design approaches, with a particular focus on the works of Seyfi Arkan, Ahsen Yapanar, and Melih Koray. Collectively, these case studies underscore the ways in which architecture not only accommodated but also actively structured the practices and ideologies of leisure across different historical moments.

Sea Baths: Coastal Use Through Privacy and Social Control

Sea baths, a significant building type that spatialized the relationship between the coast and the sea both physically and socially, began to appear in travelogues from the 17th century and became widespread in the 19th century with Westernization. Constructed on waterproof wooden piles, surrounded by walls, and connected to the shore with bridges, these structures were divided into public and private types. Public sea baths were organized by gender and functioned as spaces that governed social interaction and bodily conduct. Private baths, meanwhile, were small structures attached to waterfront mansions and served individual leisure.[3]

In Ottoman society, public interaction with the sea was limited due to modesty norms and social conventions. Swimming in open waters was frowned upon; instead, people preferred secluded coves or improvised private spaces on boats. Sea-related activities like boating, fishing, and enjoying the sea breeze were more common than actual sea bathing. Sea baths emerged as enclosed, roofless wooden structures built on piles above the water, offering privacy and shelter from the sun.[4] They allowed non-swimmers to benefit from sea water without violating social codes. These baths became especially visible in the 19th century, as attitudes shifted and medical publications began promoting the health benefits of sea water. There were two types: public sea baths, seasonal and gender-segregated, and private baths, elegant structures attached to mansions, used exclusively by residents and guests with official permission. By the 1920s, sea baths gradually gave way to modern beach culture, which brought new leisure practices and redefined Istanbul's relationship with the sea them.[5]

Sea Bath structures—built on water-resistant wooden piles within the sea and enclosed with timber walls for privacy—were established in numerous locations along Istanbul's coastline, including Yeşilköy, Bakırköy, Samatya, Yenikapı, Kumkapı, Çatladıkapı, Ahırkapı, Salıpazarı, Fındıklı, Kuruçeşme, Ortaköy, İstinye, Tarabya, Büyükdere, Yenimahalle, Beykoz, Paşabahçe, Kuleli, Çengelköy, Beylerbeyi, Üsküdar, Salacak, Moda, Fenerbahçe, Caddebostan, Bostancı, Kartal, Maltepe, Pendik, and Tuzla. By the 1920s, sea baths began to transform, gradually giving way to public beaches. Over time, the beach culture developed its own forms of leisure, fashion, and social rituals, marking a shift in the city's relationship with recreational life by the sea. In fact, their presence could still be noted in isolated cases as late as the 1970s. However, starting from the 1920s, the emergence of beach structures and the rise of beach culture gradually replaced the sea baths and the bathing traditions associated with them.[6]

Diving Towers: Essential part of the modern beach

The history of Florya as a beach destination began to take shape in the early 1920s. During this period, some of the White Russians who had fled the Bolshevik Revolution and temporarily settled in Istanbul were relocated to the Florya coastline. Seeking relief from both the heat and the parasites they had contracted during their journey; they began bathing in the sea—an activity that quickly drew the attention of Istanbul's residents. Curious crowds flocked to the area to witness this unfamiliar seaside culture.[7]

The founding story of the Beyazpark Beach and Casino in Büyükdere offers valuable insights into the transition from sea baths to modern beach culture in early Republican Turkey. Established on August 13, 1926 under the name "Beyazpark Gazinosu ve Deniz Banyosu" (Beyazpark Casino and Sea Bath), the facility was built on municipal land and initiated by entrepreneur Rasim Kayra. Flanking the seaside casino were two enclosed sea baths—one for women and one for men.

However, some local residents of Büyükdere objected to the proximity of the gender-segregated baths, especially with a casino serving alcohol located between them. They submitted a formal complaint, deeming the arrangement "contrary to morals and public decency."

Coincidentally, during this same period, Gazi Mustafa Kemal (who had not yet taken the name Atatürk) visited Büyükdere. He expressed great appreciation for the location and the quality of the seawater. Seizing the moment, the casino's owner discreetly conveyed the issue to Mustafa Kemal via Tahsin Uzer, who was accompanying him. Upon hearing of the objection, Mustafa Kemal responded with clear disapproval, stating:*"What is the meaning of this gender segregation? The problem is not the short distance between the baths, but the continued insistence on maintaining* ***haremlik-selamlık*** *divisions in sea bathing."*[8]

Following Atatürk's support, the sea baths in Büyükdere were spared from closure and began to gain popularity. The site was redesigned, and the sea baths were replaced with a large public swimming pool.

Additionally, a three-tiered diving tower was constructed, becoming one of the first of its kind in Turkish recreational history.

Figure 1. Diving tower of the beach and casino in Büyükdere Beyaz Park Beach,1932

Sunbathing Terraces: Spatialization of Modern Leisure Practices

From the mid-19th century, sunbathing terraces appeared along the Bosphorus as architectural responses to Westernized perceptions of the body and modern leisure. Built as wooden platforms, often associated with sea baths and summer homes, these terraces were planned to offer separate spaces for men and women, regulating bodily visibility and redefining social norms and engagement with nature. These structures represent unique spatial typologies reflecting late Ottoman society's transformation. These three typologies offer a strong context for understanding the historical continuity and socio-cultural transformation of spatial practices along the Bosphorus. Reading the evolution of contemporary floating architecture in light of these precedents allows for new interpretations of spatial typologies within historical frameworks.

Emerging along the shores of the Bosphorus in the mid-19th century, sunbathing terraces represent the architectural embodiment of a new bodily perception and leisure culture shaped by Westernization. Designed as wooden platforms, these structures were often integrated with sea baths and summer residences. Planned to provide separate spaces for men and women, the terraces played a critical role in spatially regulating the visibility of the individual body in public. These terraces mark a significant transformation in late Ottoman society, where privacy was increasingly redefined, social status became more publicly displayed, and the relationship with the sea was renegotiated.[9]

As such, they offer a unique example of spatial organization reflecting broader socio-cultural shifts. Together with sea baths and towers, sunbathing terraces form a triad of architectural typologies that illuminate the historical continuity and layered transformation of spatial relations with water in the Bosphorus. Understanding the development of today's floating architecture through the lens of these precedents allows for a reinterpretation of contemporary spatial forms in dialogue with their historical roots.

Modern Period Floating Architecture: From Republican Experiments to Modular Designs

Between 1935 and 1970, the first architecturally designed floating residences were developed in Istanbul by pioneering modern architects such as Seyfi Arkan, Ahsen Yapanar, and Melih Koray. These floating houses were not just technically innovative structures but also represented full-fledged residential typologies in terms of interior layout and living functions. Especially along the Golden Horn and Bosphorus shores, these experimental dwellings reflected modernist trends in housing production, explorations in spatial flexibility, and the aspiration to integrate daily life with water.

Between 1935 and 1970, Istanbul witnessed the emergence of the first architecturally designed floating dwellings, pioneered by modern architects such as Seyfi Arkan, Ahsen Yapanar, and Melih Koray. These structures were not only technically innovative in terms of construction but were also conceived as full-fledged homes—featuring interior layouts and living functions that adhered to the spatial standards of permanent residential architecture. Primarily located along the shores of the Golden Horn and the Bosphorus, these experimental floating houses embodied the modernist architectural trends of the period. They reflected a search for spatial flexibility and explored new forms of living in direct relationship with water, signaling a transformative moment in Turkey's residential architecture.

Seyfi Arkan: Florya Atatürk Marine Pavilion

The Florya Atatürk Marine Pavilion, constructed as part of Turkey's early Republican modernization projects, is a pioneering structure that integrates the international language of modern architecture with the coastal culture of the Bosphorus. Built on the sea in Florya and connected to the shore via a 70-meter-long pier, the building rests on reinforced concrete piles. Although not technically a floating structure, it creates a strong visual and spatial impression of "floating." Planned with a simple, functional, and modernist approach, the pavilion contains private spaces used by Atatürk for rest, swimming, and summer retreats. It is historically significant as both a place that witnessed the private life of a public leader and as one of the first symbols of a modern water-oriented lifestyle in early Republican Turkey.[10]

Ahsen Yapanar: Floating Pavilions and Experimental Aquatic Housing Typologies

In the 1940s and 1950s, Ahsen Yapanar emerged as a prominent figure in Istanbul's modern architectural scene, pioneering a visionary reinterpretation of the city's historical relationship with the sea. In Yapanar's projects, water was not merely a scenic backdrop but an experiential component of architectural space. His designs for floating pavilions and modular, platform-based residential prototypes were conceived as viable alternatives for coastal living along the shores of Istanbul.

Yapanar envisioned floating platforms supported by timber or lightweight steel frame structures, configured as either shore-connected or semi-autonomous units. These designs featured interior layouts that were actively engaged with sunlight, landscape, and movement—prioritizing sensory interaction between the built environment and its aquatic setting. Particularly in Bosphorus areas where access to the shoreline was restricted, these projects represented some of the earliest architectural responses to the need for alternative living platforms.[11]

Yapanar's floating housing proposals represented a visionary approach to adaptable and environmentally conscious design. They were conceived as modular, portable, and seasonally deployable structures, enabling flexible use across different contexts. Constructed with lightweight timber frames, the units combined durability with ease of assembly and relocation. Their anchorable bases were specifically designed to preserve coastal ecosystems, reflecting an early sensitivity to environmental sustainability. The dwellings emphasized mobility, allowing them to be retracted onto land when conditions required. Internally, they were planned with functional layouts to support

everyday life**,** while their orientation toward open and semi-open spaces maximized views and fostered direct engagement with the surrounding water. Together, these features illustrate how Yapanar envisioned a modern yet ecologically responsive model of floating habitation.[12]

These floating typologies embodied progressive design principles for their time. They required no dedicated land plots, enabled minimal environmental intervention, and allowed for user-led spatial production—making them early prototypes of sustainable, adaptive architecture in Istanbul's evolving urban and coastal context.

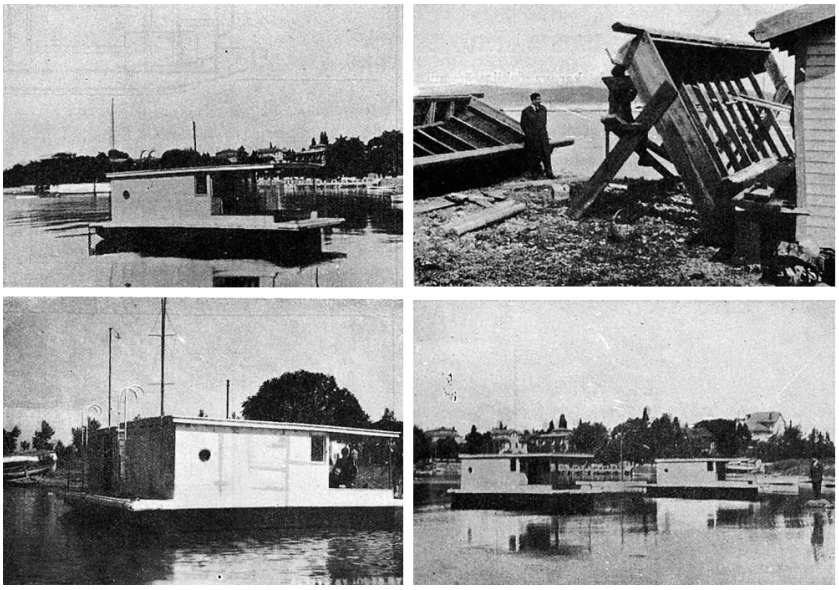

Figure 2. Ahsen Yapanar's Floating House (Yapanar, 1947).

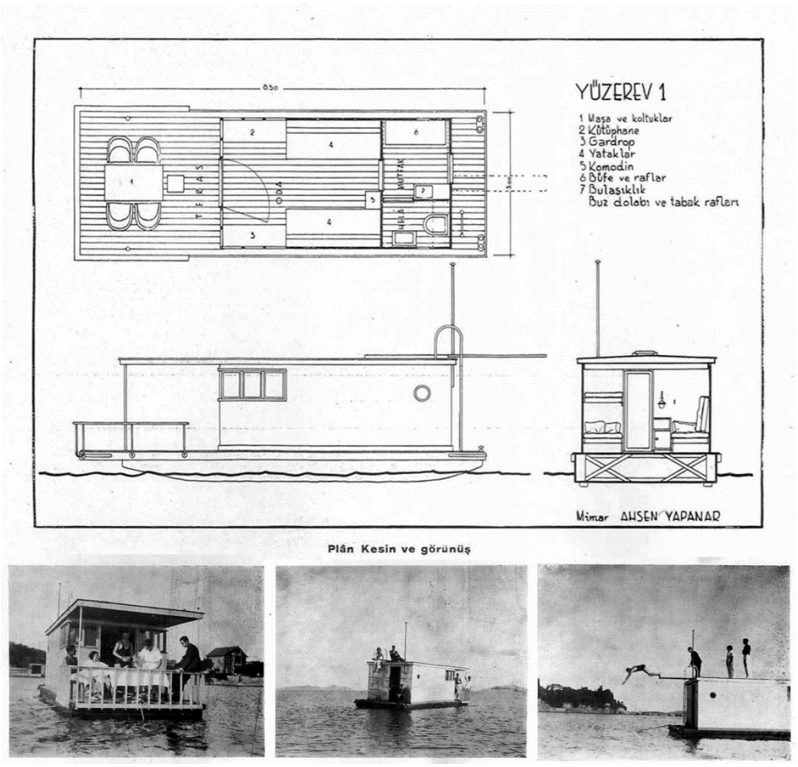

Figure 3. Ahsen Yapanar's Floating House (Yapanar, 1947).

Melih Koray: Mobile and Modular Floating Dwellings on the Bosphorus

A pioneering experimental figure in modern Turkish architecture, Melih Koray gained prominence in the 1960s and 1970s with his modular floating housing projects designed for the shores of the Golden Horn and the Bosphorus. Koray conceptualized the floating house not as a fixed architectural object, but as a container-like, mobile, and seasonally adaptable living unit. His designs typically featured lightweight construction, most often based on timber frame systems, and consisted of components that could be docked, positioned in shallow waters, and relocated when necessary.

These structures were not merely technical experiments; they also offered a critical and creative response to urban challenges of the time, including overpopulation, densification, and housing shortages. Koray envisioned the surface of water as a viable extension of urban space—an alternative realm for habitation. His proposals stood in opposition to the growing trend of marina urbanization, advocating instead for human-scaled, environmentally integrated living models along the Bosphorus.[13] Koray's floating dwellings articulated an early vision of sustainable, adaptable urban living that resonates with contemporary concerns about ecological design, spatial flexibility, and the reclamation of underutilized urban interfaces such as waterways.

Figure 4. Catamaran typology in floating house, Melih Koray, 1970s Caddebostan, İstanbul

Melih Koray's floating dwellings exemplified a small-scale yet innovative approach to aquatic residential design. Conceived as single-volume units, they embraced modular principles that emphasized prefabrication and portability, thereby ensuring efficiency in both construction and deployment. Each dwelling was supported by floating platforms built with lightweight steel or timber frames, with careful detailing to enhance structural resilience while maintaining interior comfort. Architecturally, the units were characterized by water-facing façades, expansive windows, and generous openings, which facilitated visual and physical interaction with the surrounding environment. Designed primarily for sheltered waters such as marinas, lakes, and inner harbors, Koray's proposals highlighted the potential of floating architecture to integrate domestic life with aquatic settings while maintaining adaptability and environmental sensitivity.[14]

The Palet Restaurant in Tarabya Bay: An Early Example of Public Floating Architecture in Turkey

Opened in the 1960s in Tarabya Bay, the Palet Restaurant stands out as one of the earliest and most distinctive examples of floating architecture for public use in Turkey. Unlike conventional land-based buildings, the restaurant was constructed on a floating platform set directly on the sea, connected to the shore via a timber pier. Architecturally, it resembled a pontoon—freely placed in the calm waters of the Bosphorus—establishing a visual and spatial detachment from the coastline.

Though not technically a fully mobile structure, the restaurant's placement on the water's surface and its detached composition made it an early instance of what might be called "floating sociability." Throughout the 1960s and 1970s, Palet Restaurant played a central role in the social life of Tarabya Bay. With its simple, functional design and direct architectural engagement with the sea, Palet not only exemplified a new artificial interface in modern Turkish architecture but also captured the transformation of Istanbul's coastal culture during the second half of the 20th century.

Figure 5. People enjoying the sea, next to Big Chefs restaurant once named Palet Restaurant, 2025, July 05 (by the authors)

Structure Name	Architect / Designer	Year of Construction	Description
Sea Baths (various)	Anonymous (Ottoman period)	17th–19th centuries	Gender-segregated bathing structures on piles along the Bosphorus coast.
Observation / Diving Towers (various)	Anonymous	18th–19th centuries	Small-scale observation towers on the sea, especially in Yeniköy, Arnavutköy, and Kandilli.
Sunbathing Terraces (linked to summer mansions)	Anonymous	Mid–late 19th century	Wooden terrace platforms on the waterfront façades of yali mansions and summer houses.
Florya Atatürk Marine Mansion	Seyfi Arkan	1935	The first state-built floating structure of the Republican era; a symbol of modernity on water.
Ahsen Yapanar – Floating House Designs	Ahsen Yapanar	1940s–1950s	A limited number of documented prototypes; modular floating units designed for individual use.
Melih Koray – Floating Housing Prototypes	Melih Koray	1950s–1970s	Mobile, modular living units; systematic proposals for floating neighborhoods.
Tarabya Palet Restaurant	Unknown	~1960	One of the first fixed floating restaurants in the Bosphorus; a public-use architectural prototype.

Table 1. Chronological list of floating structures

DISCUSSION

During the Ottoman period, coastal spaces were shaped by notions of privacy, social norms, and seasonal use. In the early Republican era, these spaces underwent a transformation as modern individuals began to reimagine their public and private interactions with water. Although limited in number, the floating structures developed during this transitional period marked a significant threshold in the evolution of floating architecture in Istanbul—both from an engineering and socio-cultural standpoint. These examples reflect not only the reinterpretation of waterfront spaces but also broader transformations in individual lifestyles during Istanbul's industrial modernization.

Today, these historical precedents continue to inform contemporary discussions on floating homes in the context of sustainability, mobility, and alternative living models. However, there is still no specific architectural, planning, or legal framework defined for floating residences (houseboats or floating homes) within Istanbul. According to Zoning Law No. 3194, structures are typically defined as units anchored to terrestrial foundations. Consequently, floating or water-based dwellings are legally categorized not as “buildings” but often as “marine vessels” or “temporary platforms.” This legal ambiguity presents significant challenges regarding zoning permissions, building permits, and settlement rights.

In Istanbul, strict regulations such as the Coastal Law (Law No. 3621/3830) and the Bosphorus Zoning Law prohibit the construction of permanent floating dwellings, limiting current examples to converted boats or temporary marina structures. Yet, growing urban pressures—including climate change, population density, rising sea levels, and land scarcity—are driving interest in floating architecture as a strategic alternative. Globally, countries such as the Netherlands, Norway, Germany, and Japan have already developed models—ranging from tiny floating homes and self-sufficient micro-units to semi-public floating neighborhoods and modular housing systems—demonstrating their potential as sustainable urban solutions.[15]

For Istanbul, realizing this potential requires several steps: the creation of legal definitions for floating structures, planning for non-marina coastal zones, pilot projects in less restricted areas, and collaboration among universities, municipalities, and urban planners. While still legally ambiguous, floating dwellings are technically feasible and culturally appealing, and with climate-responsive urbanism gaining momentum, regulatory support is increasingly plausible.

Strategically, floating architecture addresses four key dimensions. First, it offers flexible settlement models amid coastal pressures and land scarcity, responding to the fact that nearly 40% of the world's population resides in coastal areas (UN-Habitat, 2020). Second, it provides adaptive responses to climate change and sea-level rise, with the IPCC (2021) projecting an increase of 0.6 to 1.1 meters by 2100, threatening low-lying cities. Third, it enables sustainability and self-sufficiency through solar power, rainwater harvesting, and waste recycling, aligning with ecological and energy goals[16] Finally, it serves as disaster-responsive housing, functioning both as emergency shelters and long-term resilient dwellings, a model already explored in countries such as Malaysia, Bangladesh, and the Netherlands.[17]

CONCLUSION

This study has examined the multilayered evolution of floating architecture in Istanbul, tracing its trajectory from early typologies such as sea baths, sunbathing terraces, and diving towers to modern reinterpretations including the Florya Sea Pavilion, and the visionary projects of Ahsen Yapanar and Melih Koray, as well as to contemporary experimental and institutional applications like the Palet Restaurant. These architectural forms have spatialized the urban individual's relationship with water, while simultaneously addressing the evolving needs of their respective periods in terms of privacy, health, recreation, and aesthetic values. Floating architecture, in this light, is not merely a spatial solution for a city like Istanbul—a metropolis endowed with a historical aquatic heritage and beset by population and development pressures—but also a proposition for a reinterpreted cultural continuity, offering an adaptive, human-scaled, and climate-responsive mode of living. The mounting urban strain, the increasing interest shown by emerging architects, and the growing number of successful international precedents all point toward the inevitability of floating structures gaining a formal place within Istanbul's urban planning and policy frameworks in the near future.

To meaningfully integrate floating architecture into Istanbul's urban and coastal context, several strategies are essential. Regulatory development must establish clear zoning and construction codes, with flexibility in existing Coastal Laws (Law No. 3621/3830) to allow pilot projects. Pilot initiatives should test collaborative prototypes in sheltered zones such as the Golden Horn (Haliç), Tuzla, and Küçükçekmece, engaging universities, municipalities, and private stakeholders. A climate-resilient settlement policy should position floating structures as part of adaptation strategies, especially for post-disaster housing and long-term resilience. Design manuals need to provide typological and technical guidelines, ensuring integration with energy, water, and utility systems. Beyond housing, public floating spaces—such as cultural hubs, libraries, or community platforms—can enrich coastal life. Ultimately, floating architecture should be understood not just as a building technique but as a visionary, climate-adaptive urban model, ecologically balanced and rooted in historical identity, with the potential to shape a new chapter in Istanbul's development.

NOTES

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[2] Ekrem Buğra Ekinci, “Sea Bathing, the Good Old Fashion Way,” September 10, 2014, accessed September 15, 2025, https://www.ekrembugraekinci.com/article/?ID=626&sea-bathing--the-good-old-fashion-way.
[3] Meltem Ö. Gürel, “Seashore Readings: The Road from Sea Baths to Summerhouses in Mid-Twentieth Century Izmir,” *Journal of Architecture* 17, no. 3 (2012): 409–34, https://doi.org/10.1080/13602365.2012.695377
[4] Burçak Evren, *İstanbul’un Deniz Hamamları ve Plajları* (İstanbul: Remzi, 1994).
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[7] Meltem Ö. Gürel, “Seashore Readings: The Road from Sea Baths to Summerhouses in Mid-Twentieth Century Izmir,” Journal of Architecture 17, no. 3 (2012): 409–34, https://doi.org/10.1080/13602365.2012.695377
[8] Gökhan Akçura, “Bir Foto Öykü: İstanbul’un İlk Plajları” (*A Photo Story: Istanbul’s First Beaches*), *İST Dergi*, no 6, (June 4, 2021).
[9] Pera Museum, *Istanbul’s Seaside Leisure: Nostalgia from Sea Baths to Beaches*. exhibition catalogue (Istanbul: Pera Museum, 2007), accessed September 15, https://www.peramuseum.org/Exhibition/Istanbul%E2%80%99s-Seaside-Leisure/221
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[11] Ahsen Yapanar, “Yüzer Ev.” *Arkitekt*, nos. 189-190 (1947): 204–206.
[12] Ahsen Yapanar, *İstanbul Kıyılarında Yüzen Yaşam Üniteleri Tasarımı* (Design of Floating Living Units on the Shores of Istanbul), Kayıp Projeler Dizisi (Lost Projects Series) (Chamber of Architects Publications, 1954)
[13] Yelkencinin Gazetesi, “İstanbul’un Unutulan ‘Yüzen Evleri’” (Istanbul’s Forgotten ‘Floating Houses’), Yelkencinin Gazetesi, accessed September 14, 2025, https://yelkenciningazetesi.com/istanbulun-unutulan-yuzen-evleri.
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PATTERN LANGUAGE OF LIVING FACADE: NARMANLI HAN CASE STUDY

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INTRODUCTION

Facade, as the stage of the architectural and urban in-between, reflects city life and social milieu by creating inhabitable, performative spaces within social participation. From this perspective, this research questions the living facade based on the actual and possible design process in the cities by drawing inspiration from design patterns. To do this, it adopts Christopher Alexander's theory of pattern language to reveal the livability of the restored Narmanlı Han's facade in Beyoğlu. Han's facade creates a public inner court that also impacts plan-level. Therefore, it provides a valuable example for an examination of living-facade through Alexander's pattern language. As a method, 8 different patterns relating to design of facade selected in the 253 patterns defined by Alexander in his book entitled "A Pattern Language".[1] These 8 patterns used as a methodology for the evaluation of the pattern language of the historical Narmanlı Han's facade.

The Theory of Pattern Language

Patterns reveal the inseparability of space and user actions and the patterns of events that recur in space. The patterns are, therefore, valuable factors in the formation of the characters of buildings or cities. The design theorist Christopher Alexander, in his book entitled "The Timeless Way of Building",[2] writes about the quality and alive features of building and towns freed from the pressure of standard and lifeless geometry. Moreover, he underlines that: "every place is given its character by certain patterns of events that keep on happening there in order to define the quality in buildings and in towns. Each pattern of space is linked with patterns of events the fact that this pattern of events keeps on repeating over and over again throughout the space. Therefore, it is one of the things which gives a certain building, or a certain town, its character.*"*[3]

Looking more closely at these patterns, it is obvious that Alexander emphasizes that they are alive and meaningful rather than merely static or dead building parts, given that they embody human actions and behaviors. Alexander's patterns are explaining the concept of "Living Building and Town",[4] which are discussed in his second book entitled "Pattern Language". This book aims to bring conscious awareness to the patterns through which human beings unconsciously relate to space, providing practical language for everyday users.[5] He has developed four steps to analyze patterns which he referred to as problem (1), solution (2), pattern writing (3) and language testing (4). Using this strategy for arranging large to small, Alexander proposes 253 design patterns.[6] These interconnected patterns play fundamental role in forming a network of relationships. We can define patterns based on how they relate to the elements around them. In this way, these patterns can come together in endless combinations.[7]

Research Objectives

Using this theoretical and methodological framework, the study unearths that Narmanlı Han's facade acts as an interface that reflect embedded and performative characteristics of urban space with a deep, systemic understanding. The use of Alexander's patterns in uncovering the language of the living facade reveals that the facade is determined not by universal and figurative design rules but by the vital characteristics of the city. Facades in cities are living elements which can be designed and interpreted through pattern language, influencing the surrounding spaces and human behavior as a zone, more than its physical and geometric characteristics. Thus, the objective of research is to question the living facade based on the actual and possible design process in the cities by drawing inspiration from design patterns. As methodology in this theoretical framework, it adopts Christopher Alexander's theory of pattern language for articulating the livability of the restored Narmanlı Han's facade in Beyoğlu. Therefore, eight patterns of the 253 patterns are revealed in the book. It is claimed that these patterns form important clusters that bring the liveliness of the facade to the urban area. These patterns are categorized as "Street Café (the 88th pattern)", "Number of Stories (the 96th pattern)", "Positive Outdoor Space (the 106th pattern)", "Entrance Transition (the 112th pattern)", "Street Window (the 164th pattern)", "Opening to the Street (the 165th pattern)", "Window Place (the 180th pattern)", "Windows Overlooking Life (the 192nd pattern)".[8]

CASE STUDY: NARMANLI HAN

As a case study, this research focuses on Narmanlı Han, a historical building located in the Beyoğlu district of Istanbul. Narmanlı Han is selected as a worthy example for the examination through Alexander's patterns since it differs from the closed facade concept of Istiklal Street and creates a public inner court that also has effects on urban vitality.

Historical Transformation of Narmanlı Han

Narmanlı Han was built in 1833 for the maintenance of the previous function as Russian Embassy, after the previous wooden building of Embassy destructed in 1831 Pera fire. Architect of the building is unknown Facade of the Han also changed in Ottoman period, therefore, the current facade is not an element from its original design, but an element of the beginning of the 20th century when the tramline was installed in the Tunnel Square, and the street expanded three meters. The Han served as Russian prison until 1923 and service-functions for consulate such as post office, guestrooms, the court continued.[9] Han remained empty during the First World War as the result of politic relations with Russia and it re-used for refugees from Soviet Russia in 1917.[10]

Figure 1. Views of the historical facade of Narmanlı Han from Istiklal Street, once a central node in the city's artistic and cultural circles[11]

The function changed in 1933 when building was sold to brothers Avni and Sıtkı Narmanlı. Merchant brothers used the building as their offices and converted the rooms into residences, shops, ateliers and pension rooms.[12] Han was a bohemian refuge for the collective memory for artistic and cultural circles of city[13] – as shown in Figure1. Turkish intellectuals stayed in Han between 1940-1960, including Ahmet Hamdi Tanpınar, Bedri Rahmi Eyüboğlu, Aliye Berger.

Starting from 2000s, the restoration projects developed for the Han. Beyoğlu City Defense organized protests for socialization of the Han, for bibliopoles, independent theatres, studio and workshop areas for musicians and painters. However, the conservation degree of the back facades decreased despite the public reactions. In the end, building restored by Sinan Genim[14] and his team between 2016-2018 and eventually lost its original material texture of the facade, as a result of the design decisions taken during this restoration process.

Pattern Language of Narmanlı Han Facade

This section provides research materials gathered during the examination of the Han through 8 selected patterns of Alexander's pattern language. In addition to the damaged historical value of its facade, many other issues related to the performance of the facade are revealed through the examination of Han's facade by using patterns.

Street Cafe (the 88th pattern)

The first pattern which is put forward as a living facade in the production of social meaning is 'Street Cafe'. According to Alexander, patterns of events and patterns of space overlap in this pattern named Street Cafe. According to Alexander, a successful street cafe should meet an established local client, contain several other spaces, be available during morning to start the day, and in the evening or night as well. In front of the cafe, a set of tables can stretch out towards the street.[15]

In Narmanlı Han, the cafes are aligned with the front facade of the inner courtyard. The location of the cafes makes the facade more performative and creates public continuity in the courtyard - as illustrated in Figure 2, so provides a character to the building. On the other hand, lack of spatial diversity and local clients are the drawbacks of the Han, due to standardized designs of global cafes.

Figure 2. Cafes in Narmanlı Han's inner courtyard which makes building façade performative[16]

Number of Stories (the 96th pattern)

The second pattern selected as a living facade is 'Number of Stories'.[17] According to Alexander, the number of stories must be determined in harmony with public spaces, natural life and human activities for making buildings more livable. Alexander argues that the number of stories should be as low as possible for both keeping the building in harmony with human scale and keeping the costs lower. To do this, the ground area covered by buildings should not exceed 50 percent of the site and height of the buildings should not differ too much from the average height of surrounding buildings.

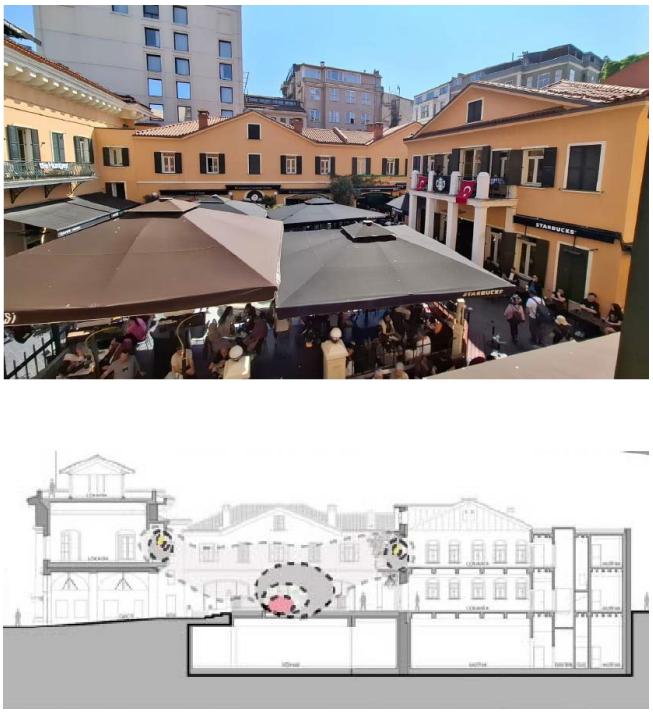

Figure 3. Number of Stories and the harmony between upper floor and the inner courtyard of Narmanlı Han[18]

Narmanlı Han, with its 2 and 3 stories, can be evaluated under this pattern as it does not disrupt the harmony between the inner courtyard, Istiklal Street and the people – as illustrated in Figure 3. Although the upper floor of the Han is less public than the ground floor, through the balconies opening, the courtyard maintains a visual connection with the public space. The interventions were made to increase the number of stories during the restoration process of the building,[19] however, it cannot be denied that the existing height of the building aligns with the contextual character of the district, and therefore, it is one of the qualities that should be preserved.

Positive Outdoor Space (the 106th pattern)

The third pattern selected is 'Positive Outdoor Space'[20] as this pattern provides an understanding of outdoor space not only as 'left over space' between buildings, but also as positively surrounded space by the design of building. Alexander argues that for positive outdoor space, we must give all the outdoor spaces some degree of enclosure; surround each space with wings of buildings, trees, hedges, fences, arcades.

Narmanlı Han's inner courtyard with a distinct and definite shape - as shown in Figure 4, therefore, can be considered as a positive outdoor space. From this point of view, it was observed that more and more people find it livable and humane for sitting in the open space surrounded by the Han's facade. This turns the Han into a unique space different than the undefined emptiness of the current situation of Taksim Square. Nevertheless, it is observed that the removal of the trees located in the courtyard of the Han during the restoration process has eliminated the green boundaries of the courtyard.

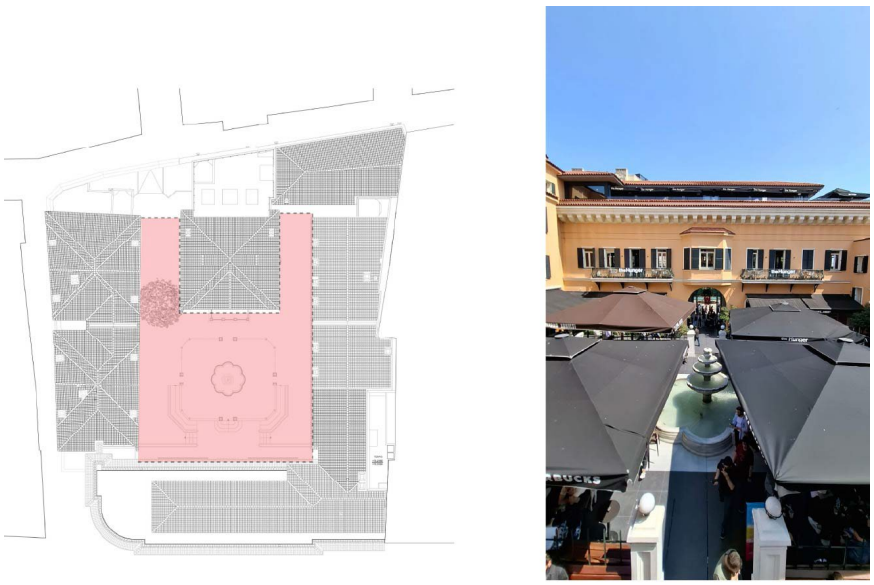

Figure 4. The view of Narmanlı Han's inner courtyard, which has a distinct and definite shape[21]

Entrance Transition (the 112th pattern)

The fourth pattern selected is 'Entrance Transition'.[22] According to this pattern, the transition exists, as an actual physical place, between the outside and the inside. The difference in the level of publicity provides physical and visual changes which also creates a psychological transition in our mind. In order to design a transition space between the street and the front door, we must bring the path that connects street and entrance through this transition space, and emphasize its effect by a change of light, a change of sound, a change of direction, a change of surface etc.

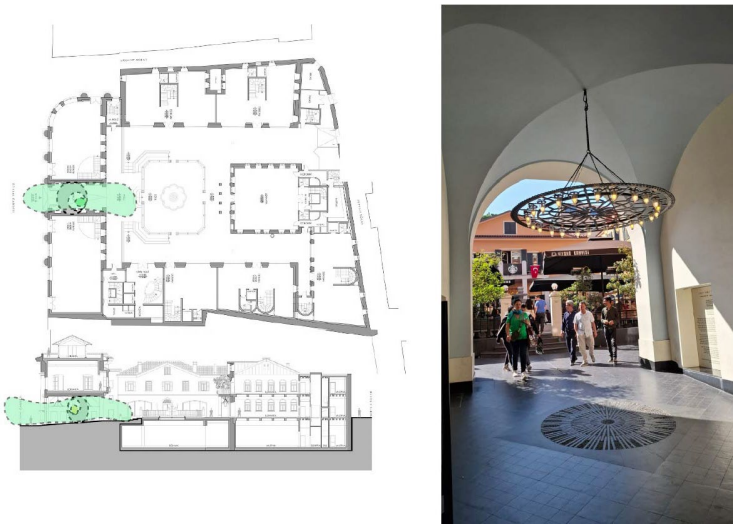

Figure 5. Entrance Transition of Narmanlı Han, creating an in-between space[23]

Narmanlı Han can be evaluated under this pattern since it has a definite entrance space – as highlighted in Figure 5. Pedestrians flow from Istiklal Street into the quieter rhythm of Han's inner courtyard. The entrance area on the facade creates an in-between space that isolates the crowd on the street through its cross-vault system, changes in light, changes in floor material, changes in sound.
On the other hand, it can be argued that certain elements introduced during the restoration of Narmanlı Han, such as the information panels at the entrance. These additional panels fall short in supporting this experience since their placement and design hinder legibility within the transitional space and visually disrupt the original facade texture of the building.

Street Window (the 164th pattern)

The fifth pattern which is put forward as a performance living facade is 'Street Window'.[24] The street window provides a unique kind of connection between life inside the building and the public space. It provides a chance to see the street from upper story windows. According to Alexander, we must build windows with window seats, looking out the street, where buildings are located alongside busy streets.

Figure 6. The windows of Narmanlı Han opening to the street and to the inner courtyard, providing public and private areas[25]

Looking more closely at Narmanlı Han's facade, it is obvious that public and private areas are provided with windows opening to the street and to the inner courtyard, shown in Figure 6. In the courtyard, windows of the bar area are quite open, in which the bar service area extends into outdoor space. On the other hand, although window tables and seats are designed in front of the windows on the ground floor, the organization of these tables is too intense, which reduces the perception of the courtyard's character.

Opening to the Street (the 165th pattern)

The sixth pattern selected as a performance living facade is 'Opening to the Street'.[26] According to Alexander, when people can see spaces from the street, their world is enlarged, and their experience becomes richer. When there is more understanding, there is the possibility for communication and learning. Therefore, a successful public space must have windows which open to the street, or a fully opening wall which can be thrown wide open, and if it is possible, must include some part of the activity on the other side of the pedestrian path.

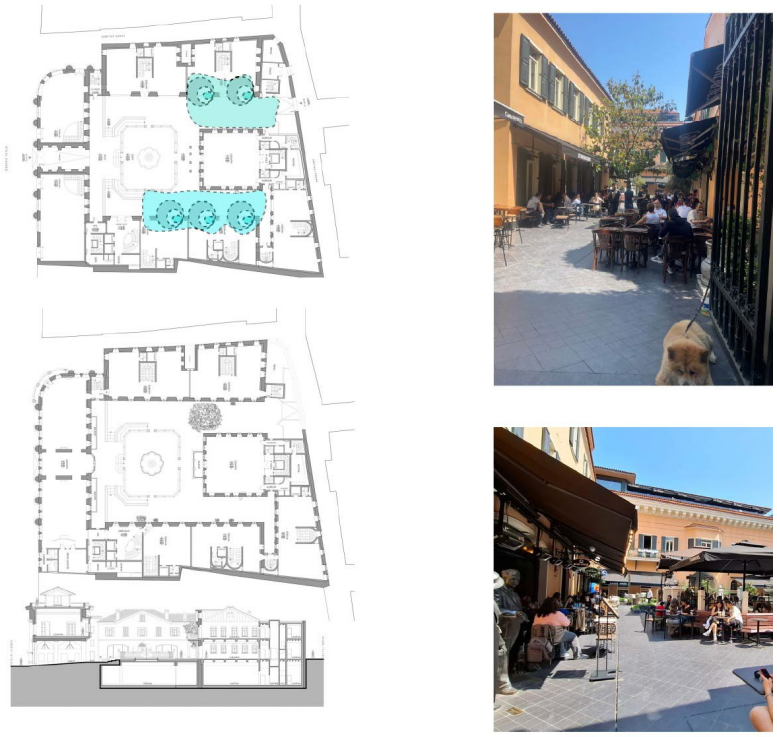

Figure 7. Narmanlı Han's wide opening windows which contact pedestrians[27]

This pattern can be used to evaluate Narmanlı Han since it has windows that are open on the ground floor that supports the movement of action created by the Han's facade, shown in Figure 7. This vital condition creates a sense of rhythm. Cafe and bar areas with wide openings provide connection with the pedestrians' interaction with the interior space. On the other hand, there is a small-scale museum called 'Museum of Illusions', which has a limited relation with pedestrians because of its closed window. This museum space is disconnected from Han's context. In this example, where human actions are integrated into design, it is seen that architectural elements make facade performative.

Window Place (the 180th pattern)

The seventh pattern selected for a performance living facade is 'Window Place'.[28] This pattern relates to the inner part of the facade. According to this pattern, the windows can be designed in a way to increase their usefulness as space. In principle, any window with a reasonably pleasant view can be a 'Window Place', when its design provides a volume that can be used, for instance as a sitting place, rather than being treated merely as a hole in the wall.

This pattern, which manifests the design of facade windows as designed spaces, is highlighting the liveliness of the Narmanlı Han. Some of the interior spaces of Narmanlı Han's cafes are functioning as window places, shown in Figure 8. The windows of Han provide large volumes, due to its historical design characteristics. So, these volumes are serving now as seating areas, especially in cafes and bars. However, it should be noted that the spatial relationship between the window dimensions and the surrounding furniture is irregular in such a historical structure.

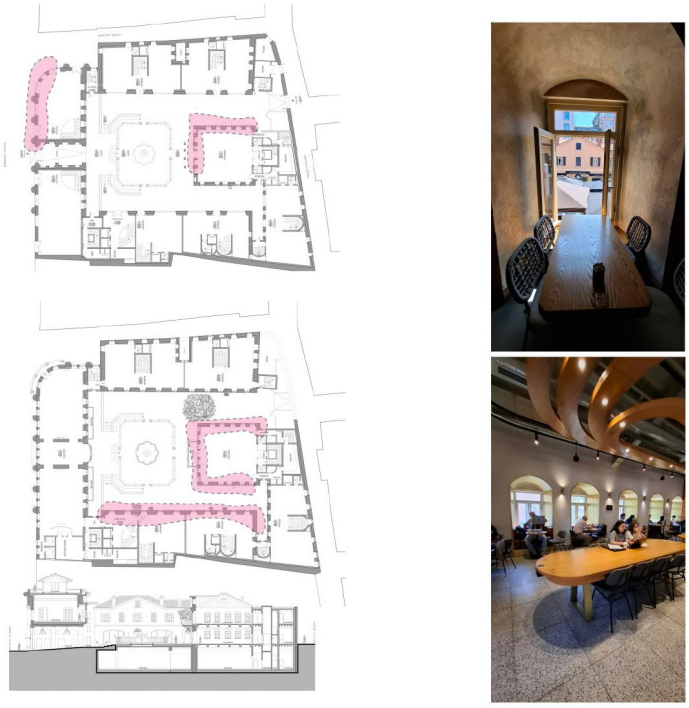

Figure 8. Narmanlı Han's interior spaces, which has window place[29]

Windows Overlooking Life (the 192nd pattern)

The eighth pattern selected to be evaluated as a performance living facade is 'Windows Overlooking Life'.[30] This pattern demonstrates the lively and dynamic solutions that can be created through placements of the windows. Alexander argues that the most vivid solution to place the windows is to design in positions which give the best possible views out over life: activities in streets, quiet gardens, anything different from the indoor scene. Narmanlı Han is evaluated under this pattern since the windows of the Han give performative views of outdoor life, pedestrian flows, and activities in the inner courtyard.

Depending on its historical nature, the window openings are narrow and regular, however, this gives a unique character to the building, since the smaller windows are creating different perspectives and a variety of visual effects between the building and the inner courtyard, shown in Figure 9. On the other

hand, the placement of large decorative parasol at the center of the courtyard significantly obstructs these sightlines and diminishes the layered visual relationships between the interior spaces and the courtyard.

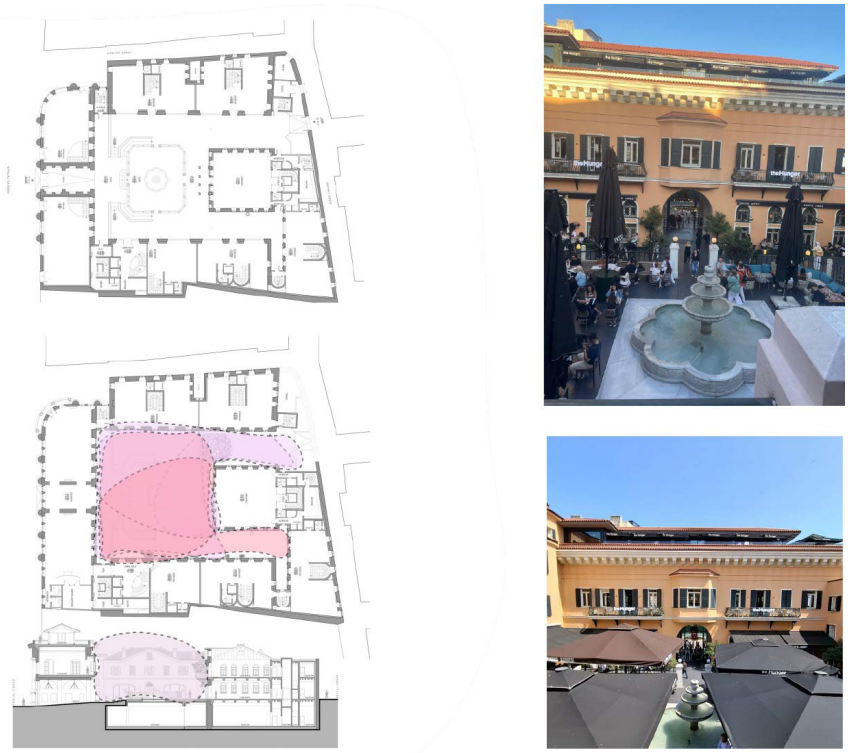

Figure 9. Narmanlı Han's windows, which give a view of outdoor life[31]

CONCLUSION AND DISCUSSION

The study includes, both a motivation to uncover the living facade-language of cities and buildings, and a question concerning whether this language operates within the facade of Narmanlı Han. The methodology that brings these into focus through Christopher Alexander's 8 design patterns.

Through an analysis of Narmanlı Han's facade based on these 8 patterns, it has been realized that the patterns operated together by generating a dynamic configuration beyond their applicability within the study area. In this context, it was observed that the intersectional nature of the patterns constructs a network of spatial events, creating an experiential narrative.

Moreover, the patterns provide significant clues regarding the character of the historic structure of Narmanlı Han, enabling the rediscovery of values that had been lost during the restoration process. John Ruskin, in 'The Lamp of Memory', the sixth chapter of his 'The Seven Lamps of Architecture (1849)', called restoration as 'the most total destruction which a building can suffer', and calls it 'as impossible as to raise the dead, to restore anything that has ever been great or beautiful in architecture.[32] Following Ruskin, written in 1877, in SPAB Manifesto William Morris, Philip Webb and other founder members oppose feeble and lifeless changes, only in this way, could we preserve our historical buildings and leave them instructive and venerable for those who come after us.[33] To sum up, through this research, it has been evaluated that 8 different patterns are inherited in the Han's design, and the patterns of Alexander are still providing a valuable theoretical and methodological framework today.

NOTES

[1] For Christopher Alexander's theory of pattern language, see Christopher Alexander, Sara Ishikawa, and Murray Silverstein, *A Pattern Language: Towns, Buildings, Construction* (Oxford: Oxford University Press, 1977).
[2] Christopher Alexander, in this book, provides a theoretical explanation of the pattern language theory and discusses the concept of buildings having a living character. For the notion of living character in architecture, see Christopher Alexander, *The Timeless Way of Building* (New York: Oxford University Press, 1979).
[3] Alexander, *The Timeless Way of Building*, 92.
[4] The concept of 'Living Building and Town' is explained through a series of design solutions in *A Pattern Language*. For more information, see Alexander, Ishikawa, and Silverstein, *A Pattern Language: Towns, Buildings, Construction*, xviii- xxxix.
[5] Ritu Bhatt argues that pattern language theory can be used as a method for place and space making. For a detailed exploration of this approach, see Ritu Bhatt, "Christopher Alexander's Pattern Language: An Alternative Exploration of Space-Making Practices," *The Journal of Architecture* 15, no. 6 (2010): 789–804.
[6] For 253 patterns list, see Alexander, Ishikawa, and Silverstein, xviii-xxxix.
[7] See David Seamon, "Christopher Alexander's Theory of Wholeness as a Tetrad of Creative Activity: The Examples of A New Theory of Urban Design and The Nature of Order" *Urban Science* 3, no. 2 (2019): 1–13
[8] For 8 patterns, see Alexander, Ishikawa, and Silverstein, xviii-xxxix.
[9] See Turan Akıncı, *Beyoğlu: Yapılar, Mekanlar, İnsanlar (1831–1923)* (Istanbul: Remzi Kitabevi, 2018), 243.
[10] See Selcen Coşkun, "Rus Elçilerin Ofisinden Küresel Turizm Durağına Narmanlı Han ve Turizm-Kültürel Miras İkilemi Üzerine Görüşler," *Mimarist*, no 22 (2022): 33-44.
[11] See Coşkun*, "*Rus Elçilerin Ofisinden Küresel Turizm Durağına Narmanlı Han ve Turizm-Kültürel Miras İkilemi Üzerine Görüşler", 33-44.
[12] Cited by B. Selcen Coşkun from "Narmanlı Han", *Istanbul Encyclopaedia: From Yesterday to Today Volume 6.* Istanbul: Tarih Vakfı: 1994.
[13] See Neumeier, Geçmişin Dokusu, Gelecek için Sorular: Narmanlı Han, 40.
[14] See the details of the restoration project, "Beyoğlu Narmanlı Han", Dr. M. Sinan Genim, Accessed May 20, 2025, https://www.sinangenim.com/tr/eserler/projeler-ve-yapilar/beyoglu-narmanli-han-1390/
[15] See Alexander, Ishikawa, and Silverstein, *A Pattern Language: Towns, Buildings, Construction, 439.*
[16] Photographs are sourced from the authors' personal archives. For restoration project drawings, see "Beyoğlu Narmanlı Han", M. Sinan Genim, https://www.sinangenim.com/tr/eserler/projeler-ve-yapilar/beyoglu-narmanli-han-1390/
[17] See Alexander, Ishikawa, and Silverstein, *A Pattern Language: Towns, Buildings, Constructions, 473-476.*
[18] Source from the authors' personal archives and M. Sinan Genim," Beyoğlu Narmanlı Han", M. Sinan Genim, https://www.sinangenim.com/tr/eserler/projeler-ve-yapilar/beyoglu-narmanli-han-1390/
[19] See the news "Narmanlı Han'a Kat Ekleniyor", *Hürriyet Newspaper*, December 12, 2000. Accessed September 3, 2025. https://www.hurriyet.com.tr/gundem/narmanli-hana-kat-ekleniyor-39206258
[20] see Alexander, Ishikawa, and Silverstein, *A Pattern Language: Towns, Buildings, Constructions, 517-523.*
[21] Source from the authors' personal archives and M. Sinan Genim, "Beyoğlu Narmanlı Han",
[22] See Alexander, Ishikawa, and Silverstein, *A Pattern Language: Towns, Buildings, Constructions, 548-552.*
[23] Source from the authors' personal archives and M. Sinan Genim, "Beyoğlu Narmanlı Han",
[24] see Alexander, Ishikawa, and Silverstein, *A Pattern Language: Towns, Buildings, Constructions, 769-772.*
[25] Source from the authors' personal archives and M. Sinan Genim, "Beyoğlu Narmanlı Han",
[26] See Alexander, Ishikawa, and Silverstein, *A Pattern Language: Towns, Buildings, Constructions, 773-776.*
[27] Source from the authors' personal archives and M. Sinan Genim, "Beyoğlu Narmanlı Han".
[28] See Alexander, Ishikawa, and Silverstein, *A Pattern Language: Towns, Buildings, Constructions, 833-837.*
[29] Source from the authors' personal archives and M. Sinan Genim, "Beyoğlu Narmanlı Han".
[30] See Alexander, Ishikawa, and Silverstein, *A Pattern Language: Towns, Buildings, Constructions, 889-892.*
[31] Source from the authors' personal archives and M. Sinan Genim, "Beyoğlu Narmanlı Han".
[32] See Roak, *The Afterlife of Dying Buildings: Ruskin and Preservation in the Twenty-First Century*, *The Courtauld,* 2021.
[33] See *The SPAB Manifesto*: 1877, Accessed July 02, 2025, https://www.spab.org.uk/about-us/spab-manifesto

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DECODING THE FUSION: EXPLORING AI-BIM INTEGRATION CHALLENGES BEFORE AND AFTER DEPLOYMENT IN CONSTRUCTION

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INTRODUCTION

In recent years, the construction industry has undergone significant digital transformation, with Building Information Modeling (BIM) enhancing project design, planning, and management. Concurrently, advancements in Artificial Intelligence (AI) have improved decision-making, risk prediction, and operational efficiency. Integrating BIM and AI can create an intelligent ecosystem that boosts accuracy and speed throughout the construction project lifecycle while fostering innovative business models.[1]

However, successful implementation of such integration faces complex challenges in the pre-implementation phase (such as choosing technical solutions, coordinating stakeholders, and conducting cost-benefit analysis) and the post-implementation phase (such as user adoption, integration with existing processes, and system maintenance). Although scattered studies have examined specific aspects of these challenges,[2] the lack of a comprehensive and systematic analysis that can identify common patterns and knowledge gaps is noticeable. This article employs a meta-synthesis approach to create a structured framework of challenges in integrating AI and BIM by systematically analyzing prior studies. By synthesizing qualitative data, it extracts deep insights into the complexities of this integration across various contexts. The study addresses these questions:

- What are the differences between the challenges before and after the implementation of AI and BIM integration?
- What are the main challenges before the implementation of AI and BIM, and what factors hinder the successful integration of these two technologies?
- In the post-implementation phase, what problems are observed in the application and operation of integrated AI and BIM systems?

This research hopes to serve as a reference for researchers, policymakers, and industry practitioners to facilitate the adoption of these transformative technologies by providing a comprehensive map of the obstacles to the integration of AI and BIM. The importance of this research is evident in both theoretical and practical domains. On the one hand, by identifying the key challenges in each stage, the path is paved for the development of evidence-based strategies, and on the other hand, its achievements can help organizations reduce the costs of trial and error, improve planning, and increase the success rate

of implementation. This article, with a systematic structure, first reviews the literature on the subject, then describes the meta-synthesis methodology and its implementation steps.

LITERATURE REVIEW

AI, with its ability to analyze complex data and predict systematic behaviors, and BIM, with its ability to integrate building data, have both made significant progress independently. However, when these two technologies are intended to work together, not only do the potential benefits increase, but also the technical, organizational, and implementation complexities increase significantly.

Numerous studies have attempted to identify the obstacles and challenges of this integration.[3] Research by Eastman et al [4] and Volk et al.[5] has shown that one of the fundamental issues in this path, in the pre- and post-implementation stages, is "the lack of specific standards for interaction between AI and BIM systems." This issue has led to "data incompatibility and lack of software interoperability," and as a result, has created problems for the practical implementation of this integration. In addition, research by Li et al.[6] points out that "lack of coordination between project stakeholders" in 'determining integration processes' is a significant obstacle in the path of successful implementation of these technologies.

Economic and implementation costs are significant barriers to AI and BIM integration, alongside technical and organizational challenges. Sacks et al.[7] highlight that high costs for developing integrated systems and the need for advanced hardware and software discourage investment by construction firms. Rane et al.[8] note uncertainties in Return on Investment (ROI) and the lack of economic models to justify integration costs as key obstacles. Additionally, legal challenges arise, with Khan et al.[9] pointing to unresolved issues like data ownership, accountability in AI decisions, and user data protection due to absent standards. The lack of specific AI regulations in construction further erodes expert confidence. Recent studies, including Gao et al.,[10] recommend addressing technical and economic issues while developing legal frameworks and standards to enhance AI and BIM adoption.

In the "post-implementation" phase, new challenges arise, such as managing the vast volume of generated data, information security, and maintaining the integrity of intelligent systems. Studies such as Ghaffarianhoseini et al. [11] and Zhang et al. [12] have shown that AI and BIM-based systems, although they have high potential for optimizing construction processes, also increase the risks associated with data security and privacy. Also, research by Succar[13] addresses the issue that "the lack of organizational readiness and the lack of specialized personnel in the management and updating of integrated models" are among the obstacles that can lead to reduced efficiency and acceptance of these technologies. In recent years, some research has suggested that the use of optimization algorithms, machine learning, and complementary technologies such as the Internet of Things (IoT) and cloud computing can help reduce these challenges.[14]

The integration of AI and BIM represents both a technological advancement and a complex, multi-dimensional challenge requiring thorough analysis and comprehensive solutions. Previous studies have often focused on isolated qualitative aspects, overlooking the full lifecycle. Using a meta-synthesis approach, this research clarifies key obstacles to integration and proposes strategies for optimization.

RESEARCH METHODOLOGY

Experts recognize that mastering all aspects of a discipline and staying current is nearly impossible due to the rapid growth of research and information overload. As a result, meta-synthesis studies, which systematically synthesize past research on specific topics, have become more common. This method aims to analyze, combine, and interpret prior studies to clarify and understand phenomena.[15] This study employs the meta-synthesis method to identify pre- and post-implementation challenges of integrating AI and BIM in the construction industry. This qualitative approach aggregates findings from existing

studies. Following Sandelowski's 7-step method of Sandelowski,[16] he research uses pattern analysis and MAXQDA 2020 software to screen and identify final indicators. The meta-synthesis process is illustrated in Figure 1.

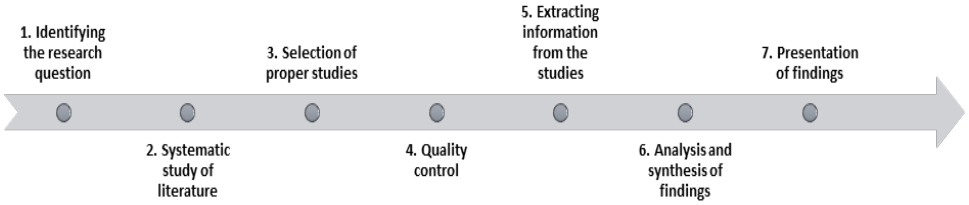

Figure 1. Steps of the meta-synthesis method [17]

Meta-Synthesis Steps

Step 1: Identifying the research question

In a meta-synthesis review, the first step is to formulate the main research question. In Table 1, the grouping and analysis of the dimensions related to the challenges of integrating the two transformative technologies of AI and BIM are questioned. In this stage, researchers must carefully define the main research question. This question should clearly and specifically cover the various dimensions of the topic under investigation. In the present study, the main question focuses on identifying the challenges of pre-implementation and post-implementation of AI and BIM integration in the construction industry.

Parameter	Research question
What?	Key challenges before and after implementing AI and BIM
Who? / When?	Statistical population under study/ Valid scientific databases/ ScienceDirect
	Research time frame/ No restrictions
How?	"Document analysis" method, secondary data analysis

Table 1. Research questions

Step 2: Systematic Study of Literature

In this section, the ScienceDirect database was searched without time limitation. ScienceDirect is a leading full-text scientific database that provides articles from journals and book chapters from over 2,500 reputable journals and over 11,000 books. There are currently over 9.5 million articles/chapters, a content base that is growing rapidly at a rate of 0.5 million additions per year.

The main keywords for the search were as follows, but it should be noted that the definitions of the search terms are continuously re-evaluated throughout the research process:

"TOPIC ("Building Information Modelling" OR "BIM") AND TOPIC ("Artificial Intelligence" OR "AI")"

In this step, articles are extracted based on the search of keywords and the relevance of the title and abstract to the research questions. In this step, 756 articles were identified.

Step 3: Selection of Proper Studies

At the beginning of the search process, the researcher determines whether the found articles are relevant to the research questions. To achieve this goal, the selected articles are reviewed, screened, and some are removed. The inclusion and exclusion criteria for selecting articles in this study are in accordance with Table No. 2.

	Inclusion criteria	Exclusion criteria
Publication time	Unrestricted	-
Research method	Qualitative, quantitative-qualitative (Mixed Methods)	Quantitative
Type of studies	Journals & Conferences	Theses, reports, books
Scope	Construction	Articles unrelated to the field of construction
Article Language	English	Non-English

Table 2. Inclusion and Exclusion criteria

According to Figure 2, articles that did not meet the above criteria were screened and eliminated in several stages.

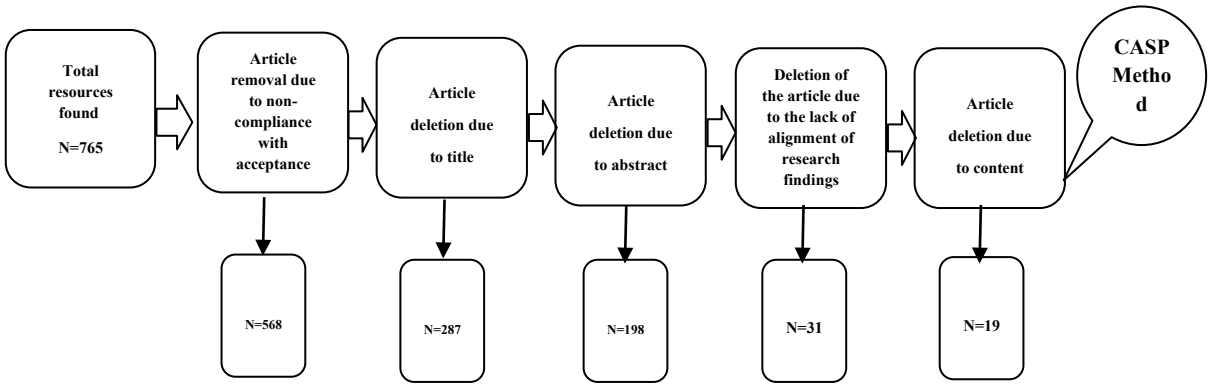

Figure 2. Flow Diagram Summarizing Study Selection

Step 4: Quality Control

The "CASP" tool is used to evaluate the content. The purpose of this step is to eliminate sources in whose findings the researcher does not have confidence. This tool includes 10 questions and they are given a quantitative score, which helps the researcher to determine the validity and importance of the qualitative research studies. The questions of the mentioned tool are as follows: 1. Research objectives, 2. Logic of the method, 3. Research design, 4. Sampling method, 5. Data collection, 6. Reflexivity, 7. Ethical considerations, 8. Accuracy of data analysis, 9. Clear and explicit statement of findings and 10. Value of the research.

During this process, the researcher reads the full text of the articles to be aware of their content. After completing this step, the final number of articles to enter the meta-synthesis process is determined, which in this study is 31 articles. In this process, which is based on a 50-point scale, any article that has a score lower than good (lower than 31) has been re-moved, and a total of 19 articles remain.

Step 5: Extracting Information from the Studies

During the meta-synthesis review, the researcher repeatedly examines the finalized articles to extract detailed findings. As outlined in Figure 2, 19 articles are approved for further analysis. Meta-synthesis incorporates diverse qualitative and quantitative studies, including their results and related qualitative data. On the other hand, Jensen and Allen[18] believe that there should be no limitation for the selection of studies (published or unpublished) in order to take advantage of all the capabilities of the available articles and to avoid the risk of losing valuable data. The results of extracting the codes from the selected texts are shown in Table 3.

Row	Pre-Implementation Challenges	Common challenges	Post-Implementation Challenges	References
1	Data Collection and Integration Issues	Collaboration Gaps Across Stakeholders, Complexity of AI Methods in AEC Contexts, Resistance to Digital Transformation, Collaboration Gaps Across Stakeholders	Scalability Across Diverse Projects, Validation of AI Reliability	[23]
2	Complexity of Integrating AI with BIM, Data Quality and Availability	Limited Adoption in Construction Tech, Uncertainty in Predictive Outcomes	Skill Gaps Among Practitioners	[11]
3	incomplete models, poorly structured or inaccessible file formats, the lack of semantically rich objects, and incompatibility of BIM data representations and machine learning algorithms	fragmented nature of construction industry	create, standardize, maintain, and reuse thousands of object templates in digital BIM libraries	[24]
4	Generalization, convergence problem caused by the mismatch between input and structure, Algorithm-Specific Limitations, Integration Challenges with BIM	Variability uncertainty types in AEC industry, incomplete grasp of inherent uncertainties, Constraints on Productivity and Decision-Making	optimizing neural networks ‘structures	[25]
5	Complexity of Implementation, Data Dependency and Quality, Integration with Existing Systems	Cost and Skill Barriers, Regulatory and Ethical Concerns, Stakeholder Resistance	Knowledge Gaps in Application, Scalability Across Projects , Maintenance and Updating of AI Models	[26]
6	Narrow Data Retrieval Scope, Limitations of Existing ASR Systems	Security and Privacy Concerns, Lack of Automation	Accuracy of Voice Recognition, Accessibility Issues for Disabled Users	[27]
7	Lack of Systematic Trust Research,	Data Privacy and Security, Context-Specific Adaptation, Trust as a Barrier to User Acceptance, Interdisciplinary Complexity	Safety and Reliability Concerns, Opaque Work Mechanisms, Interoperability Complexity	[28]
8	Limited AI Reasoning Capabilities, Data Integrity Across Disciplines, Lack of Effective Platforms	Adoption Resistance, Security Risks in Cloud Systems	Scalability of Cloud Infrastructure, Interoperability Issues,	[29]

9	Standardization Issues, Data Management Difficulties, Technical Integration Complexity, Lack of Comprehensive Review	Cost and Resource Intensity, Fragmented Application Across Lifecycle	Skill and Knowledge Gap	17
10	Data Quality and Variability, Interfacing Point Clouds with HBIM, Semantic, Segmentation Limitations, Research Gap in Automation	Geometric Complexity of Historical Features	Scalability Across Heritage Contexts, Time-Intensive Manual Processes,	30
11	Accuracy and Contextual Understanding, Technical Integration Complexity, Limited Research Insights,	Data Privacy Concerns, Lagging Adoption in AEC	Scalability Across Projects, Validation of Opportunities,	8
12	Knowledge Gap in AI Subfields, Data Availability and Quality	Cost and Resource Constraints, Complexity of Deconstruction Processes, Limited Adoption in Deconstruction	Interoperability with BIM Tools	31
13	Computational Resource Demands, Interoperability with BIM Platforms, Knowledge Gaps in ML Applications, Data Quality and Availability	Limited Adoption in C&D Waste Management	Scalability Across Project Types, Complexity of Waste Management Processes	7
14	Human Errors, Standardization Issues	Decision-Making Conflicts, Data Security Vulnerabilities, Acceptance and Trust Barriers, Reliability and Safety Issues, Data Privacy Risks,	Liability Ambiguity, Job Security and Loss	32
15	Integration with BIM Systems, Data Processing Complexity	Privacy and Security Risks, Cost of Implementation, Slow Adoption Across Domains	Validation of AI Reliability, Skill Gaps Among Practitioners,	33
16	Dependence on Infrastructure, Knowledge Gaps in Research, Data Integration Complexity	Cost Issues , Barriers to PC Adoption, Limited Holistic Understanding	Real-Time Processing Demands, Scalability Issues	34
17	Data Type Variability, Limited Dataset Sizes, Research Disparity Across Facade Aspects, Time-Intensive Manual Alternatives	Integration with BIM Workflows, Complexity of AI Techniques	Validation of AI Outputs	35

18	Data Availability and Quality, Limited Research	Cost and Resource Constraints, Technical Integration Complexity, Adoption in Construction	Validation and Reliability Concerns, Scalability Limitations, Expertise and Skill Gaps	36
19	Integration Complexity with BIM, Data Availability and Sample Size Limitations, Limited Research Across OMC (Offsite and Modular Construction) Stages	Resource and Expertise Demands, Fragmented Knowledge Landscape	Under-Explored Post-Construction Applications, Lack of Dynamic Site Adaptation,	37

Table 3. Extracted codes

Step 6: Analysis and Synthesis of Findings

In the course of this research, we first consider all challenges extracted from the references as codes, then, considering the concept of each code, they are categorized into a similar concept (pattern analysis). This classification and coding by the pattern analysis method was done using the MAXQDA software version 2020, which is shown in Figure 3 as an example for its output.

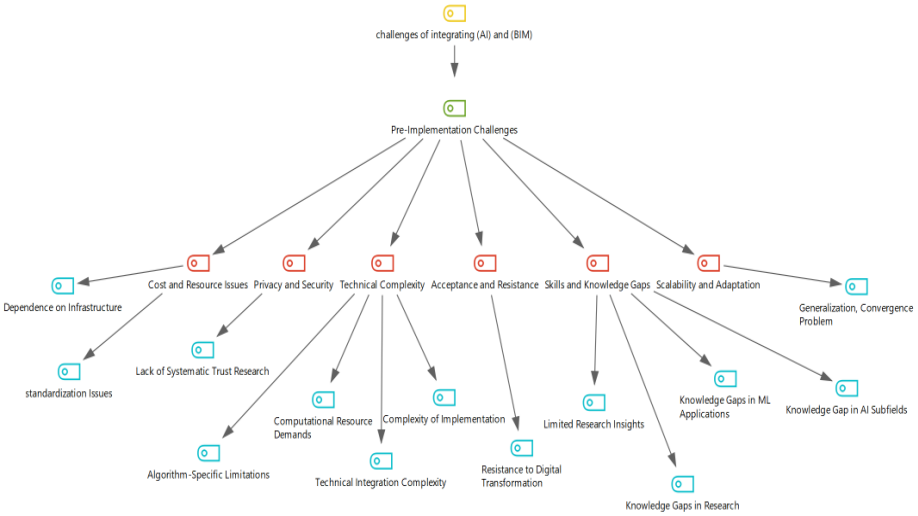

Figure 3. Example of the MAXQDA software output

Step 7: Presenting the Findings

After studying and coding the challenges of integrating the two transformative technologies of AI and BIM, 127 challenges are extracted from the existing literature using the Meta-synthesis approach, and after pattern analysis, a heat map is presented in accordance with Figure 4 to examine the severity and extent of these challenges, which shows the relative intensity of the problems in each area. Based on Figure 4, the most severe challenges are observed in the Pre-Implementation phase, as the AI and BIM integration process is still in its early stages. Data-related issues have the most weight at this stage, as the low quality of BIM data and compatibility problems of AI data create serious challenges in the integration process. Also, AI and BIM integration is considered one of the most critical challenges. The incompatibility of Machine Learning (ML) models with BIM data and the lack of effective interaction

between AI algorithms and BIM platforms are key obstacles. Many experts in this field still rely on traditional methods and follow the adoption of new technologies with skepticism, and resistance to this change is another important challenge of this phase. As a result, in this phase, the main focus should be on improving data quality, creating integration standards, raising awareness and reducing organizational resistance to artificial intelligence.

One of the most important common challenges in both phases is the limitation in adapting AI models to BIM. Traditional AEC methods require accurate and flexible integration with ML models, which is a complex process. AI should be scalable for various projects, including new buildings, renovation projects, and cultural heritage, but this is still a challenge due to processing limitations and the lack of appropriate infrastructure. Despite the high potential of AI in optimizing project costs, the initial costs of setting up, developing and maintaining AI models are one of the key obstacles. Therefore, to solve these common challenges, we should focus on standardization and development of scalable models, developing cost reduction strategies and increasing access to integrated BIM-AI tools. In the post-implementation phase, optimizing the performance of ML models for real-time processing and improving the accuracy of outputs, the lack of transparency of AI mechanisms, cloud data security and user privacy management are among the challenges raised. AI models should be able to continuously adapt to new conditions and meet the operational needs of BIM. In this phase, the focus should be on improving data security, developing standardization frameworks, optimizing AI algorithms and managing system updates.

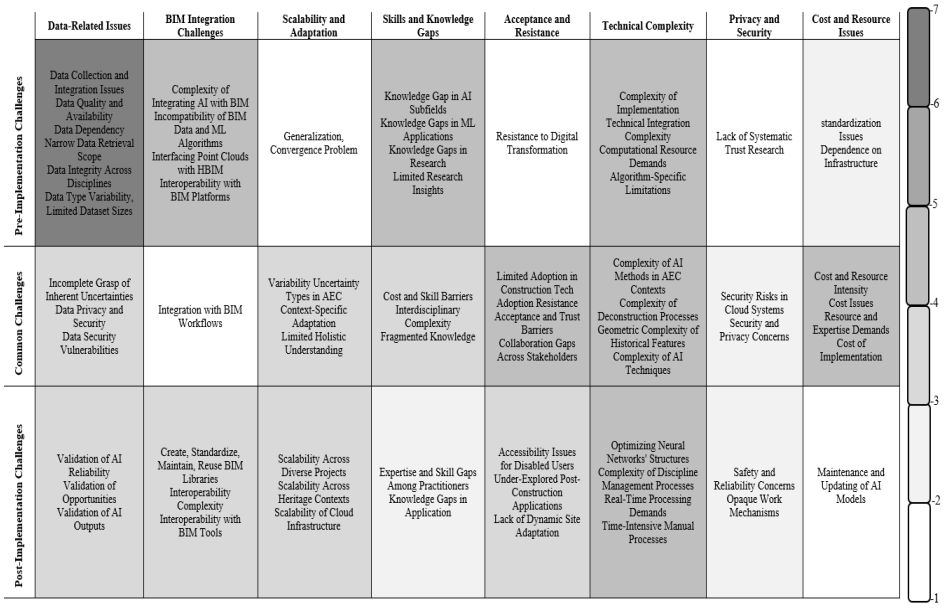

Figure 4. Heatmap related to the challenges of integrating (AI) and (BIM)

DISCUSSION AND CONCLUSIN

This research, using a Meta-synthesis approach and pattern analysis, identified and visualized the key challenges of integrating AI and BIM in the AEC industry in the pre-implementation, common challenges, and post-implementation phases. The heat map of the results shows that the most severe challenges are concentrated in the pre-implementation phase (data quality and BIM-AI integration), common challenges (scalability and technology adoption), and the post-implementation phase (optimization, security, and standardization).

The results of this study, by providing a heat map, show the uneven distribution of challenges in the pre-implementation, common challenges, and post-implementation phases, which highlights the key areas of data quality, BIM-AI integration, scalability and technology adoption, and security, privacy, and transparency of AI models. These findings can serve as a basis for developing practical solutions, including standardizing BIM data, training stakeholders to adopt technology, and strengthening security infrastructure. Also, the innovation of this research in using a heat map to visualize challenges has provided a powerful tool for analyzing and prioritizing obstacles in future research.

These findings are consistent with previous studies, such as the research by Amos Darko et al.[19] and Sacks et al., which identified challenges related to data quality and resistance to digital transformation in AEC; however, the emphasis of this research on phase-by-phase differences and visualization of challenges through a heat map provides a significant innovation in this field. The severe challenges in the pre-implementation phase, especially in the area of data quality and BIM-AI integration, indicate the technical and organizational complexities in the integration of these technologies. These findings are consistent with the limitations in data standardization and compatibility of AI algorithms with BIM formats, which are also mentioned in the studies by Abdirad & Mathur.[20] Also, the focus on scalability and technology adoption in the common challenges phase reflects the inherent resistance of stakeholders and cultural barriers in the AEC industry, which is consistent with the findings of Pan & Zhang[21] on the barriers to digital adoption. In the post-implementation phase, the emphasis on optimization, security, and standardization indicates the urgent need to develop technical and legal infrastructure to ensure the sustainability and trust in integrated systems.

This study, despite its scientific value, has limitations, including limited data volume and lack of challenge weighting by importance or frequency, which may reduce analysis depth and require further research. The meta-synthesis method, reliant on qualitative data, may limit result generalizability across contexts, and complexities in MAXQDA pattern analysis suggest the need for validation. These findings are strategically significant, guiding AEC experts and policymakers to focus on key barriers like data quality, resistance to adoption, and security infrastructure to enhance efficiency, reduce costs, and foster innovation in AI-BIM integration. Future research should incorporate larger quantitative datasets, advanced statistical methods (e.g., clustering, network analysis), and challenge weighting for greater depth and applicability. Exploring specific areas like heritage projects or modular construction and developing a standardized, multi-dimensional framework for data improvement, expert training, and security protocols are recommended to support successful integration.

NOTES

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THE SHOP AROUND THE CORNER. DYNAMICS IN THE CONFIGURATION OF GROUND FLOOR ACTIVITIES IN BARCELONA

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INTRODUCTION

In dense European cities, the ground floor is where urban form becomes lived experience. Beyond providing access to housing and work, street-level premises mediate everyday routines: buying food, meeting neighbours, collecting parcels, or accessing local services. These apparently mundane acts have cumulative effects on walkability, safety, local identity, and the resilience of small economies. In Barcelona, this relationship is particularly visible in the Eixample, where the regularity of the grid coexists with fine-grained variations in plot subdivision, chamfered intersections, and a long history of regulation of uses.

Recent public-space interventions—such as the transformation of selected streets into green axes and the reconfiguration of chamfered corners—have renewed debates about what kinds of street-level activities are enabled, displaced, or transformed. These debates often focus on mobility or environmental performance, but they also hinge on the micro-architectural and property structures that condition ground-floor layouts. The size of subplots, depth sequences, storefront frontage, and the number and position of entrances can facilitate certain business types while constraining others.

This paper asks: how do plot structures and ground-floor architectures shape the spatial distribution, diversity, and dynamics of street-level commercial activities? The paper contributes by combining a plot-based morphological reading with an activity census and a longitudinal perspective that tracks change from the late-2000s to the mid-2020s. The aim is not to predict retail demand, but to clarify how the built and legal substrate of the city frames what is possible at street level, and how this substrate interacts with contemporary planning and public-space projects.

Two chamfered intersections in the Eixample are used as paired case studies. They are comparable in typology but differ in the configuration of plots and in their recent exposure to public-space transformation. By holding the broader urban context constant, the analysis foregrounds how small differences in plot geometry and ground-floor depth can lead to distinct patterns of occupation and turnover.

LITERATURE REVIEW

Research on retail and street-level activity has developed along several trajectories. Retail geography has traditionally focused on location choice, accessibility, and market behaviour, often using network and catchment models to explain clustering and displacement. More recently, scholars have argued for bridging retail geography with urban morphology, in order to explain not only where businesses locate but also how the physical city conditions the availability and adaptability of premises.[1]

Urban morphology provides a complementary lens by treating plots, buildings, and streets as interrelated layers that evolve over time. Parcel-based analysis has been used to link the subdivision of land ownership to patterns of building typology and to the emergence of street interfaces. In consolidated grids such as the Eixample, small differences in plot width, aggregation, and depth can have outsized effects on the internal organisation of ground floors, especially where buildings have been incrementally adapted.[2]

At the scale of the street interface, work on thresholds and depth sequences has highlighted how permeability between public and private realms shapes everyday practices. Depth is not only a geometric measurement; it is a way to describe sequences of access, visibility, and territorial gradation from street to interior. Such configurations influence how ground floors support mixed uses, from small shops with direct street exposure to service and logistics functions that rely on deeper layouts.[3]

Urban design scholarship further emphasises that the quality of public space and the distribution of uses are mutually reinforcing. Corners and intersections concentrate flows and visibility, and are therefore strategic sites for commerce and sociability. Yet the same locations are also where conflicts emerge: noise, tourism pressures, and rising rents can displace daily retail, while vacancy can undermine perceived safety and continuity. Accounts of city-centre revitalisation and retail innovation underline that resilience depends on both demand-side dynamics and the supply of adaptable premises.[4]

Barcelona's Eixample has long been studied through its plot structure and its capacity to accommodate change while maintaining a recognizable structure. The relation between the Cerdà grid, the progressive subdivision and aggregation of plots, and the role of the chamfer as a mediator between movement and public life are central to understanding contemporary ground-floor transformations. This paper builds on these readings to examine the ground floor not as an undifferentiated layer, but as a system shaped by property geometry and building depth.[5]

Finally, regulatory frameworks and planning instruments matter. In Barcelona, licensing regimes and plans of uses can actively steer the composition of ground-floor activities, particularly in relation to food-related businesses and hospitality. Regulation operates together with design interventions: pedestrianization or the redesign of the chamfer changes the value and visibility of certain frontages, but the ability of a building to respond depends on its subdivision, access, and interior logic.[6]

Taken together, the literature suggests that explaining ground-floor change requires connecting three dimensions: (1) the morphological substrate (plots, depths, frontages), (2) the policy environment (licensing, plans of uses, public-space projects), and (3) the temporal dynamics of occupation (turnover, vacancy, adaptation). The following sections translate these insights into an operational methodology applied to two Eixample intersections.

METHODS

The research uses a mixed-methods approach combining GIS-based spatial analysis, field surveys, morphological mapping, and temporal data assessment. Two chamfered intersections in the Eixample were selected to enable comparison: Consell de Cent-Rocafort (A), and Borrell (B). These intersections, located 400 metres apart, provide variation in plot geometries, building continuity, and public-space configurations.

The study focuses on ground-floor premises facing the street, including corner units on chamfers and the adjacent frontages that shape the perceived continuity of activity.

Cartographic and Morphological Survey

Plot geometry was obtained from the Spanish Cadastre and cross-referenced with a 1:1,000-scale topographical map from the Metropolitan Area of Barcelona.[7] Field surveys documented entrances, active and inactive frontages, and indicators of adaptation (temporary partitions, merged units, changes in signage). These observations were used to refine subplot boundaries where cadastral parcels did not correspond to current commercial units.

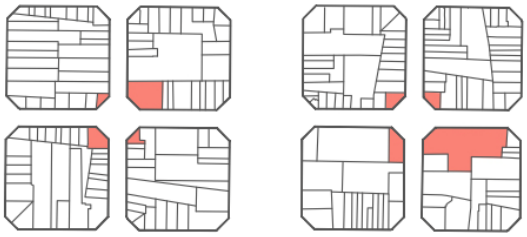

Figure 1. Plot structure in the two selected crossings. Source: Author, based on Cadastre (2025)

Three-dimensional CAD models were developed using the topographical map and street-level Google Maps imagery as reference. The models served two purposes: (1) to clarify the relationship between plot lines and built volumes, and (2) to visualize the exposure of interior ground floors on chamfers, where corner conditions often create additional entrances or display surfaces.

Morphological indicators were derived from the models and the cadastral base: plot width at frontage, plot depth (street to inner courtyard line), and the proportion of the chamfer occupied by a given unit. These indicators were not treated as deterministic variables; rather, they provided a consistent vocabulary to describe how different premises are spatially framed by the built substrate.

Classification and Mapping of Activities

Commercial premises were classified into ten categories: food retail, daily non-food retail, hospitality, pharmacies, hairdressers and personal care, services, logistics, facilities, parking, and vacant. The classification was designed to balance interpretability with the diversity of Barcelona's ground floors, distinguishing between everyday retail and experience-oriented hospitality while isolating uses that have distinct spatial requirements (e.g., facilities or logistics). Longitudinal data from the Barcelona Ground Floor Activities dataset for the years 2014, 2016, 2019, and 2022 were supplemented with Google Street View imagery from 2008, 2012, 2013, 2015, 2017, 2018, and 2025.[8] A total of 11 temporal data points were analysed for each intersection.

A GIS layer was created to geolocate activities at the subplot level. Each unit was attributed with its category, approximate floor area, and street frontage length. The analysis emphasized the street as a continuous interface: frontage length was used to approximate visibility and contribution to perceived activation, while depth-related measures helped interpret which activities tend to occupy deeper, less permeable premises.

Temporal Analysis

Temporal analysis assessed change in activity type, business turnover, and occupancy. The starting point was the municipal ground-floor activities dataset complemented by field verification and targeted use of street imagery for earlier years.

To avoid over-interpreting short-term fluctuations, the analysis focuses on medium-term transitions: for example, substitution of daily retail by hospitality, persistence of services, and the duration of vacancy. Where premises merged or subdivided, changes were recorded at the level of the most stable subplot boundary to maintain comparability.

The combined approach—plots, measured interface attributes, and time—supports an interpretive reading of causality. Rather than attributing change solely to market forces, the method highlights how the configuration of premises makes certain adaptations easier (e.g., converting to hospitality through façade opening and interior reconfiguration) while making other transitions more costly (e.g., maintaining small daily retail in shallow, narrow units under rent pressure).

RESULTS

Spatial Patterns

The analysis shows consistent relationships between plot morphology and ground-floor occupation. In both intersections, corner conditions concentrate hospitality and highly visible retail, but the intensity and diversity of these uses vary according to the size and subdivision of plots. Where plots are narrow and deeply subdivided into multiple units, the ground floor tends to support a finer grain of everyday retail and personal services. Where plots are larger or have been aggregated, the ground floor more often accommodates hospitality, facilities, or single tenants with larger floor areas.

Chamfer A exhibits a more regular sequence of storefronts along the chamfer and adjacent frontages. This continuity is associated with a high share of daily non-food retail and services that rely on predictable passers-by and stable local demand. Chamfer B, by contrast, includes larger units and more pronounced depth, enabling more heterogeneous occupation and a stronger presence of hospitality. The corner thus behaves as an interface where differences in internal depth become visible in the type of activity that can be sustained.

Three-dimensional representations further clarify how the redesign of chamfered intersections affects commercial exposure. Where pedestrianisation expands the usable public-space surface on the chamfer, corner premises gain opportunities for terraces, seating spillovers, and façade activation. Yet these opportunities materialise unevenly: units with multiple entrances or shallow layouts can convert their interface more easily than deep, corridor-like premises. The same public-space project can therefore produce different commercial outcomes depending on the inherited ground-floor architecture.

A key qualitative finding is the role of threshold management. Premises with intermediate zones—recessed entries, semi-public vestibules—tend to support uses that depend on gradual invitation rather than immediate purchase. Conversely, highly flush frontages favour uses that benefit from fast decision-making and high turnover of pedestrians. This aligns with research that links depth sequences and permeability to patterns of appropriation and territoriality.[9]

Quantitative Indicators

Across the two intersections, hospitality premises are the most numerous, while facilities show the largest average footprint and street frontage. Vacant premises are typically characterised by shorter frontages and less favourable corner exposure, suggesting that visibility and interface continuity are important for retention.

Comparing the distribution of frontage length by category indicates that hospitality and certain services disproportionately occupy the longest and most continuous frontages, while daily retail is more

frequently found in smaller units where fine subdivision remains. This supports the hypothesis that plot aggregation contributes to functional specialisation: as premises become larger, they can absorb the spatial requirements of hospitality or facilities, potentially at the expense of diverse daily retail.

Temporal Evolution

From 2008 to 2025, the intersections display different trajectories. One pattern is substitution: daily non-food retail gives way to hospitality as the economic and symbolic value of corners increases. Another pattern is persistence: certain service uses remain stable, especially where premises are small, locally embedded, and less attractive to high-turnover models.

Turnover is not random: it tends to concentrate in premises that are simultaneously highly visible and easily adaptable, especially those where interior depth can be reconfigured without major structural change. Conversely, deep premises with limited frontage often experience longer periods of vacancy, as the cost of adaptation is higher and the range of viable business types is narrower.

The temporal diagrams also reveal that public-space transformations can act as ‘accelerators’ of change. After improvements to pedestrian conditions, certain frontages show increased hospitality or mixed retail formats, likely reflecting both increased footfall and the enhanced value of terrace-capable edges. However, the study suggests that these changes are filtered through the existing plot and ground-floor structure: interventions do not produce uniform outcomes across all premises, even within the same intersection.

Beyond the overall mix of activities, the mapping makes visible a recurrent subdivision logic inside the Eixample perimeter block. Many chamfer plots are internally partitioned into narrow subplots that pair a short street frontage with relatively deep interiors. This configuration tends to favour a succession of small commercial units at the public edge while reserving deeper surfaces for storage, workshops, or back-of-house functions. Where depth increases and access is mediated through a single portal, premises more often consolidate into fewer, larger units (for example, facilities or logistics). In practice, the chamfer becomes a hinge between two logics: the continuity of the street retail strip and the block’s internal depth structure.

The visual comparison between the two intersections also highlights how design interventions in the public realm alter commercial legibility. Pedestrianization and the insertion of greenery or seating effectively extend the ‘front’ of some premises, making corner units more prominent and encouraging uses that benefit from visibility and dwell time, such as hospitality. Conversely, when curbside access and short-stay parking are reduced, certain everyday services may relocate to less exposed positions or to nearby streets with easier access. These shifts are not deterministic: rather, they show how the same plot framework can host different commercial ecologies depending on mobility regimes and the affordances of the street section.

Finally, vacancies concentrate in premises with either very limited frontage or awkward internal geometries—conditions that reduce adaptability as demand changes. In the case studies, vacant units often occupy the transition zones between corner consolidation and mid-block subdivision, suggesting a ‘mismatch’ between inherited spatial form and contemporary retail formats. This is where small-scale, low-threshold activities (repair, second-hand, micro-services) can play a role, but only if regulation, rent levels, and management practices allow incremental reuse. Identifying these mismatch conditions is therefore relevant not only for description but for targeted policy measures aimed at maintaining diversity.

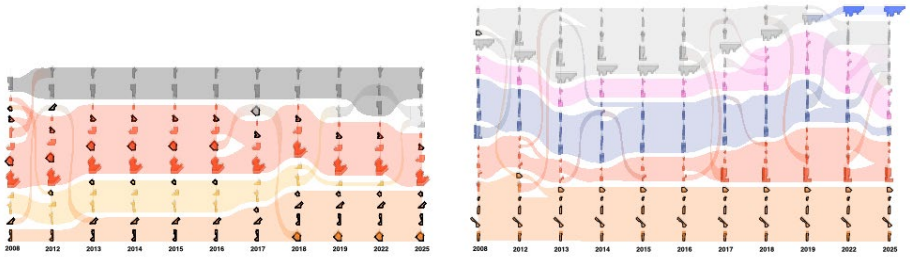

Figure 2. Temporal evolution of activities in the studied premises, by type. Source: Author, based on Cadastre (2025)

DISCUSSION

The findings support a relational understanding of ground-floor change. Plot geometry, frontage continuity, and depth configuration influence the distribution and type of commercial activity, but these morphological conditions interact with planning policies and public-space projects. The chamfer emerges as a particularly sensitive interface, because it concentrates visibility and is often targeted by redesign projects; yet its commercial capacity depends on how plots were subdivided and how buildings were adapted over decades.

This has implications for how urban interventions are evaluated. A project that improves public space may inadvertently favour uses that can monetise visibility and outdoor spillover, such as hospitality, while creating new pressures on daily retail that relies on stable rents and small-unit availability. If policy goals include social inclusivity and everyday accessibility, then interventions should be paired with measures that protect or enable a fine grain of premises—through licensing, rent mediation, or incentives for subdivision where feasible.

Methodologically, combining GIS mapping with CAD-based morphological reading offers a transferable framework for linking the 'hardware' of plots and depths to the 'software' of activity. The approach can be extended to compare multiple intersections or to test how specific regulatory thresholds (for example, limits on certain licences) interact with morphological capacity. Importantly, the method works at a scale that is legible to designers and planners: it produces spatial evidence that can be discussed alongside projects, rather than only through aggregate economic indicators.

For practice, the study suggests four attention points for future transformations of chamfered intersections: (1) preserve or create multiple entrances and small units where diversity is a goal; (2) evaluate how depth and internal circulation constrain adaptability before assuming that frontage activation will follow public-space improvements; (3) monitor vacancy as a morphological signal, not only an economic one; and (4) align licensing and design interventions to avoid reinforcing a single dominant activity type.

A practical implication of the plot-based reading is that 'retail policy' cannot be reduced to licensing alone: it also operates through the physical grammar that determines how premises can be combined, subdivided, accessed, and made visible. By tying these levers to measurable morphological indicators (frontage continuity, depth, and the corner condition), municipalities can identify where diversity is structurally supported and where it is vulnerable. In Barcelona, the chamfer is a strategic site for such diagnosis because it concentrates visibility, pedestrian crossing flows, and opportunities for public-space redesign. A plot-sensitive strategy would complement the Plan of Uses: instead of treating food licences uniformly, it could distinguish between corners with high consolidation potential (where chain takeover is likely) and mid-block segments where small units underpin everyday services. The same logic can be used to monitor vacancies and target low-threshold reuse in 'mismatch' premises whose geometry restricts adaptability.

CONCLUSION

Ground-floor architecture plays a critical role in shaping the organisation and diversity of urban retail. In Barcelona's Eixample, plot structure, building depth, and frontage geometry influence which activities can locate, persist, and adapt—especially at chamfered intersections where visibility and public-space transformation intensify pressures.

The study contributes methodologically by combining GIS mapping, morphological assessment, and temporal analysis to generate a framework for understanding the interplay between urban form and street-level activity. By foregrounding the structural logic of land ownership and the spatial logic of ground-floor depth, the paper shows that 'retail change' is also a question of urban form.

Future work can expand the sample of intersections and incorporate additional indicators, such as rent trajectories or pedestrian counts, to test the robustness of the observed relationships. Even within the limits of a paired case study, the findings underline a practical point: designing inclusive, everyday streets requires attention to plots and ground floors as much as to the surface of public space.

NOTES

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COASTAL COMPLICITY: BEIRUT SHORELINE REIMAGINED

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INTRODUCTION

In Beirut, formal public spaces are scarce and often lack the broad appeal necessary to foster genuine public engagement. Instead, the city's social life and collective identity are predominantly expressed through its vibrant street life—through spontaneous interactions, and everyday urban encounters—rather than through designated parks or official public areas. Beirut is a coastal city, its shoreline emerges as one of the rare domains where publicness manifests in a different, more elemental form. The shoreline, with its rugged rocks and proximity to the sea, exemplifies this liminal space—neither fully public nor fully privatized but vital, nonetheless. It serves as a refuge and a site of confrontation, where socio-spatial practices exist and spans across different social classes.

Positioned at Ras Beirut's edge, the Corniche of Ein el-Mreiseh, a major strip of the shoreline, embodies a duality—belonging and detachment, safety and volatility (figure 1). This contested space, balancing on the brink of stability and uncertainty, embodies a fragile publicness—one that shapes collective bonds amid ongoing urban and regional upheavals. Our paper explores how contexts of inequality and crisis reshape the nature of spatial practices. In underprivileged countries, the usage of public spaces often reflects underlying social inequalities and injustices—spaces become sites of visible societal divides. These dynamics are further magnified during war and crisis, where familiar rhythms of public life are accelerated and intensified. In such moments, the meanings and functions of public spaces shift dramatically; routines are disrupted, and spaces take on new, often layered, significance. Ein el-Mreiseh is a unique example that reflects these dynamics.

This significance is analyzed through observing public socio-spatial practices on the Ein el-Mreiseh strip on different instances, during times of peace and during the recent Israeli war on Lebanon that started in October 2023. This paper argues that these practices reveal the heightened visibility of inequality in underprivileged countries, where public space is often produced through improvised, bottom-up arrangements rather than planned design. Such practices—how people gather, move, and regulate access—materialize inequalities in observable, everyday forms. Wartime conditions further intensify these disparities by disrupting formal space and elevating the imperative to rely on informal public domains. The study is organized around a twofold comparative framework: (1) detailed observations of a key site on regular days to establish baseline spatial practices, and (2) the same site analyzed during wartime to assess how conflict reshapes visibility and distribution of public space.

Figure 1. On the rocky landscape of Ein el-Mreiseh. Source: Leyla El Sayed Hussein, 2023.

SHORELINE THEORIZED: THE SMOOTH, THE STRIATED AND THE PROSCENIUM

The symbolism of the shoreline had been theorized by many scholars. Deleuze and Guattari explored the juncture between land and sea and spoke of the water in its literal and figurative form. They coined two terms to understand the relationship between land and sea, the "smooth" and the "striated" space.[1] The former takes the sea as an example, a space in continuum and constant flow, where trajectories are not fixed, but rather sensed. It is the place where the "nomad" wanders following their instincts and senses. The latter is the city or the land, that is measured, organized and controlled, its space usually follows property lines, and is navigated through a set of rules. The sea for Deleuze and Guattari is the resisting force against state control or water "striation".

Building on Simon Unwin's notion of place as a theater, designated functions of "performance" and "audience" can transcend designated functions. From an architectural standpoint, theater places could

be a courtyard, a street, or even a traditional stage with a proscenium arch.[2] The shoreline is perceived as a theater, where the meeting point of land and sea acts as a proscenium. Brooke spoke about the proscenium arch, a feature in theater, acting as an "instrument of focus" to guide the audience towards the stage, he then later criticizes the proscenium due its divisive nature.[3] Although not visible, the proscenium arch of the shoreline is double sided. It is a metaphorical window framing the boundary between two worlds: the city and the sea, the real and the imagined. Shoreline users allure to an audience; the sea is their stage. However, perceiving the sea as a space of conflict and control, as argued by Virilio,[4] the proscenium inverts, people become the stage, targeted by the sea.
The informal socio-spatial practices on the shoreline of Ein el-Mreiseh are within this proscenium, at the edge of the "smooth" versus the "striated" and reflect this dynamic power between the rigid and the soft.

EIN EL-MREISEH: OVERVIEW

Our observations center on Ein el-Mreiseh Corniche, a vital public waterfront. Today, it remains one of the last accessible public outlets along Beirut's coast, shaping a critical segment of the city's coastal landscape and embodying the complex socio-spatial realities we seek to understand. Ein el-Mreiseh was urbanized during the last century. Sitting on a slope and overlooking the sea, the area was filled with planting orchards and contained few fishermen's ports. While Beirut was gradually urbanized, the area underwent different changes. Its main Avenue, parallel to the shoreline, was constructed, and gradually widened. Its extension concealed a big portion of the geological layers and its rocky landscape (figure 2).

Figure 2. Ein el-Mreiseh, past and present. Source: Lower- Bonfils Collection, AUB Archives, circa 1880. Upper: Roula el Khoury, 2024.

Due to the sloppy edge, the sidewalk was paved, and elevated above the rocky edge, leaving a difference of two meters in height. Our area of research stretches from the St. George Hotel to the Sporting Beach Club. Between these two beach clubs, many upscale leisure projects were erected mostly catering for the rich. Since the 1960s the Ein el-Mreiseh seafront was an upscale area for hotels and restaurants.[5] However, before the 1960s the area had few public beaches, among them is the "public star" beach, known in Arabic as "Al-Najmeh el-Shaa'bi", established in 1920.[6] Rather than leading to the development of more public beaches, more private resorts were erected, such as the St. George Hotel built in 1932,[7] made of four stories, the hotel was built on the rocky shoreline of Ein el-Mreiseh erasing

a big portion of the "Al-Najmeh el-Shaa'bi". Other private projects followed, the AUB beach in 1936,[8] the Bain Militaire, known as "Al-Hammam al-Askari" in 1943, the Long Beach in 1945, Sporting club in 1953[9] and the Riviera in 1956.[10] Most of these resorts were built directly on the shoreline then expanded gradually into the sea. These developments, reclamation, and infrastructural projects have increasingly disrupted this natural continuum. Private property ownership and projects along the Corniche made it difficult for the public to freely use the beach.[11] Through cadastral plans and urban policies, the shoreline has been segmented into discrete parcels of land and sea, often privatized and commodified to serve economic interests. These interventions tend to transform what was once an accessible, shared space into a series of exclusive, tradable assets, fundamentally opposing the inherent openness of the shoreline. Policies favoring privatization and capital accumulation have facilitated the commodification of Beirut's coast. Overall, these policies reveal a pattern where the Lebanese state has frequently prioritized economic interests—particularly real estate and tourism—over equitable access, environmental sustainability, and social justice. The clearest depiction of such fragmentation is the aerial photo of the stretch under research. The encroachments on the shoreline are a physical translation of Deleuze and Guattari's state's desire for striating the sea, of superimposing a rectilinear grid over a smooth organic space. These series of private sector encroachments fragmented the once continuous shoreline and confined the public between every encroachment and the other (figure 3).

Figure 3. Evolution of violations. Source of diagrams: Authors. Source of Base Maps: Below, 1921 Beirut Map by A.F.L Bureau Topographique. Above: Google Earth, 2011.

THE SEA WATER AS A STAGE, EIN EL-MREISEH AS AN AMPHITHEATER

Establishing that accessing the sea for the public is challenging, among the most apparent social practices revolves around accessibility. The main practice that occurs is where people break one bar from the balustrade's sidewalk, either insert a ladder, or a thick rope to access the sea. A striking observation is parking the motorcycle, a common mode of transport in Beirut due to lack of proper public transport, near the broken balustrade. Hence, the user designates this spot as an entry to the sea, as well as a strategic parking spot (figure 4).

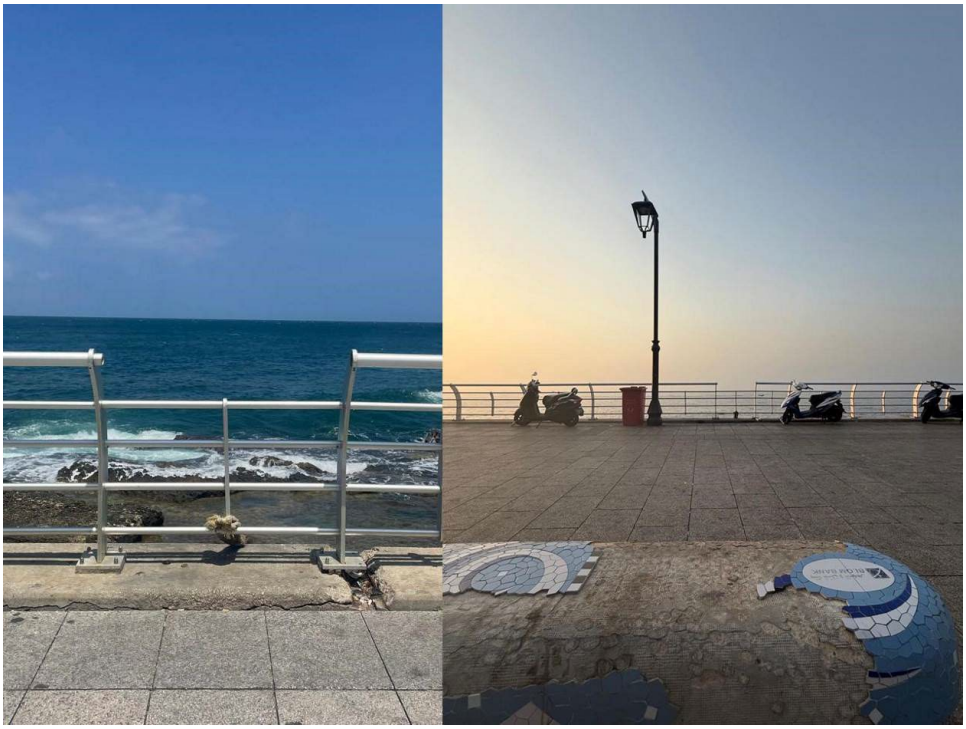

Figure 4. Accessibility interventions

Some users break a full balustrade's module, build uneven ramps from the pebbles of the shoreline, designing informal infrastructure accommodating bigger groups, such as families and kids (figure 5). The balustrade along the Corniche was implemented as a safety measure, again acting as a border between land and sea. Historically the balustrade did not exist, the gentle rocky slope that no longer exists acted as a transition between land and sea. Removing the balustrade, or portions of it, is a clear desire towards less of a "striated" space and more of a "smooth" space.

Figure 5. Accessibility interventions: Improvised Ramp. Source: Roula el Khoury

Once the public access the sea, they identify a place and design their own seating areas. Place identification becomes a "primitive motivation of architecture" such as place recognition, creating its identity, etc.[12] The public are rendered to be their own architects. Some create one, or two seaters, few of the users bring their own chairs and furniture, rather, they use the available rocks or build some seats from existing big pebbles (figure 6). These modular interventions offer a fresh approach to using modularity as a driver for individual and collective urban spaces of enjoyment.[13] Often, most of the public users demarcate their property for one day, mostly building short walls, or ground lines, using available rocks or big pebbles on the shore. These soft boundaries delineate the space for each of the users, a sort of non-permanent soft striation (figure 7). Public users also intervene on existing architectural features, designed and owned by private resorts. While the shoreline lacks any public furniture, people create their own shading devices, sometimes anchoring textiles on nearby walls (figure 8). Others demarcate their space under the few trees remaining on the shore, or even on the flat sidewalk. Cardboard mats are often used for families to sit or lay down. The shoreline also offers an event space for marginalized groups of the city, such as foreign workers. While most of the portions of the shoreline have been commodified, the remaining public portions of the strip are a free terrain to be designed and re-appropriated.

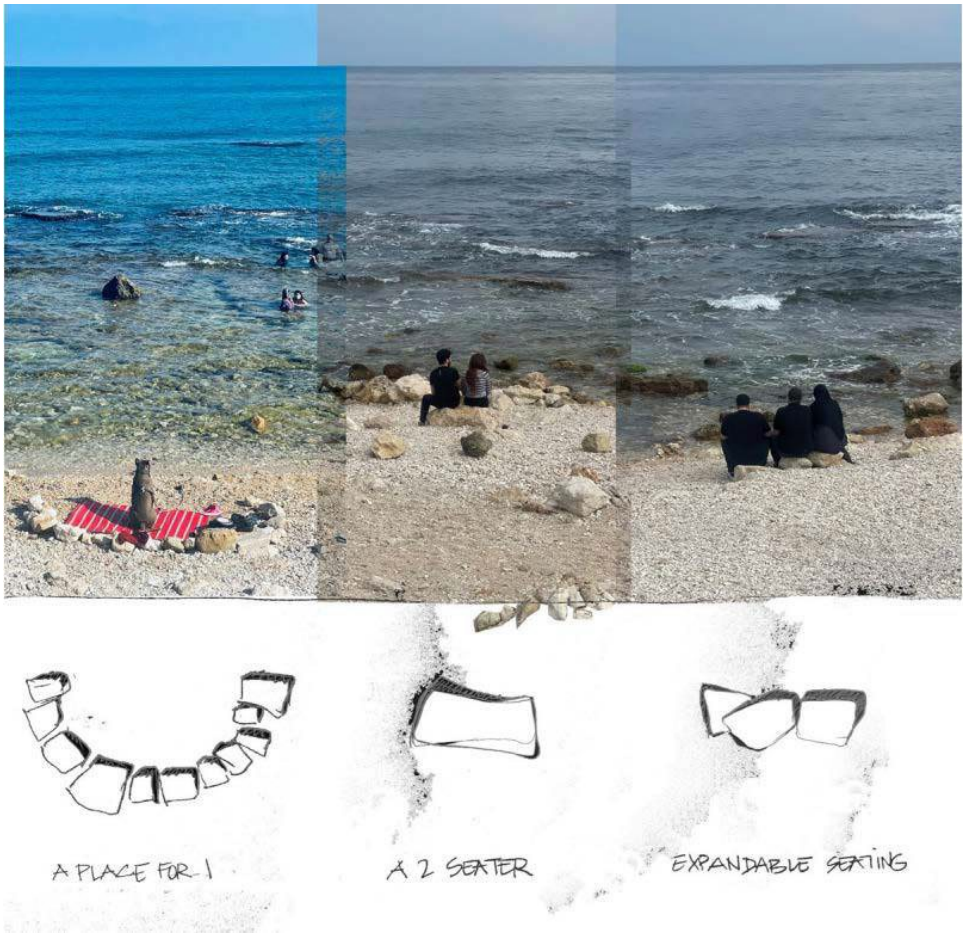

Figure 6. Improvised pebble seating variations _ Source: Roula el Khoury 2023

Figure 7. Improvised units _ Source: Roula el Khoury, 2023.

Figure 8. Improvised unit _ source: Roula el Khoury, 2024.

Such practices can be described as archetypal, in the sense that they use available material found on site, such as using pebbles and rocks to build a seating space. The places are ephemeral and functional. When the sun sets, families leave behind these archetypal spaces that will be further modified by other users. A chain of public coastal design that breaks the boundaries between the architect/user, the state/the public, where each individual is the designer and user at the same time, a participatory design approach by excellence. The proscenium here is oriented towards the sea. City users use the shoreline as a seating space; the sea is their stage. A proscenium soon to be flipped when the city is under occupation and maritime siege. The seawater that was once a stage for a jouissance to emerge, is now a landscape of war. While Eurocentric literature spoke of the transformation of the European beach line from domains of fear to domains of enjoyment and leisure during the 19th century,[14] the Mediterranean beach line remains altering between being a stage of leisure and war until today.

THE EIN EL-MREISEH AS A STAGE, THE WORLD AS AN AMPHITHEATER

As of September 2024, the Israeli war intensified, and the southern suburbs of Beirut were heavily attacked. The Lebanese seawater was a vessel for Israeli warships in the war of 1982, and 2006, accentuating the precarity of death emerging from the sea. In 2024, the residents under bombing turned the Corniche into their refuge, often sleeping and sitting in the cars, or on the wide sidewalk. Within this charged environment, the warnings that had begun to haunt daily life—Avichay Adraee's evacuation messages[15] for residents in Lebanon, disseminated via social media to highlight neighborhoods, buildings, or corridors the IDF intended to strike—took on a lived afterlife on the Corniche. As this flux of evacuees converged on the promenade, the boulevard's luxury hotels stood emptied of their guests, the upscale units were vacant while squatting on the Corniche and along the sidewalks swelled to capacity (figure 9).

Figure 9. Improvised living units during the war. Source: Ali Chehade Farhat.

Vacancy on the one side of the avenue coexisted with full occupancy on the other: the street became a living byword for uneven access to safety, a binary urban experience where the splendor of high-rise towers framed a parallel world of tents, makeshift shelters, and informal commerce. The contrast could not be starker: one edge of the street lined with tiles, damaged floors, and broken benches; the other with marble façades and polished entrances—yet the same urban fabric carried the same sea-salted breath of risk and mobilization. The mattress emerges as more than an object of comfort. For some, the mattress anchors a routine privacy within a sheltered space. For others, it is a compact and movable home, a claim for a family's right to rest, privacy and dignity while the private sphere is dragged into the streets and sidewalks and amid an environment of fear and uncertainty (figure 10). The flux of people moving toward the waterfront did not merely mirror danger; it manifested it, turning the Corniche into a facade on which targeted populations were displayed, exposed, and made legible to the world. Those living in danger zones, those in areas deemed fertile for violence, and those associated with particular partisan or civilian vulnerabilities occupied the same public space, but in radically different registers of visibility and risk. The Corniche thus became not only a refuge but a means to expose the shapes and identities of those at risk—a loupe through which the viewer could see, and the warring parties could judge who belonged to public life and who did not. In this sense the Corniche embodied a form of dialogue, an unspoken conversation with the opponent. For some, the response to warnings and aggression was immediate and practical: they sought shelter, navigated routes, and relied on improvised arrangements to endure the day's threats.

Figure 10. Temporary home as mattress and blankets. Source: AP Photo Bilal Hussein, 08 Oct 2024.

For others—more advantaged, less targeted, or communities deemed less of a threat—the demand to engage in this back-and-forth was muted, or absent, leaving a discernible asymmetry in the rhythm of the city's public life. The Corniche thus records a staged, unequal negotiation: a space where the demands of survival dictated public presence, while privilege and proximity to safety permitted a different kind of everyday life to continue offstage. The Corniche hardened into a dual landscape: on one side, luxury tourism and spectacle; on the other, a makeshift economy anchored by those most vulnerable to displacement and violence. This juxtaposition intensified the long-standing urban divide, crystallizing in a way that wartime conditions can intensify preexisting disparities.

And yet, in wartime Beirut, public space became a stage watched from afar as well as up close. Observers across the sea, and viewers via screens and satellites, bore witness to the widening gap between the advantaged and the disadvantaged. The Corniche, once a serene site of public engagement, transformed into a vivid record of how public space is distributed and redistributed under crisis. It encapsulated not only the immediate perils but also the social reorganization—that is, who remains visible, who is dispossessed of visibility, and who claims a measure of dignity in the midst of upheaval. Space thus functions as a barometer of urban inequality, revealing more sharply than peacetime the stark contrasts between those with access to protection and mobility and those who must improvise a life on the margins of the shoreline. In wartime Beirut, the Corniche does not simply reflect social difference; it amplifies and materializes it, turning the edge of the city into a public theater where the disparity between rich and poor is performed, observed, and endured in real time.

CONCLUSION

In conclusion, the struggle between the "smooth" and the "striated" space is a clear reflection of a complex class struggle in a city lacking any formal public spaces. Moving from the fact that underprivileged countries display a usage of their public spaces that reflect inequality and injustice, we discussed further how wars and crises magnify this dynamism. During wars, the notion of space-time becomes rather accelerated, and intensified and patterns of public space usage acquire new meanings. When feelings of precarity and sense of survival take over, new socio-spatial practices emerge alarming us about the shortcomings of public policies, and the importance of the intuitive appropriation of space that reflects latent potential to be learned from. During war, these practices further echoed the state's failure in providing adequate shelters, and reflected urban challenges navigated by the public users themselves, often creating their own shelter while nearby upscale resorts fragmented the shoreline and

failed to be adaptively re-used as a refuge. Such initiatives should not be viewed as temporary solutions, but they represent a vision for more inclusive and participatory strategies that can thrive amid the city's challenges. Such informal soft interventions sustain and maintain the importance of Ein el Mreiseh's significance as a public space.

NOTES

[1] Gilles Deleuze and Felix Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia,* trans. Brian Massumi (University of Minnesota Press, 2011), 496.
[2] Simon Unwin, *Analysing Architecture* (Routledge, 2003), 54.
[3] Peter Brook, *The Empty Space* (Simon & Schuster, 1968), 7-48.
[4] Paul Virilio, *Speed and Politics,* trans. Marc Polizzotti (Semiotext (e), 2006), 59-73.
[5] Samir Kassir, *Beirut*, trans. Malcolm B. DeBevoise (University of California Press, 2010), 365.
[6] عصام شبارو، عين المريسة: صفحة مشرقة من تاريخ بيروت ودور وطني قومي لا يموت (دار مصباح الفكر، 2000)، 4.
[7] Christine Delpal, "Une Promenade de Bord de Mer: la Corniche de Beirut". In *Reconstruction et Réconciliation au Liban*, ed. Eric Huybrechts and Chawqi Douayhi (IFPO, 1999), 193.
[8] عصام شبارو، عين المريسة: صفحة مشرقة من تاريخ بيروت ودور وطني قومي لا يموت (دار مصباح الفكر، 2000)،439.
[9] "About", Sporting Beach Club, accessed August 10, 2025, https://sportingclub-lb.com/about/
[10] عصام شبارو، عين المريسة: صفحة مشرقة من تاريخ بيروت ودور وطني قومي لا يموت (دار مصباح الفكر، 2000)،497
[11] Nadine el Khayat, "Beirut's (Dis)integrated Seafront: Diverse Identities, Experiences, Typologies and Governance at the Edge of the City" (PhD diss., The University of Sheffield, 2022), 158.
[12] Simon Unwin, *Analysing Architecture* (Routledge, 2003), 9.
[13] Roula el Khoury and Leyla el Sayed Hussein. "Rigid and Soft Modularity: The Case of a Beiruti Shoreline", VITRUVIO International Journal of Architecture Technology and Sustainability 9, no.1 (2024), 24, doi: https://doi.org/10.4995/vitruvio-ijats.2024.21675.
[14] Laleh Khalili. "The Politics of Pleasure: Promenading on the Corniche and Beachgoing", Environment and Planning D Society and Space 34, no. 4 (2016), 588, doi: 10.1177/0263775815623538.
[15] As the Israeli war of 2024 intensified, Avichay Adraee, the Arabic-speaking spokesperson for the Israeli army (IDF) started issuing evacuation warnings to residents in Lebanon on social media platforms like X (formerly Twitter). This became a regular pattern during the war, where a plan was issued as an image often highlighting buildings or neighborhoods that the Israeli military intended to strike. These warnings were used to "terrorize" rather than genuinely protect civilians, causing widespread panic and displacement. Some even had misleading maps and information. These warnings also served as a ticking clock for residents to flee their homes towards the corniche of Ein el-Mreiseh.

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THE FABRICS OF BARCELONA: VERTICAL WEAVING

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INTRODUCTION

Barcelona's Urban Evolution addresses its urban fabric as a palimpsest—each layer revealing the city's evolving response to geography, population pressures, and political forces. Its origins lie in the Roman settlement of Barcino, established around 15 BC as *Colonia Iulia Augusta Faventia Paterna Barcino*, a colony for retired Roman soldiers in the northeastern Iberian Peninsula. Tracing its early foundations, Barcelona has passed through multiple transformations in its form and has emerged over time as order, expansion, and limited systems that together have shaped approaches to the city's density, public space, and growth. With a historical perspective in mind, this paper considers how contemporary challenges related to population growth, limited green and public spaces, and public space management can be addressed through applications of vertical urban design.

ROMAN FOUNDATIONS: ORDER AND ORIENTATION

The planning of Barcino began not with fortification but with orientation. Roman *gromatici*—specialized surveyors trained in geometry, astronomy, and ritual practice—were responsible for defining the city's spatial order. Following the principles described by Vitruvius and Hyginus Gromaticus, they observed the rising sun to establish the decumanus maximus (an east–west axis) and calculated the perpendicular cardo maximus (a north–south axis), thereby forming the basis of an orthogonal grid through a process known as centuriation. This method was both technical and symbolic, embedding cosmic orientation within the city's rational street system.[1] Barcino was strategically sited on Mons Taber, a modest elevation between two intermittent watercourses, offering defensive and topographic advantages while maintaining proximity to the fertile Llobregat River delta. The city was fortified as an oppidum, enclosed by stone walls roughly two meters thick and reinforced by 78 defensive towers. Within the walls, the orthogonal street system, public forum, and administrative buildings reflected the Roman ideal of urban order. This Roman structure provided the morphological foundation for future development. Even as the city expanded in later centuries, the cardo, decumanus, and fragments of the ancient walls remain legible today within the Gothic Quarter, exemplifying how foundational urban logics persist across historical transformations.[2]

MEDIEVAL EXPANSION AND THE RISE OF THE *VILES NOVES*

Following the decline of Roman authority, Barcelona evolved into a medieval city shaped by trade, craft production, and religious power. By the 11th century, population pressures and economic dynamism drove significant urban growth. The city became a refuge for people escaping the feudal system, offering relative personal freedoms and economic opportunities in exchange for taxation and

civic participation. As population density increased, the Roman walls constrained development, leading to the emergence of the viles noves ("new towns")—planned suburban districts constructed just outside the fortified nucleus to accommodate demographic and economic expansion.[3] These new settlements developed around key institutional and commercial nodes, creating a semi-ring of urban activity around the old core:

1. Vila Nova del Mercadal – grew opposite the Portal Major market, consolidating one of the city's earliest commercial hubs.
2. Vila Nova de Sant Pere – formed around the Monastery of Sant Pere de les Puelles, combining religious and residential functions.
3. Vila Nova del Mar – the largest and most dynamic, expanding toward the port and anchored by the construction of Santa Maria del Mar, underscoring Barcelona's maritime rise.
4. Vila Nova del Pi – developed more slowly, extending westward around the Church of Sant Pi near the Jewish quarter.

Each vila nova maintained radial connections to the city gates and was linked by a peripheral track, functioning as an early ring road, as seen in Figure 1. While spatially distinct, they were economically and socially tied to the historic centre, marking Barcelona's first significant departure from a strictly defensive urban form toward a more polycentric structure.[4] By the 13th century, this growth transformed Barcelona into a leading Mediterranean mercantile capital, laying the morphological and economic foundations that would shape its later transformations under Bourbon fortifications and Cerdà's 19th-century grid.[5]

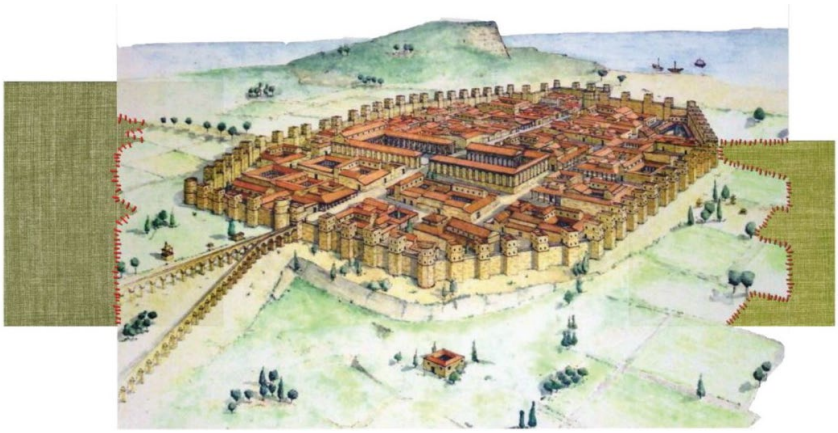

Figure 1. Illustration of Medieval Barcelona: Expansion beyond the Roman walls toward the sea, reflecting the city's growth as a hub of Mediterranean trade.

THE BIRTH OF MODERN BARCELONA

By the early 18th century, Barcelona's urban trajectory entered a period of severe constraint. The city's defeat in the War of Spanish Succession (1701–1714) and subsequent capture by the Bourbon King Felipe V marked a turning point. The Decret de Nova Planta (1716) abolished Catalonia's medieval institutions and placed Barcelona under direct military control.[6]

Urbanistically, the Bourbons sought to contain rather than expand the city. A massive military fortress, La Ciutadella, was constructed in the heart of Barcelona, requiring the demolition of an entire neighbourhood and forcing residents to relocate to the newly planned coastal district of La Barceloneta. The city's fortifications were reinforced, locking development within medieval boundaries and exacerbating overcrowding.[7] Despite these restrictions, the Industrial Revolution catalysed rapid

economic transformation. Between 1717 and 1855, Barcelona's population surged from 37,000 to nearly 189,000, driven by rural migration and the expansion of manufacturing industries. Unable to expand outward, the city grew vertically: by 1790, four-story buildings accounted for 72% of residences, compared to just 13% in 1772. The resulting mix of housing, workshops, and factories created unhealthy living conditions, forcing some industries to relocate beyond the walls.[8]

Political upheavals further reshaped the urban fabric. The Napoleonic occupation (1808–1814) converted religious buildings into barracks, while subsequent liberal reforms confiscated and auctioned approximately 80% of church properties. This redistribution of land facilitated the creation of markets, squares, and public spaces, including the Boqueria Market and Plaça Reial, introducing a new civic identity aligned with modernization.[9] By the mid-19th century, Barcelona's confinement had become untenable. In 1854, Queen Isabel II authorized the demolition of the walls (excluding La Ciutadella), opening the hinterland to urban expansion. Recognizing the opportunity to connect the medieval core with surrounding villages, the municipal council organized a design competition in 1859. Although the winning proposal came from Antoni Rovira i Trias, the Spanish government imposed the alternative vision of Ildefons Cerdà.[10]

CERDÀ'S PLAN: A VISIONARY MODERN GRID

Cerdà's Pla Cerdà was revolutionary in both scale and philosophy. Extending Barcelona by 1,600 hectares beyond the 190-hectare medieval core, the plan introduced a regular orthogonal grid of 113.3 by 113.3-meter blocks and 20-meter-wide streets (Figure 2 and 3). While modern in intent, the grid subtly echoed Roman centuriation, organizing urban space through geometric rationality and connecting mobility, orientation, and land division into a coherent spatial framework.[11] Cerdà envisioned a healthier, more humane city, prioritizing light, air, and green space. His design featured chamfered block corners to improve visibility and circulation, interior communal gardens for recreation, and pedestrian pathways that linked open spaces independently of the street network. In many ways, his plan anticipated a compact garden-city model, balancing density with liveability.[12] However, economic realities clashed with these ideals. Driven by real estate speculation, Barcelona's industrial bourgeoisie resisted dedicating valuable land to open space. Municipal ordinances soon doubled allowable building density, enclosing entire blocks and eliminating most interior gardens. By 1872, nearly 90% of new constructions violated Cerdà's original guidelines.[13] Despite these compromises, the Pla Cerdà provided the framework for Barcelona's transformation into a modern industrial metropolis.

Figure 2. A layered collage of Barcelona's growth from Roman Barcino to Cerdà's Eixample, showing horizontal expansion.

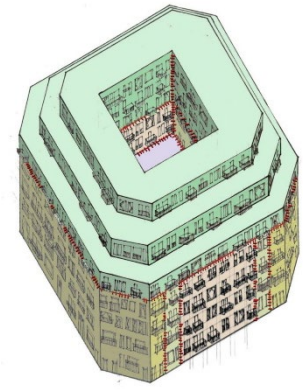

Figure 3. Illustration of Barcelona's blocks evolving vertically to accommodate the growing population and programs.

MODERN URBAN SOLUTIONS

Vertical density is increasingly adopted in contemporary urban planning, which is progressively moving away from horizontal sprawl. The transition is a reaction to population growth, land scarcity, and the demand for sustainability.[14] Examining local experiments, global examples, and policy frameworks that may guide future directions is crucial, however. Cities cannot simply replicate one another; the Gothic Quarter will not become Manhattan, nor can the Eixample be transformed to resemble Tokyo's Shinjuku. Nevertheless, examining different dense urban areas demonstrates how vertical urbanism can be employed to harmonize growth with livability. In this context, Barcelona has begun exploring these concepts through initiatives such as the Superilla (Superblock) strategy and gradual densification projects.[15] The challenges of today can be addressed by an approach that examines how the city is reclaiming public space, reducing vehicle traffic, and promoting sustainable mobility.

INTEGRATION OF PUBLIC AND PRIVATE SPACES

The worldwide understanding of vertical space functions has existed for a long time, as cities throughout the globe employ vertical solutions to address population density, limited outdoor spaces, and multiple spatial requirements. The vertical connection between public and private spaces, as seen in Tokyo, Hong Kong, and Singapore, demonstrates an effective method for enhancing urban living standards. More so, the combination of public and private areas in urban planning involves placing public spaces within or adjacent to private properties to create regions that integrate public functions with commercial activities.[16] In Barcelona, superblocks are urban planning units made up of multiple city blocks that are combined to limit automobile traffic, reclaim streets for bicyclists and pedestrians, and establish public areas that foster environmental sustainability and social interaction. Although studies acknowledge Barcelona's Superblocks' spatial limitations, they have proven success in increasing sustainability and pedestrian life.[17] According to academics and urban theorists, incorporating vertical extensions could address density concerns while maintaining vibrant and sustainable urban areas (Figure 5).

Figure 5. Illustration of Reimagining programs and circulation vertically, transforming facades into active, three-dimensional urban spaces.

Global Urban Strategies and Relevance

First, in Tokyo, city planners turned the renovation of Shibuya Station into a case study for vertical integration. Another construction within the area is Shibuya Scramble Square, which is also part of the initiative 'station-city development'[18]. These improvements show how vertical integration can create new community spaces and ease congestion at the street level. In Shibuya, most walking spaces incorporate additional vertical layers to alleviate congestion at street level.[19] This is the approach that Barcelona ought to adopt in resolving the issue of crowding and fragmentation of walking spaces along the rambles.[20] Second, according to Lam and Yu, there are more than 3,000,000 square meters of elevated privately-owned walkways and other Privately Owned Public Spaces (POPS) systems throughout Hong Kong.[21] To elaborate, POPS are designed through partnerships between the public and private sectors, which provide public access to previously closed private areas. Nevertheless, studies point out limitations such as surface access constraints and commercial branding, which shape public usage.[22] Barcelona can integrate walkways and rooftop terraces into elevated public space systems, complementing the already available ground-level spaces, particularly in dense Eixample blocks and historic districts with limited horizontal expansion.[23] Third, Singapore leads the way in biophilic design, incorporating green infrastructure into building massing. More so, the Parkroyal Collection Pickering Hotel boasts an impressive 15,000 square meters of sky gardens, reflecting pools, and cascading vertical greenery.[24] Similar projects, such as Sky Ville at Dawson, include communal green spaces, spas, and ecological elements, as seen in figure 4. These designs effectively reduce urban heat islands, decrease stormwater runoff, and improve air quality. However, there is criticism that vertical greenery systems, over the long term, may lack sustainability, require ongoing maintenance and irrigation, and consume significant amounts of energy.[25] For Barcelona, rooftop gardens and vertical green corridors could enhance the outdoor lifestyle, improve urban ecology, and address shortages of green spaces.[26] Lastly, the High Line in New York exemplifies the potential of transforming neglected infrastructure into public space. The 2.33-kilometer-long elevated park attracts over 8 million visitors annually, weaving together cultural, ecological, and recreational spaces.[27] Similarly, in Barcelona, the old industrial area of Poblenou could transform abandoned railway lines into greenways that vertically connect parks, cultural sites, and pedestrian zones.[28] As a result, these examples, seen in Figure 6, demonstrate how Barcelona can use green infrastructure, elevated public areas, vertical integration, and adaptive reuse to solve contemporary urban issues and build a more sustainable, livable, and connected city.

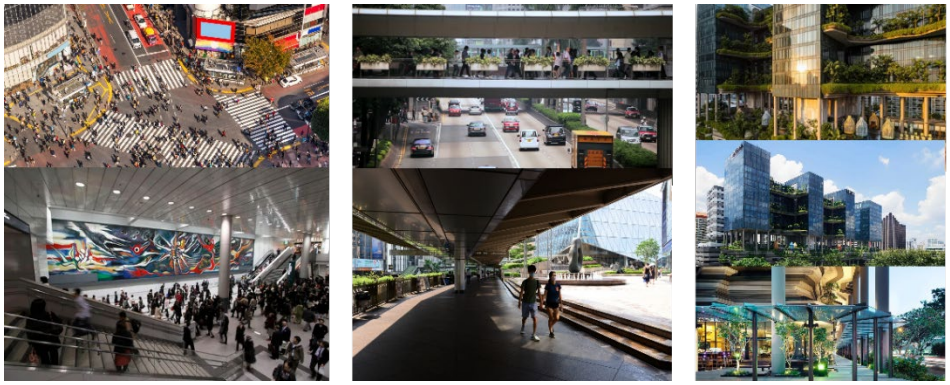

Figure 6. Global precedents of vertical urban integration (Tokyo, Hongkong, and Singapore).

Barcelona: Evolving the 'Superblock' through Vertical Integration

Barcelona's Superblocks (Superilles) have improved quality of life in neighborhoods like Poblenou by reducing traffic and reclaiming streets for pedestrians, at the same time prioritizing people over cars.[29] The model creates micro-public spaces that lower pollution. With that, horizontal interventions alone may risk overloading ground-level spaces as tourism and population growth continue. Over 16,000 people live in the central districts,[30] and over 12 million tourists visited in 2019.[31] Barcelona offers only 6.6 m² of green space per resident, which is below the WHO recommendations.[32] Vertical strategies are therefore crucial. Lessons from Tokyo, Hong Kong, Singapore, and New York suggest that integrating vertical strategies into Superblocks can enhance functionality, preserve historic character, and support sustainable density. By using comparable strategies on existing Superblocks, Barcelona could increase its horizontal resilience vertically. Rooftop playgrounds, community centers on the upper floors, and connected terraces would distribute activity across multiple levels. Anchored in sustainability and heritage-conscious regulations, vertical stacking may further improve air quality and public health.[33] Integrating green infrastructure, developer incentives, and elevated public spaces can create a cohesive urban ecology blending sustainability, heritage, and density.

VERTICAL STITCHING PROPOSAL

This thesis explores vertical architectural interventions woven into Barcelona's urban blocks, fostering a layered, multi-level public life; drawings, models, and mixed media present ideas suggestively rather than prescriptively (Figure 7 and 8). According to Gehl,[34] these interventions promote connectedness, equitable behavior, and environmental responsiveness. Circulation routes pass through and above buildings, directing occupants past study centers, retail stores, and communal spaces. Pathways blur private and public boundaries, transforming corridors, stairways, and rooftops into active spaces (Figure 4). Programs integrated vertically reduce pollution and road stress while preserving social and cultural life. The Ecology Agency of Barcelona notes that "intervention in the compact city occurs by proposing vertical extensions in buildings and redesigning their skins, as well as the way they relate to the surrounding environment, regarding the cityscape, sustainable systems, and infrastructures".[35] This emphasizes that vertical interventions strategically improve circulation, integrate sustainable systems, and enhance usability and livability. Ultimately, vertical weaving transforms Barcelona's urban fabric into a multi-level, human-centered metropolis, creating a durable, livable, and socially equitable model for dense historic cities. Vertical weaving involves reprogramming the city's vertical dimension to restore balance among residents and tourists, and heritage is not about building towers (Figure 5).

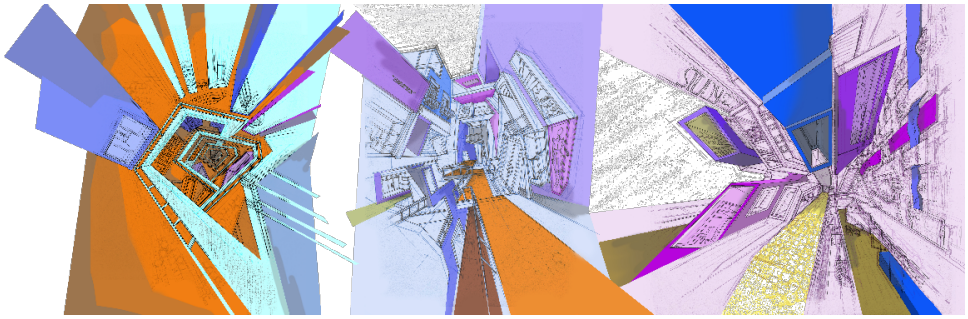

Figure 7. Program illustration of the circulation routes through the block.

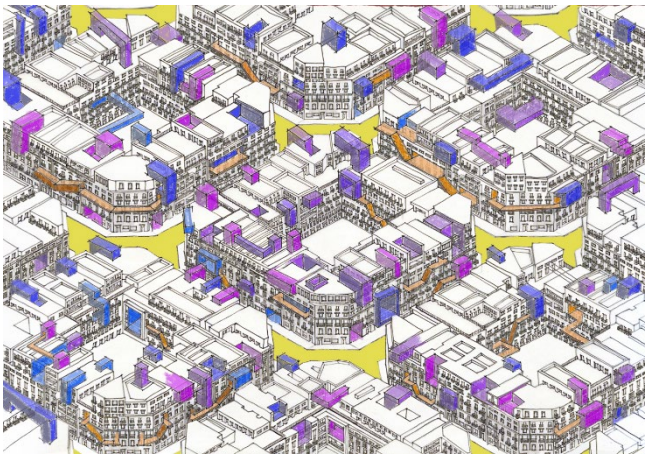

Figure 8. Program illustration of the Fabrics of Barcelona blocks.

CONCLUSION

The history of Barcelona shows a continuous adaptation to expansion within a constrained area. Strategies beyond horizontal expansion are now required due to pressures for sustainability and density. In addition to easing traffic and preserving cultural heritage, vertical development can reclaim rooftops, enhance circulation, and spread public life across levels. Rethinking its morphology is essential to Barcelona's resilience.[36] By creating a dense, livable, and sustainable future that balances tradition with modern urban needs, vertical interventions continue this legacy. In this manner, with precedent-informed and heritage-aware intervention strategies, a structure exists for their effective implementation, and it becomes possible to apply the concepts of innovative vertical urbanism in relation to challenges posed at the environmental and social levels.

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HYBRIDIZING MORPHOLOGIES: VERTICAL SOLUTIONS FOR WALKABLE FUTURES

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INTRODUCTION

Skylines attract attention, yet urban life is decided at ground level. This paper examines how spatial morphology, understood as the arrangement and interaction of plots, blocks, streets, and building types, governs ground-level experience in cities that seek to grow vertically while preserving pedestrian continuity. The research focuses on the tension between vertical capacity and everyday liveability. Barcelona and Dubai are treated as deliberate foils: in Barcelona, the dense, fine-grained fabric of the Gothic Quarter concentrates activity through small plots, narrow streets, and continuous frontages that sustain walkable networks, yet recent tourism, congestion, and housing speculation strain permeability and civic use.[1] In Dubai, isolated towers and highway infrastructures generate vertical capacity, often fragmenting the ground plane and public space, illustrating how height without street-level connectivity weakens continuity.[2] The paper proposes hybrid spatial strategies that reconcile verticality with walkable, human-scaled design by aligning new volumes with existing blocks and passages, and creating multi-level public interfaces. The design strategy features a set of vertical seams, small-scale insertions that add capacity and shared interfaces woven into existing pedestrian networks. Urban history and precedent inform decisions related to organization, density, and movement. The design proposal demonstrates these principles through the deployment of new, vertical structures within Barcelona's Gothic fabric.

BARCELONA: HISTORICAL AND URBAN CONTEXT

Barcelona's urban form is characterized by a series of layered histories, with each phase leaving a distinct spatial imprint that shapes the modern city. As Busquets notes, the foundation of Barcino during the Roman period, likely between 15 and 13 BCE, established a formal orthogonal grid oriented around the cardo maximus and decumanus maximus, intersecting at a central civic hub (Figure 1). This urban logic, rooted in Roman city-building traditions, organized the city around a structured geometry and civic zoning that still influences movement and spatial understanding today. The original urban layout, built on Mons Taber and defined by a network of gates, walls, and perpendicular streets, formed a compact urban core that remained largely unchanged through successive urban developments over the course of two thousand years. As Busquets emphasizes, this Roman legacy endures not only in the visible street network but also in the fundamental urban logic of modern Barcelona.[3] This framework both constrained and enabled later changes, showing how inherited forms can limit and facilitate transformation.

Figure 12. Barcino's Roman grid oriented by the cardo maximus and decumanus maximus. Source: Busquets, Barcelona, 25.

During the medieval period, the street network formed a continuous but weak urban system with an irregular layout; squares often appeared as widenings of the streets, and rows of small artisan houses in the viles noves gradually converted approach roads into narrow streets, intensifying the fabric.[4] As Busquets and Pérez-Ramos describe, this growth extended across the plain, integrating peripheral settlements such as Gràcia, Sant Andreu, and Poble Sec through localized grid-like layouts that prefigured later annexation and rational planning.[5] This process was not orchestrated by a centralized authority but emerged from speculative urbanization by a rising patrician class.[6] As Bensch details, the economic drivers behind this transformation included artisanal production, dynastic merchant networks, and income-generating real estate subdivisions.[7] These irregularities later constrained comprehensive replanning efforts.

Responding to the urgent need for urban reform in nineteenth-century Barcelona, Judith Urbano shows that Ildefons Cerdà's 1859 Eixample Plan addressed overcrowding, unsanitary conditions, and social division. She explains that the proposal advanced hygiene, mobility, and equity through a rational structure of uniform blocks, chamfered intersections, standardized dimensions, and central courtyards

intended to secure access to light, air, and public services.[8] Marshall notes that this city-scale intervention became feasible only after the demolition of the Ciutadella fortress and the lifting of restrictive military zoning.[9] Amati et al. emphasize that the Eixample's gridded layout, broad streets, and hygienic priorities enabled nineteenth-century expansion while improving public health and infrastructure. In the present, the same rational scaffold underpins Superblocks, which reprogram the grid toward pedestrian, ecological, and social functions.[10] Urbano also documents how speculative development distorted Cerdà's intent by enclosing interior courtyards, exceeding height limits, and prioritizing private gain over public welfare.[11] Russo and Scarnato further observe that the repurposing of collective spaces eroded civic cohesion, reducing permeability and everyday interaction.[12] In parallel, today, the Gòtic's residential fabric is increasingly unsettled by tourism-driven gentrification, second-home investment, and short-term rentals, privileging transient foreign residents while displacing long-term locals.[13] In sum, the Eixample's block logic and street hierarchy provide a stable scaffold for gradual change; we use this as a precedent and carry its lessons of selective recalibration into the Gothic Quarter, where wholesale replanning is neither feasible nor desirable.

DUBAI: VERTICAL DENSITY AS URBAN STRATEGY AND MORPHOLOGICAL CONTRAST

Dubai's urban development offers a compelling counterpoint to Barcelona's horizontal density. Dubai adopted verticality as a primary urban strategy, using towers to accommodate rapid economic and population growth while simultaneously crafting a globally recognizable urban image. Districts such as Downtown Dubai achieve plot-level densities of approximately 6,600 people/km²,[14] whereas older districts like Deira maintain densities around 3,950 people/km².[15] In contrast, Barcelona's Eixample reaches 36,000 people/km², and the Gothic Quarter exceeds 27,000 people/km², despite remaining predominantly mid-rise.[16]

The disparity between Dubai and Barcelona highlights how density is governed not only by height alone, but also by an array of factors, including transportation networks, pedestrian accommodations, and zoning. Dubai's towers are interspersed with highways, podiums, and landscaped setbacks, resulting in low plot coverage and disconnected street networks.[17] Conversely, Barcelona's compact grid, narrow streets, and small plots maximize ground coverage and occupancy, resulting in high population densities within a cohesive pedestrian environment.[18]

Scholars such as Elsheshtawy critique Dubai's model for producing "vertical enclaves" that lack integration with public life, while Safarik et al. describe it as a "polycentric spectacle city," prioritizing visual impact over social continuity.[19] Alawadi further highlights the commodification of public space, where access remains contingent on consumption rather than civic belonging.[20] These scholarly critiques are critical to this research, as they demonstrate that vertical interventions, when detached from public life, risk replicating Dubai's spatial and social failures despite their density advantages. However, Dubai's towers reveal that verticality has the architectural capacity to absorb rapid growth without requiring horizontal expansion. Koolhaas frames such vertical intensification as "congestion without chaos," although it is realised in Dubai with significant social costs due to disconnection and exclusion.

COMPARATIVE URBAN CHALLENGES

The urban conditions of Barcelona and Dubai, while visually and historically distinct, converge around a shared dilemma: how to sustain human-centered livability amid intensifying density. In Barcelona, this challenge emerges from the cumulative pressures of tourism, visitor congestion, and market-driven housing speculation, which disrupt opportunities for social interaction and strain the quality of public space.[21] The city's dense grid remains structurally robust, but struggles to absorb elevated visitor flows,

traffic, and noise, placing new burdens on its pedestrian environment and civic infrastructure. Dubai, by contrast, demonstrates that vertical density does not automatically foster social cohesion. Its clusters of high-rise developments, organized primarily around infrastructure and investment priorities, produce a visually striking skyline yet fail to support integrated civic life.[22] These vertical enclaves highlight that proximity alone does not sustain collective urban experience if connective public space is neglected. The comparison highlights that density is neither inherently positive nor negative, but rather depends on spatial articulation and the capacity to sustain social exchange. Barcelona's evolving urban structure presents an opportunity to expand through vertical interventions and carefully designed underground public spaces, which can provide relief from street-level congestion, foster social programs, and maintain walkability. These calibrated morphological insertions, including modest towers and subterranean civic platforms, aim to negotiate density by layering new forms of light, air, and collective amenity within the inherited urban grain. Rather than replicating the spatial isolation of Dubai or surrendering to uncontrolled growth, this thesis positions verticality as a tool of mediation, capable of redistributing and reconnecting urban life while preserving Barcelona's tradition of civic accessibility.

DESIGN PROPOSAL – BARCELONA

In response to the mounting pressures on Barcelona's historic fabric, like rising density, tourism congestion, and the gradual erosion of communal courtyards, we propose the strategic insertion of small-scale vertical towers within the existing urban grid. These towers do not mimic Dubai's monumental skyline but instead operate as micro-interventions: vertical nodes embedded into older fragments of the Gothic and Raval neighborhoods. Their scale is deliberately modest, rising just above the surrounding rooflines to remain legible within the city's pedestrian rhythm. Rather than dominate the skyline, they peek, anchor, and frame urban life below.

The proposal reinterprets the contrasting urban logics of Barcelona and Dubai to recover neglected values of spatial intimacy, sensory richness, and human-scale engagement. Each tower is conceived as a spatial journey, an orchestration of compression and release, shadow and light, designed to activate the full range of human senses. Informed by Pallasmaa's assertion that architecture must "address all the senses simultaneously" rather than privilege the visual alone, the design reframes multisensory engagement as essential rather than ornamental.[23] Entry points are intentionally narrow, funneling users through shaded, acoustically soft thresholds before revealing moments of openness above. The vertical sequence is not simply upward movement, but a calibrated shift: from quiet to vibrant, inward to outward, a spatial mechanism for self-regulation in the overstimulated city. At the top, views stretch out in all directions, offering a rare, uninterrupted glimpse of the horizon, a condition Dubai has made feel strangely ordinary.[24]

By layering personal refuge and communal activity within a single vertical framework, the towers aim to reclaim density as an opportunity, not a constraint. For the solitary resident, they offer moments of introspection and retreat; for the neighborhood, they provide connective tissue, punctuating the city with spaces that invite pause, dialogue, and gathering. In doing so, these towers function as architectural mediators, harmonizing the demands of a growing city with the need for human-scale experience. They reimagine verticality not as a symbol of capital or dominance, but as a scaffold for social life.

Roots

Figure 2 presents a multi-part drawing of the tower's roots zone, illustrating its subterranean spatial configuration and programmatic intent. On the left, a diagrammatic section shows three distinct program volumes floating within the excavated underground space, highlighting the design strategy of suspending forms to create a dynamic relationship between solid and void. Adjacent to this section is a plan diagram, rendered in poche, depicting circulation paths and the positioning of key programmatic

elements within the roots zone. The bottom left quadrant features a perspective view showing the suspended library volume within the underground environment, separate from the communal table zone. The perspective also depicts a large central table designed for collaboration, conversation, and shared work. At the same time, carved-in seating niches along the periphery provide intimate spaces for focused study or quiet retreat. Integrated lighting fixtures cast dim, controlled illumination, reinforcing the subdued and contemplative atmosphere of the subterranean setting. At the top of the drawing, a perspectival view illustrates one of the floating program volumes in isolation, clarifying its formal logic and suspended positioning within the underground void. Together, these drawings demonstrate how the roots zone employs darkness, quietness, and calibrated lighting to create a grounded, introspective environment that anchors the building's vertical journey with spaces for focus, refuge, and sensory reset.

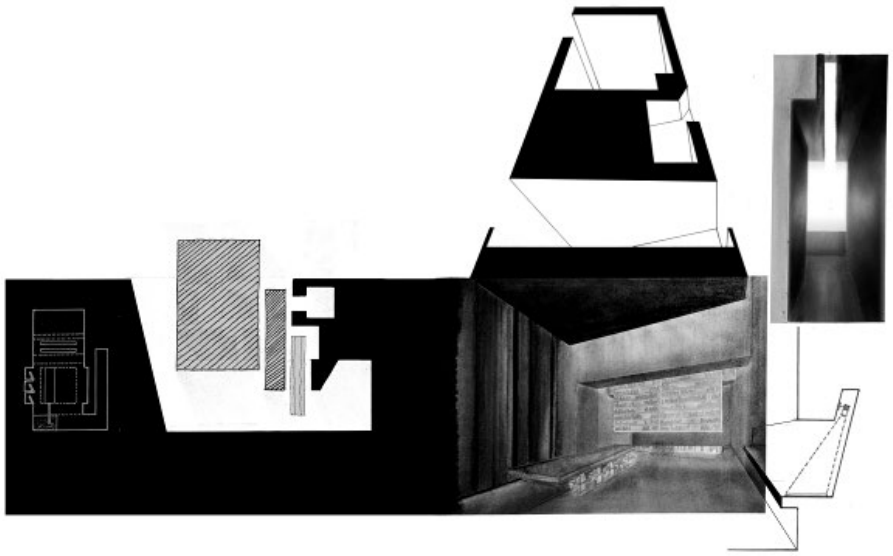

Figure 2. Heidy Thabet & Dana Abodahab - ARC 401, American University of Sharjah - Fall 2024

Entry

Figure 3 presents a multi-part drawing of the tower's entry zone, illustrating its spatial sequencing and material strategy. The main perspective view depicts the double-glazed façade as an elegant vertical veil framing the street. Frosted translucent glass panels create a layered threshold, obscuring and revealing movement behind them to produce a shifting play of shadows and silhouettes that hint at the life within. The section drawing details the double-glass system, clarifying its layered assembly and the gap between glass planes that modulates light, thermal comfort, and visibility. This design strategy enhances environmental performance while choreographing visual permeability and privacy.

The plan diagram illustrates the entry pathway, where visitors slip into the building through a narrow, strategically positioned opening. This sequencing creates an intentional moment of compression upon entry, establishing an intimate and focused transition before descending into the root zone.

Together, these drawings demonstrate how the entry zone combines material articulation, spatial choreography, and sensory layering to establish an approach sequence that is simultaneously inviting, mysterious, and grounded in controlled experiential design.

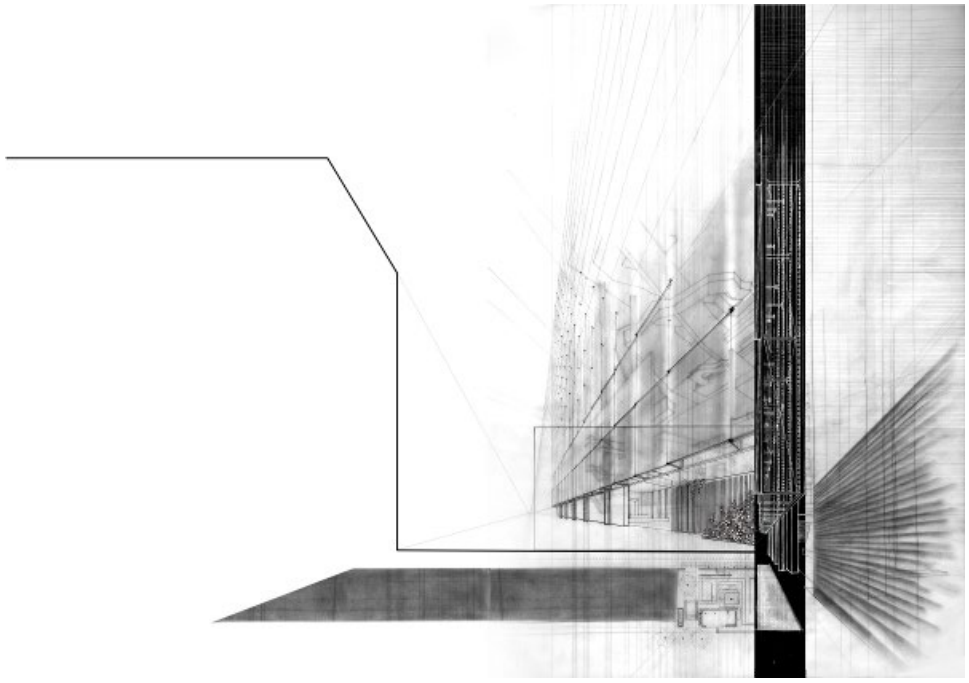

Figure 3. Heidy Thabet & Dana Abodahab - ARC 401, American University of Sharjah - Fall 2024

Trunk

Figure 4 presents a perspective of the tower's trunk zone, illustrating its role as a curated spatial realm that emphasizes framing and controlled interactions. The main view shows the ground-level trunk space, characterized by multiple inserted volumes that create curated pathways and discrete programmatic zones. These volumes support flexible uses for small groups or individual activities while maintaining spatial intimacy within the overall trunk zone. On the left side of the drawing, a narrow-framed view is depicted, directing attention towards a single branch-like element outside. This framing strategy privileges focused visual connections over expansive vistas, encouraging occupants to engage with subtle details of the external environment. Throughout the trunk, smaller niches and integrated seating are embedded within the inserted volumes, offering moments of pause, reflection, and solitary retreat within a layered spatial composition.

Interior courtyards further curate views, bringing filtered light and natural textures into the space, thereby blurring the boundaries between inside and out. Together, these elements demonstrate how the trunk operates as a mediating zone in the vertical journey, privileging curation, framing, and sensory focus over openness, and connecting the grounding stability of the roots to the aspirational release of the canopy.

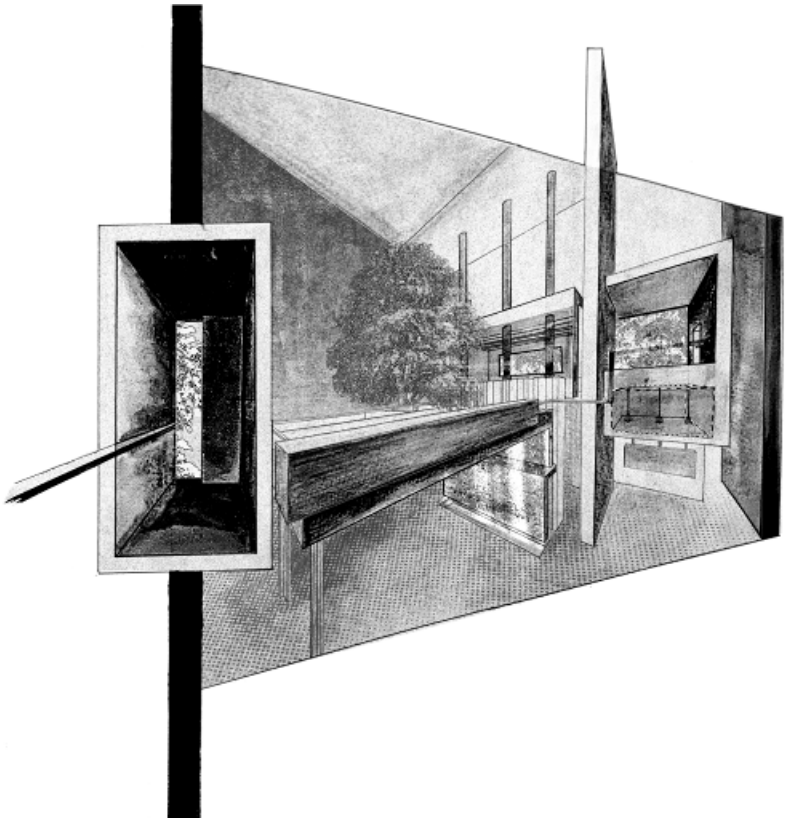

Figure 4. Heidy Thabet & Dana Abodahab - ARC 401, American University of Sharjah - Fall 2024

Canopy

Figure 5 presents a perspective of the tower's canopy zone, focusing on the communal stadium-style stepped seating and dramatic rainwater chandelier system. The main view depicts the stadium stairs as the primary gathering element, with circulation paths cutting diagonally through the steps to create dynamic movement and layered occupation.

Suspended above is the rainwater chandelier system, where multiple chains descend from winding pipes, converging to funnel rainwater into a central collection point below. This system introduces acoustic, cooling, and visual effects, transforming rainwater into a multisensory feature that is experienced differently depending on the proximity of circulation.

To the left, a folded wooden seating area is oriented towards panoramic glazing, allowing for reclining views of the Barcelona skyline. The vertical village dormitories are positioned along one side as a thick inhabited façade, maintaining occupant privacy while contributing to the spatial layering of the canopy.

The bottom right inset shows an abstract plan diagram mapping circulation routes in relation to seating areas, dormitories, and the rainwater feature. The top left zoom-in depicts a typical dormitory unit, highlighting framed views towards the skyline or sky for focused work and contemplative retreat.

Together, these elements demonstrate how the canopy integrates environmental strategy, programmatic diversity, and choreographed circulation to create a sanctuary that balances communal openness with private retreat.

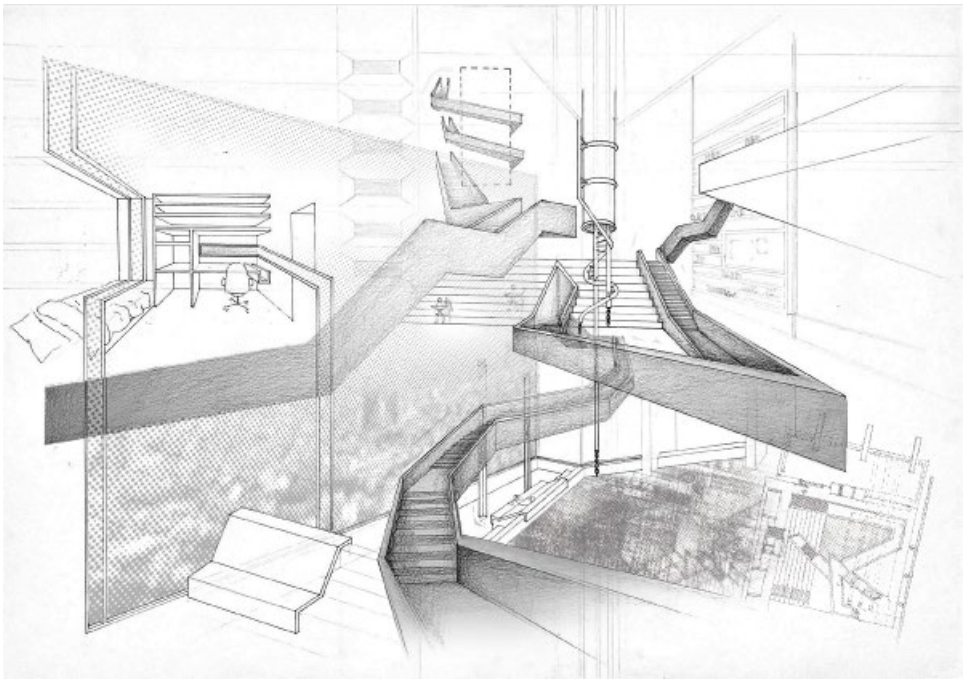

Figure 5. Heidy Thabet & Dana Abodahab - ARC 401, American University of Sharjah - Fall 2024

Section

Figure 6 presents a comprehensive section drawing of the tower, illustrating its integration within Barcelona's urban context. The drawing situates the tower within its immediate environment, highlighting how its massing engages both the street front and interior courtyard. Towards the street, the section shows an articulated façade that maintains a defined urban edge. At the same time, towards the courtyard, setbacks and openings foster daylight penetration and visual connectivity with neighboring buildings.

The section clarifies the tower's overall vertical organization, showing the relationship between the roots, trunk, and canopy zones and how they align to create a coherent spatial journey. It also demonstrates how the tower peers only slightly above adjacent rooflines, maintaining legibility within the dense cityscape without dominating it. This calibrated height ensures continuity with surrounding buildings while introducing a distinct vertical marker within the urban fabric.

Ultimately, this drawing captures the tower's role as a sensitive yet assertive urban intervention, striking a balance between visibility and contextual integration while enhancing the city's spatial and experiential fabric.

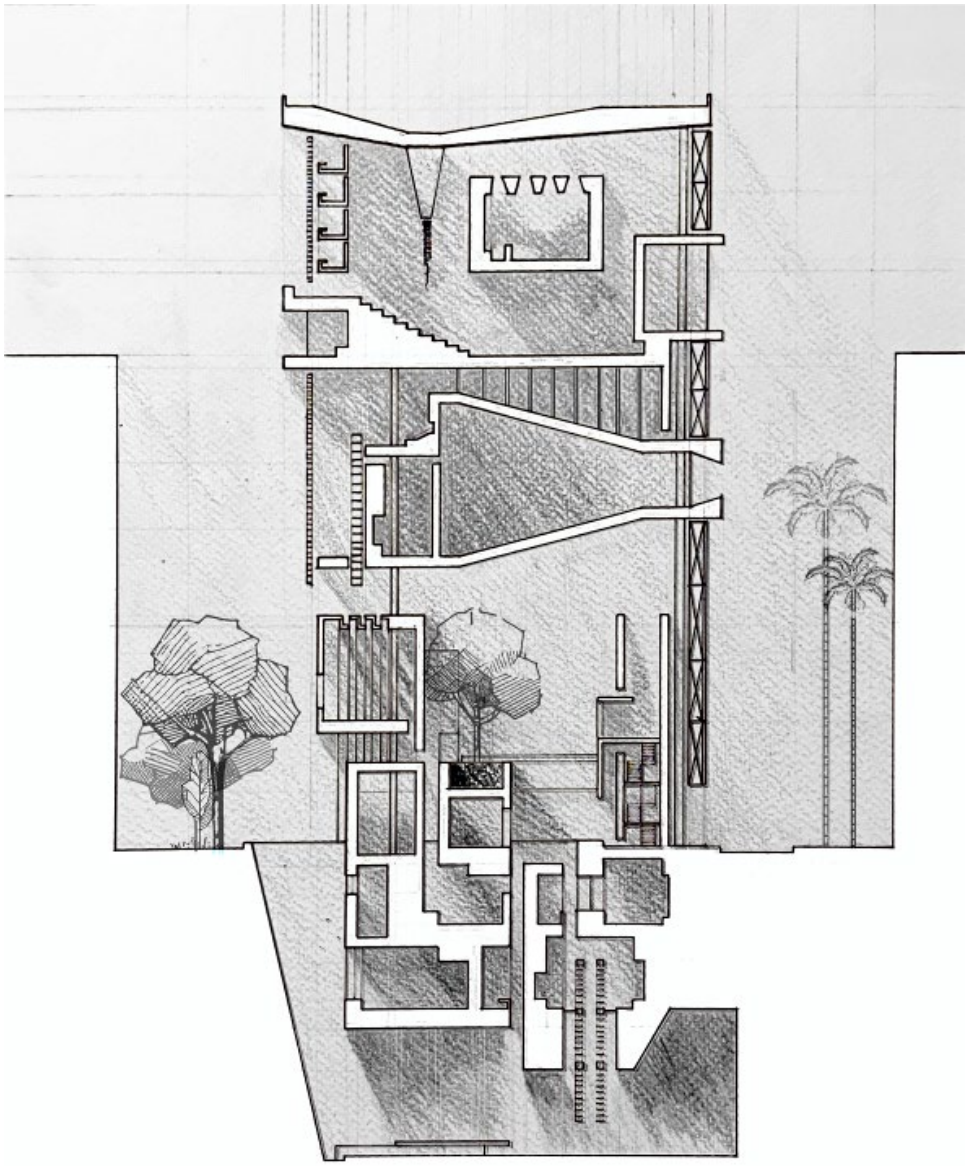

Figure 6. Heidy Thabet & Dana Abodahab - ARC 401, American University of Sharjah - Fall 2024

CONCLUSION

This research demonstrates how a comparison of Dubai's vertical typologies and Barcelona's horizontality offers a model for addressing Barcelona's pressing urban challenges (Figure 7). Adopting a dual lens as both critic and local, the approach applies to a broader evaluation of cities, where density is approached not as an inevitable byproduct of tourism and globalization, but as a layered experience that sustains urban vitality. Skyscrapers, long critiqued as isolated entities, can thus be reframed as opportunities for controlled density. Ultimately, the challenge is not whether cities can accommodate density, but how they might shape it into a condition that preserves and amplifies civic life.

Figure 7. Heidy Thabet & Dana Abodahab - ARC 401, American University of Sharjah - Fall 2024

NOTES

[1] Judith Urbano, *"The Cerdà Plan for the Expansion of Barcelona: A Model for Modern City Planning," Focus: Journal of the City and Regional Planning Department, Cal Poly* 12 (February 26, 2016): 48.
[2] Khaled Alawadi, "Whatever Happened to Dubai's Public Spaces?" International Journal of Middle East Studies 50, no. 3 (August 2018): 562–567, https://doi.org/10.1017/S0020743818000557
[3] Joan Busquets, *Barcelona: The Urban Evolution of a Compact City* (Rovereto: Nicolodi Editore, 2006), 23.
[4] Busquets, Barcelona: The Urban Evolution of a Compact City, 43–45.
[5] Joan Busquets and Pablo Pérez-Ramos, *Barcelona: Manifold Grids and the Cerdà Plan* (Zürich: Park Books, 2017), 6.
[6] Stephen Bensch, *Barcelona and Its Rulers, 1096–1291* (Cambridge: Cambridge University Press, 1995), 4.
[7] Bensch, Barcelona and Its Rulers, 1–2.
[8] Urbano, "The Cerdà Plan for the Expansion of Barcelona," 48.
[9] Tim Marshall, ed., *Transforming Barcelona: The Renewal of a European Metropolis* (London: Routledge, 2004), 22.
[10] Marco Amati et al., *"Taking Play Seriously in Urban Design: The Evolution of Barcelona's Superblocks," Cities* 134 (2023): 157, 162.
[11] Urbano, *Cerdà Plan*, 50.
[12] A. P. Russo and A. Scarnato, *"Barcelona in Common: A New Urban Regime for the 21st-Century Tourist City?"* (manuscript, June 28, 2017), submitted to *Journal of Urban Affairs*, manuscript ID JUA-16-172.R2, 16–17.
[13] Alexandros Cocola-Gant and Antonio López-Gay, "Transnational Gentrification, Tourism and the Formation of 'Foreign Only' Enclaves in Barcelona," *Urban Studies* 57, no. 15 (2020): 3035–3037.
[14] Dubai Statistics Center, "Population Density by Area, Downtown Dubai," 2022.
[15] Dubai Statistics Center, "Population Density by Area, Deira," 2022.
[16] Ajuntament de Barcelona, "Dades demogràfiques per districtes," 2023.
[17] Yasser Elsheshtawy, Dubai: Behind an Urban Spectacle (New York: Routledge, 2010), 85.
[18] Joan Busquets, Barcelona: The Urban Evolution of a Compact City (Rovereto: Nicolodi Editore, 2006), 45–67.
[19] Safarik et al., "Polycentric Urbanism," 23.
[20] Khaled Alawadi, "Whatever Happened to Dubai's Public Spaces?" International Journal of Middle East Studies 50, no. 3 (2018): 562–567.
[21] Cocola-Gant and López-Gay, "Transnational Gentrification," 3038.
[22] Daniel Safarik, Shawn Ursini, and Antony Wood, "The Tall, Polycentric City: Dubai and the Future of Vertical Urbanism," CTBUH Journal 2018, no. IV (October 20, 2018): 21–29.
[23] Juhani Pallasmaa, The Eyes of the Skin: Architecture and the Senses, 3rd ed. (Chichester, West Sussex: Wiley, 2012), 41.
[24] Author's own observations, based on over two decades of residence in Dubai. The ubiquity of high-rise viewing platforms in the city has rendered panoramic vistas commonplace, diminishing their spatial and emotional impact.

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RETHINKING A LANDSCAPE FRAMEWORK OF HO CHI MINH METROPOLITAN REGION

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INTRODUCTION: (RE)READING AS A KEY

"Modernity" and "modernization"—as soon as these terms were coined, cities shifted their gears towards reconfiguration to accommodate new economic, social, and technological conditions. This shift has led to the nonstop urbanization and colonization of new land to provide resources for cities' operations, which recalls the image of "the space-endless megapolis".[1] In 2017, a total of 4,231 cities worldwide had populations exceeding 100,000 and nearly all ice-free ecoregions host cities of this size.[2] Through the influence of globalization, cities have become interconnected and interdependent with the metabolism of earth's processes, or in other words, the planet's ecological resources.[3] Brenner and Schmid have characterized this development as "planetary urbanization";[4] while Weller has proposed the term "the new nature"[5] to describe the inseparability and indistinguishability of the urban and the natural worlds. Recently, it has been estimated that over 4 billion people[6] live in urban areas, and this number is expected to more than double by 2050. The endless expansion in population growth, urbanization, and globalization have imposed enormous pressures on the environment. Global warming has also exacerbated the challenges for natural systems. All of this poses an urgent invitation to rethink the future of cities and their relation to the environment in order to develop in a more conservation-oriented and sustainable manner.

Borrowing and widening Frampton's concept of "Megaform" (1999),[7] this paper adopts the territory of the megacity, Ho Chi Minh (HCM) Metropolis, as its case study, with the aim of rethinking its urban landscapes (both built and non-built). The Metropolis is the economic capital of Vietnam, located at the transition point between the highland territory and the Mekong Delta. The city's economy has gradually recovered in the wake of the COVID-19 pandemic. The year 2025 marks a major change in the city's administrative and political management, leading to the expansion of its administrative boundaries (Figure 1). The "new" city has an area of 6,700 km2, which is 3.25 times its previous size, and now covers a population of about 14 million.[8] This has created radical change in the configuration of land use, socio-economic infrastructure, and ecology. The city has been vastly and densely expanded since 2000 (through both planned and spontaneous urbanization) and absorbed productive landscapes in the lowland areas. This has resulted in Ho Chi Minh City (HCMC) having one of the lowest densities of green space for an urban area, less than 1 square meter per capita[9], which has significantly reduced the number of water-permeable areas in the city (Figure 2). Consequently, the city is increasingly susceptible to the ramifications of global warming (Figure 3) and, thus, necessitates a (re)envisioning of the city's planning.

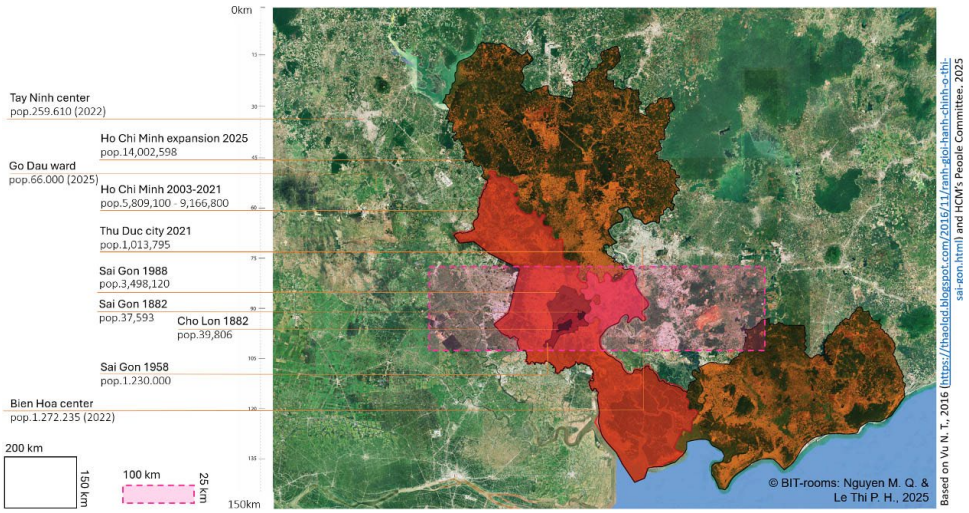

Figure 1. The endless expansion of HCMC.

Figure 2. The urbanization towards productive landscapes.

The paper presents an alternative interpretation of urban and landscape morphological structures, contrasting with the existing planning method. Sequentially, it proposes urban design strategies aimed at initiating the development of urban scenarios through design research. HCMC's master plans, conventionally, focus on expanding infrastructure systems, especially road systems, to ensure connectivity and accessibility within the city. The road systems then serve as a framework for the arrangement and balancing of fixed land use functions (Figure 4).[10] Meanwhile, such plans propose

little intervention in the urban or landscape morphological structure, which is nevertheless important, and has been formed by centuries-long interactions between cultural practices and the natural environment. This conventional approach to master planning has been widely discussed.[11] Based on the background, it is hypothesized that topography has implied a foundational structure that has shaped the fabric of the Metropolis since its inception. Aided by mapping as a research tool, the (re)reading or (re)interpretation of urban fabric in terms of "megaforms" can uncover the underlying structure of settlement patterns, which serves as a foundation for further rethinking and reimagining metropolitan landscapes to adapt to global warming while simultaneously absorbing increased urban density.

Notably, this is not the first time a city has been subjected to (re)reading in the wake of crises and political shocks. In 1977, a manifesto by Ungers and colleagues introduced the concept of "green archipelago," the first theoretical model for a shrinking city, taking Berlin as a case study.[12] Likewise, a consultancy study of the Paris Region characterized Paris as "the porous city",[13] offering an analysis of its existing metropolitan complexities and future potentials. The study indicated that Paris would confront significant challenges which necessitated the projection and consideration of three development scenarios. One such scenario introduced a large landscape figure of wetland into the metropolitan area, "aiming at a composed ecological and recreational system starting from the 'dross' biotic system".[14] Similarly, a recent development scenario has projected an extensive metropolitan park to deal with future social-ecological challenges in HCM Metropolis.[15]

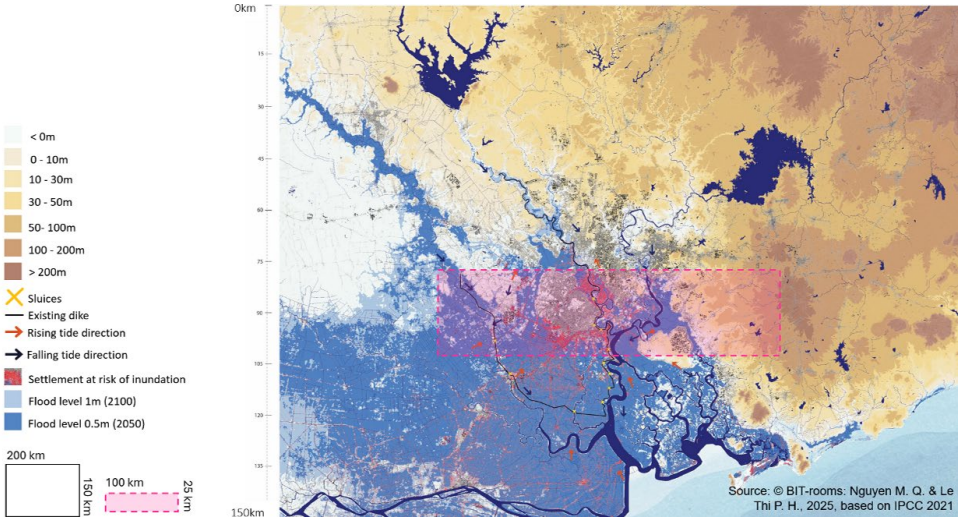

Figure 3. A regular scenario projects severe flooding between 2050 and 2100 due to rising sea levels and inland inundations.

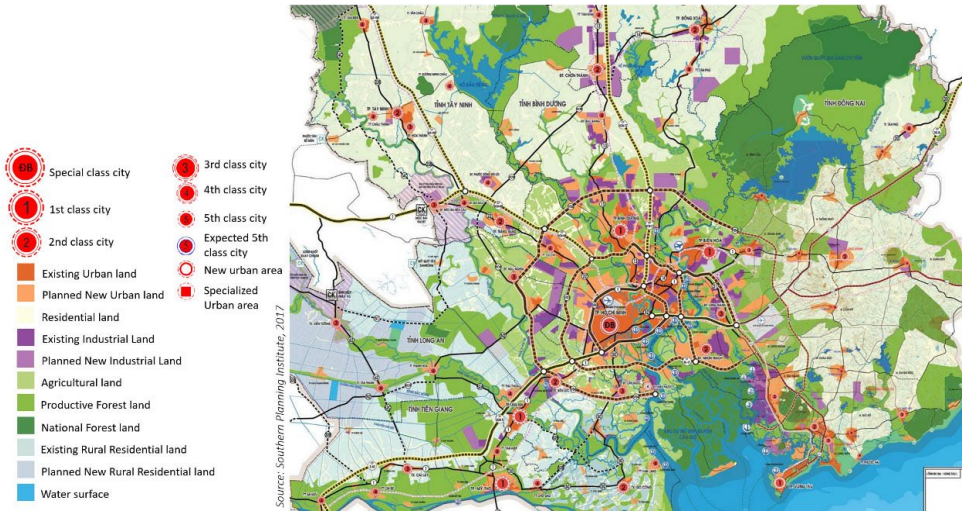

Figure 4. The regional planning of HCMC until 2030, a vision to 2050, with a forecasted population of 24-25 million people.

TOPOGRAPHY AND WATER AS THE TERRITORIAL STRUCTURAL BASE

Historically, the region was home to two villages named Prei Nokor ("cotton forest" or "a village in the forest") and Kas Krobei ("Bến Nghé" or "buffalo wharf").[16] Control of the region was disputed between the Chenla (Khmer government) and the Champa Kingdom from the 12th century. The Nguyen lords established administrative control and initiated urban development in the area after receiving it from the Khmer King in the mid-17th century.[17] The city was called Gia Dinh, later changed to Saigon and situated within the extensive tropical environment of the Saigon-Dong Nai River delta.[18] From the 19th century, under French colonization, the city became an urban trade and processing center. It expanded further to the west with the establishment of Cholon District as well as the expansion of water infrastructure, roads, and tree planting. The map "Environs De Saigon", published in 1946, clearly illustrates the topographical structure of the environment that the city has colonized (Figure 5). The elevated and dry areas were depicted in light yellow, resembling islands atop the vast lower lands, which were represented in light blue. Saigon and Cholon were developed on a large, elevated, and dry-centered island adjacent to the Saigon River. The smaller islands to the west were occupied by villages, some of which were resettled after being displaced by the Nguyen. These villages consisted of clustered settlement structures interspersed with gardens and are associated with productive landscapes in the delta, primarily featuring wet rice, lotus ponds, and water mimosa. The city and villages were connected by a mesh of rivers and canals combining with network grid boulevards. Tree planting has enhanced the areas along waterways, roads, boulevards, and public spaces, following the model of European cities.[19] Thus, the urbanism of Saigon is "an interplay between drastic water management (draining and diverting water to set aside dry land), road building (to create accessibility), and intense urban forestry (to generate a bearable micro-climate) operations."[20]

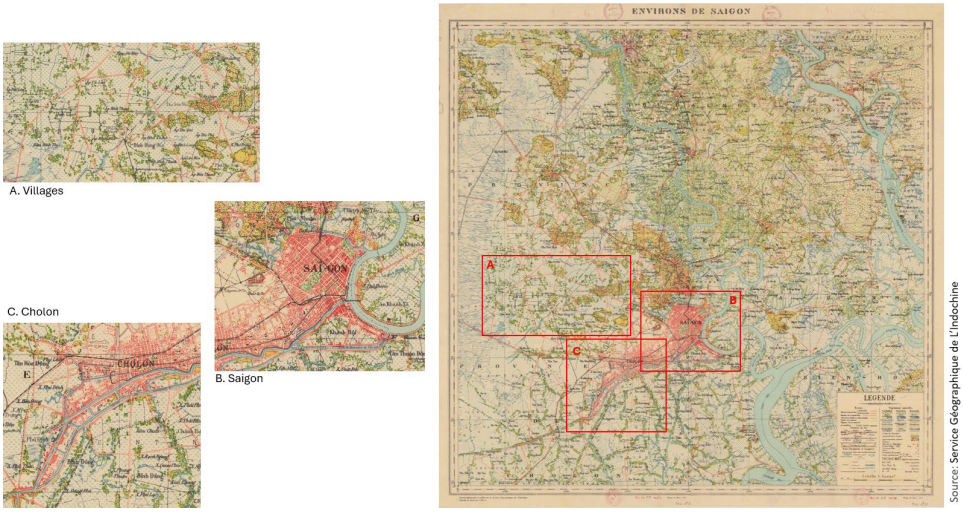

Figure 5. Extensive Blue & Green Environs of Saigon in 1946.

When further developing the same mapping approach employed by the French cartographers, while amplifying the topographical exaggeration, the implied structural power of the city's topography and water system can be elucidated, along with their "horizontal thrust," that has shaped the urban morphology in tandem with socio-economic forces. If viewed in a simplified manner, the territory of HCMC exhibits a stark contrast between high and low, as well as dry and wet terrain. The Vam Co River (a tributary of the Mekong), the Dong Nai River, and the Saigon River create a hinge that connects three primary "ecological floors":[21] the expansive Dong Nai Plateau (ranging from 5 to 120 meters above sea level); the mountains (ascending from 200 meters above sea level) in the east; and the Mekong Delta (below 5 meters above sea level) in the west (Figure 3). HCMC itself is situated on the mediating zone between the delta, the plateau, and the mountains, functioning as a hidden extension of the Mekong Delta,[22] which can be considered as a sub-ecological floor. Moreover, the territorial terrain can be interpreted as comprising at least five distinct watersheds (namely: Saigon, An Ha, Dong Nai, Vam Co Dong, and Vam Co Tay) (Figure 6). The water flows have shaped linear, alternating configurations of land and water landscapes toward the southeast. Intensive waterworks have been developed since the Nguyen and French eras, comprising a mesh of canals (perpendicular to the rivers), dikes, and sluices for transportation, irrigation, and the diversion of water from the creeks and rivers.[23] This initiative has established a comprehensive water system that specifically aids in regulating hydrological processes in the interests of the city's safety and prosperity. Two canals, Thay Cai–An Ha and Tham Luong, constructed in the early 20th century, can be considered as representing this feature. The Thay Cai–An Ha Canal spans approximately 30 km and serves as a diversion, redirecting water from the Saigon River to circumvent HCMC before linking to the Vam Co River, thus alleviating water pressure in the urban region. Turning to the Tham Luong Canal, with approximately 25 km in length, it formerly served as the limitation up to which the Saigon metropolitan region could expand without intruding onto the rural landscape. The canal links the Vam Thuat River, a tributary of the Saigon River, with the Tau Hu Canal, which facilitates drainage for the city, thereafter, traversing the Vam Co River before discharging into the East Sea.

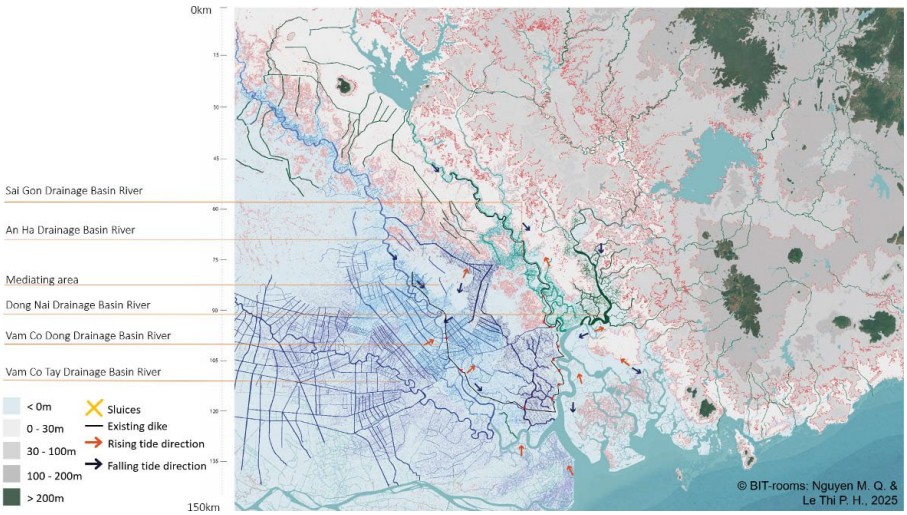

Figure 6. The extensive topographical and hydrological structures of the territory.

(RE)READING THE URBAN MORPHOLOGIES

As indicated, the territorial landscape structure has been shaped through the horizontal thrust of the water system. On top of this base structure, the morphological structure of settlements can be read and interpreted as influenced by, or in relation to, the area's topography and water landscapes, rather than depending on the logic of endless road-based urbanism. From the east to the west, the settlements can be (re)classified in terms of seven morphology types, according to the topographical structure of each ecological floor (Figure 7). On the Dong Nai Plateau, at an elevation below 30 meters (ASL), settlements are scattered along springs and reservoirs. These settlements are closely linked to productive agroforestry landscapes, which primarily consist of rubber plantations. Additionally, dense urban areas and towns, such as Ben Cat, Tan Uyen, Di An, and Bien Hoa, are developing alongside industrial parks, occupying the low slopes that range from 10 to 30 meters. At the edge of the plateau, the difference in elevation divides the space into two distinct areas. The first is where the settlement structure extends to the edge of the forested highland, creating continuous urban balconies that overlook the second area, the magnificent landscape and settlements of the Saigon–Dong Nai confluence basin, and the autonomous center of the HCM Metropolis. Similarly, another system of urban balconies can be identified at the edge of the Vam Co Dong River basin. Morphologically, these two systems of urban balconies are different in scale and typology, as well as density. The Dong Nai urban balconies consist of a grid configuration that combines industrial parks and dense residential buildings, while the Vam Co Dong balconies are mostly comprised of housing typologies. Lastly, in the Mekong Delta, small towns and cities are arranged in constellations, with linear settlement structures extending along the canals and rivers. Within this interpretation, at the territorial scale, the urban structure takes on the appearance of a linear system aligned with the five watersheds, rather than resembling the multipolar system previously depicted in the existing master plan of HCM City.

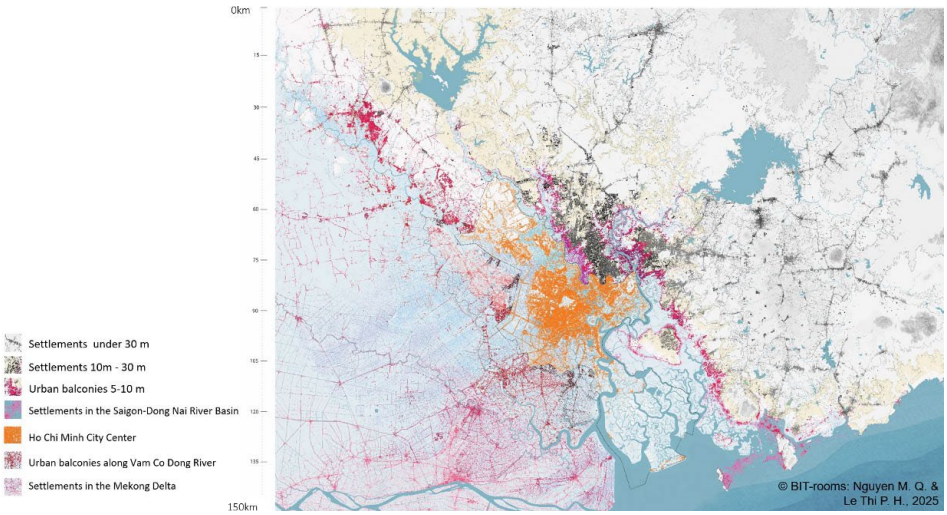

Figure 7. The seven settlement structures are defined by the topography and water system.

AN ASSEMBLAGE OF "MEGAFORMS"

When the urban morphologies are interpreted in relation to the structural force of topography and water, it is possible to read and analyze the implied structural logic of the settlement patterns as "megaforms". If a transect of 100 km is constructed through the three ecological floors, it clearly shows that the figure-ground configuration composes an archipelago structure connected by the five watersheds. Two centered islands that have been subsumed by the core of the Metropolis and the Tham Luong Canal basin serve as a hinge between two distinct water landscapes: one is more artificial, featuring dense grid networks of canals, while the other represents the natural root of the Dong Nai and Sai Gon rivers (Figure 8). The two islands, the city itself, and the stepping-stone public parks form a weak link between four gigantic ecosystems. These ecosystems comprise the Dong Nai forested plateau, the vibrant and productive wetlands of the Dong Nai–Saigon Confluence, the mangrove forest along the An Ha Canal, and the extensive agricultural fields of the Vam Co River Delta (Figure 9). Each of these ecosystems has a structural logic that depends on topography, soil, water system, and cultivation practices. Therefore, if these ecosystems are viewed as landscape figures, they can be seen to possess the characteristic of a megastructure that, together with topography and the water system, serves as a structural framework for the city.

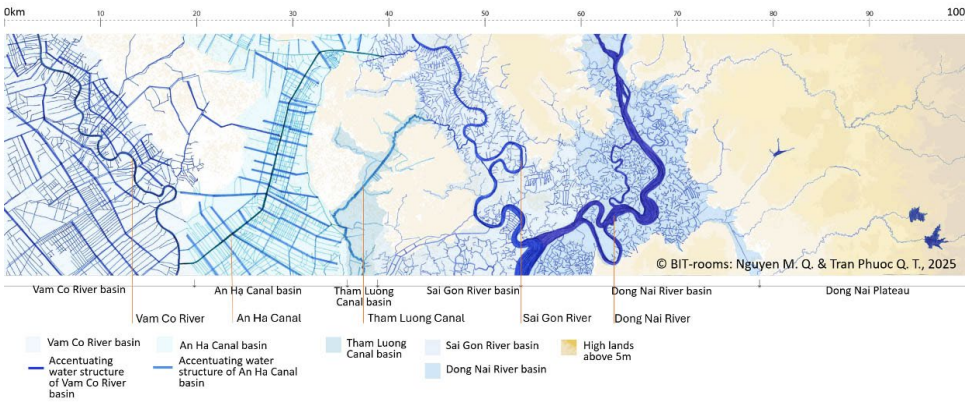

Figure 8. Watersheds as hinges.

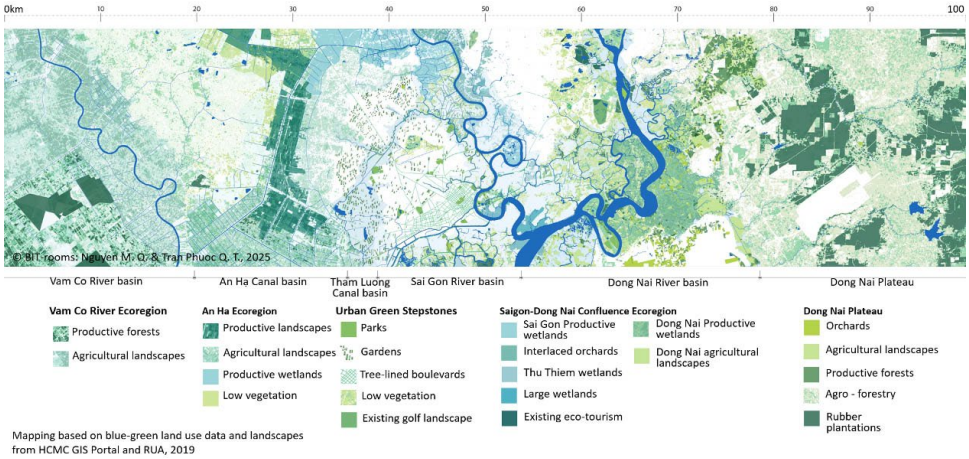

Figure 9. Diverse ecoregions create a blue-green megastructure.

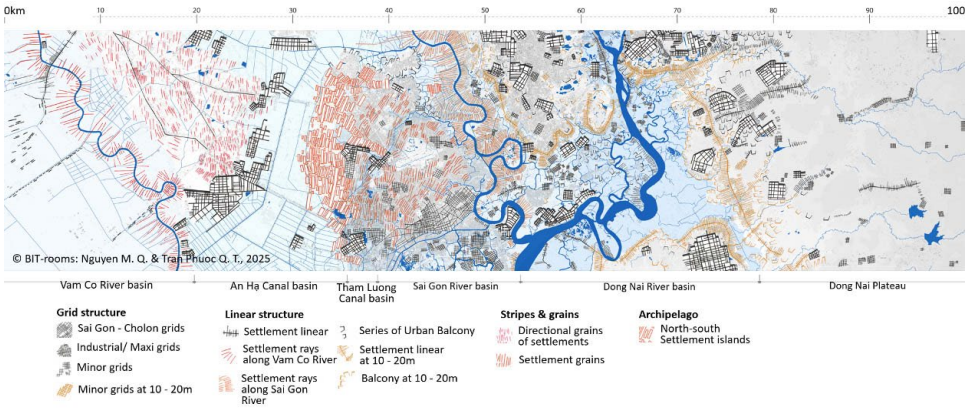

Figure 10. The representation of hidden urban structures.

Similarly, the complex settlement patterns in HCM City can be mapped and de-layered as geometric forms, serving as a foundation for rethinking the landscape framework. The intention of the mapping analysis is not to provide an interpretation of the entire urban fabric of HCM City, but rather to reveal hidden structural significance within it. The existing urban fabric is thereby rendered perceptible, not only in terms of built form, but as urban landscape (Figure 10).

The late 19th- and early 20th-century districts, which are called Saigon and Cholon, were initially constructed, following a plan by Betraux (1890), with a grid structure, imposing a low building density to guarantee sufficient space for public areas, gardens, and parks.[24] Today, although the density of construction has increased, the grid layout, several prominent public parks, and tree-lined boulevards persist largely unaltered. Inherently, Saigon and Cholon remain entrenched under the microclimate region established by tree canopies. Another notable structure is the industrial parks, which primarily exist as free-standing patches on the Dong Nai Plateau, while some, near the An Ha Canal, are extensively developed. These industrial parks generally follow a rectangular configuration, measuring 200 by 600 meters. The size of built-up areas varies, ranging from 64 hectares to 2,395 hectares. Currently, subsequent to the recent alteration of the administrative boundaries of HCMC, there exist roughly 27,000 hectares of industrial land.[25] Furthermore, the Ho Chi Minh City Export Processing and Industrial Zones Authority has announced plans to expand the industrial area to 49,000 hectares until 2050.[26] Paradoxically, the construction of infrastructure to facilitate industrial production is a protracted process, whereas (current) industries rapidly become outdated due to technological advancements. In many cases, the built infrastructure cannot accommodate emerging industries, leading

to the underutilization of many existing industrial parks. Simultaneously, many underutilized factories have benefited from a trend of reinvention, seeking to enhance land use in response to the post-industrial context.[27] Thus, drawing on the Saigon-Cholon precedent, it is possible to reconceptualize industrial infrastructure as a landscape framework that is capable of adapting flexibly to rapid industrialization.
Besides the landscape framework described above, a visible linear structure of settlements connects to rivers and national roads. Settlements are oriented perpendicular to rivers or roadways. As mentioned, along the edge of the plateau, settlements are formed as a series of urban balconies, exemplifying another sort of linear structure. Additionally, to the west of the Tham Luong canal, the villages continue to develop in a north-south archipelago structure. The spaces between these archipelagos may occasionally take the form of alleys, small gardens, or vacant lots, which could be enhanced to create a stronger system of green archipelagos. Lastly, within the remaining heavily urban fabric, interstitial spaces between buildings are depicted as grains or stripes that may potentially infiltrate landscapes. Hence, the urban landscapes of the HCM Metropolis are shown to be comprised of identifiable megaforms encompassing both built and non-built landscapes.

CONCLUSION: THE FIVE URBAN DESIGN STRATEGIES

The representation of the figure-ground configurations seeks to blur the boundaries between open landscapes and constructed environments. It marks an initial step in morphological analysis, although it avoids delving into the intricacies of socio-economic conditions. Nevertheless, this approach encourages urban design strategies to reconsider the metropolitan landscape framework in the following points:

1. By interpreting with the territorial topography and water system, the urban landscapes of the Metropolis represent a kind of linear and archipelago structure in contrast to the polycentric urban landscape depicted in the city's master plan. The intention to omit the road infrastructure system makes clear the approach to understanding settlement patterns as continuous with the landscape system. It establishes that the region's natural horizontal thrust (i.e., topography and water flows) has a significant impact on shaping the urban structure.
2. If so, it raises the concept of "landscape urbanism" or specifically "water and forest urbanism"[28] as an urban design strategy to project a development scenario where again water and (urban) forest landscapes may reemerge as two main features guiding the form of the future settlement. The city that includes a greater area of water and forest landscape will have a greater ability to absorb and contain floodwater, making it more adaptive to global warming, especially with projected floods in 2050 and 2100 which are in line with the government vision.[29]
3. Notably, there are still some obstacles hindering the rapid urbanization and industrialization of the Metropolis. This is evident in the underutilized industrial parks and the lands and spaces between buildings. The situation presents an opportunity to introduce a series of gardens, ponds, and parks as an infiltrative landscape system within the densely urban fabric. These additions would complement the existing stepping-stone public parks and tree-lined boulevards, bridging the two ecoregions (i.e., Dong Nai Plateau and Mekong Delta) and creating a vast landscape framework for the entire Metropolis.
4. Urban balconies at the edges of the Dong Nai Plateau and Vam Co Dong Delta (ranging from 5 to 10 m above sea level) can significantly absorb future urbanization because they are safe from floods and provide scenic views.
5. The road infrastructure unquestionably remains a pertinent part of the urban system. However, by deploying the conceptualization of the extensive landscape framework, it is possible to integrate the road infrastructure within that framework so as to utilize the landscape itself as infrastructure.

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REIMAGINING SPACE: THE POTENTIAL OF PUBLIC-PRIVATE TRANSITION SPACES AS A CONTRIBUTION TO LIVABILITY IN DENSE URBAN ENVIRONMENTS

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INTRODUCTION

Urban development and ideas of transformation in global cities raise important questions about how urban planning contributes to livable, socially and ecologically sustainable environments. The concept of livability is used by indexing systems such as the *Global Liveability Index* by the Economist Intelligence Unit offering a ranking of 173 cities worldwide primarily for economic purposes. Based on structural and institutional aspects these systems remain abstract in order to ensure comparability.[1] However, to achieve a contextual understanding of urban livability as experienced by inhabitants, it is essential to examine concrete urban settings and everyday spatial practices. In this context low-rise and high-density residential areas (LRHDRA) in western Tokyo represent a meaningful field of investigation due to their rapid urbanization and idiosyncratic character.

Away from the bustling and mighty skyline, the city's residential areas are quiet, village-like neighborhoods with different characters. In an interview, the Japanese architect Kisho Kurokawa describes: „I define Tokyo as being composed of 300 little towns."[2] With features such as small buildings and narrow streets in human-scale the various districts offer good living conditions and opportunities for social encounters. However, the high building density and resulting scarcity of space go along with a lack of green areas and buffer zones that could mediate between public and private realms. This absence not only reduces habitats for plants and animals - essential for environmental resilience and social well-being - but also encourages demarcation strategies aimed at protecting privacy. These strategies manifest in closed-off house facades or the placement of boundary objects, ultimately reinforcing tendencies towards social withdrawal and isolation.[3] That is why the Public-Private Transition Spaces (PPTS) play a crucial role in the connection to their surroundings. With their lively design they embody social and ecological potentials that make a city livable.

In this research, Public-Private Transition Spaces (PPTS) refers to the area between the façade of the building with the front door and the property boundary to the street. Therefore, the PPTS is a private area belonging to the building that is visible to the public. The term refers to Kim Dovey´s research about and definition of "Public Private Urban Interfaces". In his work he explains the urban interfaces as zones where "...the transition from public to private space is framed, formed, negotiated and governed."[4] While Dovey evocatively narrates the in-between space as a site of layered social and spatial meaning, his analytical focus remains primarily on the interface point and abstract boundary concepts. In contrast, this study extends the perspective and understands the transition not merely as a

conceptual line, but as a spatial realm, shaped by spatial practices. Relevant components of the PPTS are various existing boundary objects such as walls or fences, activity-promoting elements such as household or garden objects, tools, bicycles and cars, as well as green spaces and potted plants with ecological abilities.

In this way, the design and use of PPTS offer potential for the creation of vibrant, communal spaces that can contribute to the promotion of social cohesion and the improvement of local environmental conditions like heat and biodiversity in urban areas. This assumption raises the questions: *What types of public-private transition spaces (PPTS) can be identified in low-rise high-density residential areas (LRHDRA) in western Tokyo? How can their social and ecological qualities be analyzed and mapped in order to derive a contribution to urban livability?*

This paper highlights the significance of small, often overlooked spaces as social and ecological resources for livable cities, emphasizing the importance of people's participation in shaping them. Drawing on Henri Lefebvre's notion of spatial practice, it shows how residents' daily routines materialize in space through objects and plants, becoming inscribed in the built environment. By making these practices visible and spatially legible, the study provides a basis for assessing the qualitative contributions of these micro-scale spaces to urban livability.

THEORY | STATE OF THE ART

Livability has been defined as emerging from the dynamic relationship between community and environment.[5] Including economic dimensions broadens the concept towards overall quality of life. Southworth emphasizes the experiential quality of the built environment,[6] while Pacione links livability to people's actions and spatial perceptions. Classical authors such as Jacobs,[7] Appleyard,[8] and Gehl[9] underline everyday use, social interaction, and human scale, framing livability as a dynamic interplay between private and public realms. Building on this, Çalışkan and Şevik call for a better comprehension of urban form on a performative basis.[10] This perspective highlights the role of spatial form as a medium through which livability is enacted and supports the turn toward analyzing space as socially and ecologically active.

In Japan, previous studies have examined how residents appropriate street edges with objects and plants,[11] primarily focusing on social cohesion and the positive contribution to the built environment.[12] More recently, research has increasingly expanded from a sole focus on the built environment toward more integrated approaches that incorporate natural and ecological dimensions. In the case of Tehran, Alijani et al. demonstrated that increased vegetation improves livability due to the enhancement of the urban microclimate, such as air quality and especially temperature for thermal comfort.[13] Birtles et al. emphasize the role of small-scale spaces in delivering ecosystem services that support urban livability[14] and studies on container gardens have identified them as valuable components of green infrastructure regardless of size.[15] As such, ecological interventions at the micro scale enhance both the environmental and experiential qualities of urban space.

While the appropriation of public space and its social dimensions has been widely studied, the informal use of privately owned micro-zones remains largely overlooked. Likewise, the ecological value at the micro scale has received little scholarly attention. Furthermore, a systematic typology that links spatial form with everyday practices is still absent. This study addresses these gaps by focusing on micro-scale PPTS, proposing a novel framework layering typologies of spatial form and everyday practice - expressed through objects and plants - to enable a comprehensive assessment of their social and ecological contributions to urban livability.

METHODS AND CASE STUDY

To investigate how everyday practices shape the spatial, social and ecological qualities of urban environments, this study applies Henri Lefebvre's spatial triad[16], understanding space as a product of social processes. Based on this framework, types of spatial form representing *conceived space* (planned/formal configurations), and types of spatial practice including objects and plants representing *perceived space* (informal, lived adaptations) are developed and superimposed to reveal social and ecological performance at the micro level, ultimately leading to a typology of PPTS. By concentrating on the structure and composition of PPTS the study does not address their meaning and refrains from interpreting *lived space*, the third element of Lefebvre´s triad.

A mapping of the resulting types across a selected study area shows their spatial distribution. As can be seen from the map of Tokyo (fig. 1), many LRHDRA are located in the west, where most of the residential suburbs were built after the Second World War.

Figure 1. Map of Tokyo and Map of 3-chome Taishido (figure-ground)

The area of 3-chome Taishido, located in the popular and livable district of Setagaya, was chosen as a representative neighborhood due to its high residential density and well-connected location along the Den-en-toshi Line, which links suburban areas to the city center. The neighborhood is characterized by a heterogeneous urban fabric, including narrow pedestrian-only streets. Particularly striking in this dense setting are several small gardening fields, reflecting Setagaya's progressive and community-oriented character. The area is typically residential and borders a shopping street. Of the total of 584 buildings, 371 are detached houses and 187 are apartment buildings of various sizes.

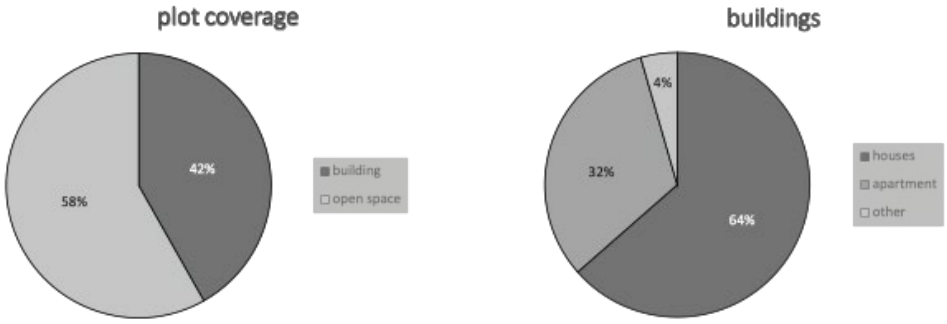


Figure 2. Description of 3-chome Taishido

The study focuses on PPTS of single-family houses, as the transition zones of apartment buildings are neither clearly private nor express a relevant spatial practice as a valuable contribution to their surroundings. In his study of dense residential areas, Naoki Saito also found that residential complexes do not feature any elements of activity and therefore do not contribute to a vibrant urban landscape.[17]

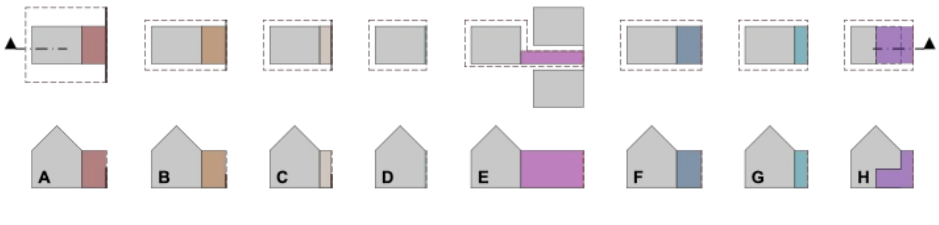
TYPOLOGY OF PUBLIC-PRIVATE TRANSITION SPACES

Types of Form (shape, setback, and permeability)

Based on on-site investigation, eight types of form of PPTS (fig. 3) were identified and categorized according to three key dimensions: shape, setback and permeability. These dimensions are crucial for understanding the potential uses of the spaces, the degree of social interaction, and the level of privacy maintained between private homes and the public street:

- **Shape** is determined by the layout of the plot and the footprint of the building. In most cases, the transition space appears as a linear strip along the façade, varying mainly in width. Exceptions occur when the transition space serves as an access path between two buildings (E) or when the transitional zone merges with the building volume (D, H).
- **Setback** refers to the distance between the building and the plot boundary or the public street. This is where the zone is created, which can be used in different ways and thus gains its vitality. The setback determines the size of the PPTS and thus has a significant influence on the usability of the resulting space.
- **Permeability** defines the visual and physical openness of the transition space by non-moveable boundary objects such as walls, fences, or hedges put by the people. This regulates the possibility of social exchange and simultaneously reflects the residents' individual needs regarding privacy and safety. Permeability ranges from fully open (no physical separation) to transparent, semi-transparent, or completely opaque barriers.

While shape is clearly controlled top-down by city planning, permeability is controlled by the residents in response to the surrounding. Setback is depending on both regulations and usage as well. Above all, a connection between the generation of the house and the TF of PPTS can be seen as a result of the rapid densification of the city, explained by Atelier Bow Wow.[18]



	A	B	C	D	E	F	G	H
VR	0	3	3	3	3	3	3	3
PC	0	1	1	3	3	3	3	3
TI	0	1	2	3	1	2	3	1
DoT	3	3	3	0	2	1	1	1
NfS	3	2	2	0	1	1	1	1
DoP	3	2	2	0	2	1	1	2

VR = visual relation, PC = physical connectivity, TI = transition intensity, DoT = degree of territoriality, NfS = need for safety, DoP = degree of privacy

Figure 3. Types of Form of PPTS and description of spatial articulation by author

Overall, the greatest variation among the observed types of form of PPTS lies in their permeability. While the spatial form typically is a narrow strip along the house, that alters in setback width the choice and design of boundary elements significantly influence how these spaces are perceived. In this way, residents subtly negotiate their relationship with the public realm, expressing openness or retreat through spatial articulation. The forms of PPTS therefore constitute the basis on which social and ecological practices take place, serving as a framework for diverse uses.

Types of Practice (daily items and plants)

As representatives of residents' activities, daily items and plants located within this framework bring the PPTS to life and define their social and ecological qualities, reflecting Lefebvre's view that space is shaped through everyday practice. Objects – such as postboxes, bicycles, goods for household or gardening and tools – as well as a variety of plants – from potted plants to bushes and trees – have been recorded on site. As mediators of activities, like maintenance or gardening, they enable social interaction. Jan Gehl highlighted the duration of stay as a key factor for spontaneous encounter when defining three types of social activities that occur in urban environments.[19]

Beyond their social role, the existing plants also possess an ecological performativity, primarily by contributing to microclimate regulation and biodiversity,[20] while other ecosystem services like water management or food production showed only low relevance in the city of Tokyo. Thus, activities linked to the duration of stay serve as indicators of social interaction, while plant quantity and species provide a measure **of** ecological performance. Based on these two dimensions seven types of spatial practice were identified (fig.4). When examining attributes other than social and ecological potentials, the typology of practice could also be adapted using other dimensions within the flexible typology of form.

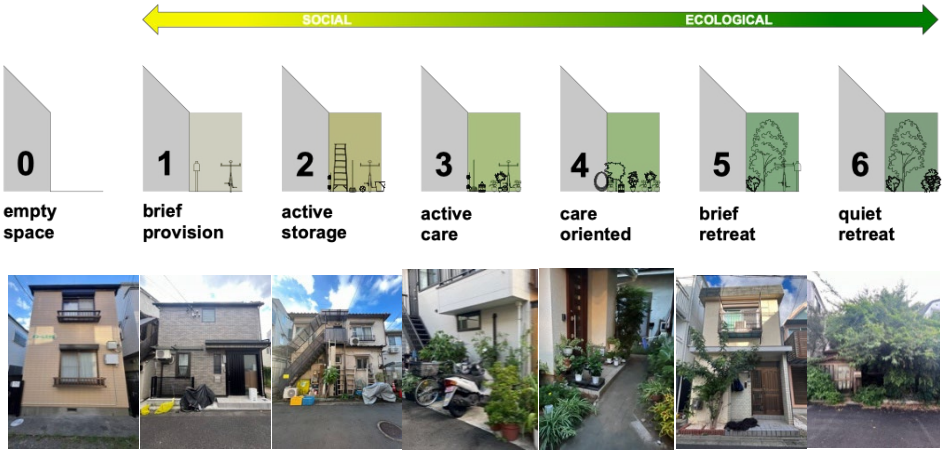


Figure 4. Types of Practice_graphic and pictures by author

Having defined the typologies of form and practice, the next step is to analyze how they manifest in the case study of 3-chome Taishido.

About 3-chome Taishido

The PPTS-diagram reveals that a large portion of the area is characterized by completely open PPTS, with no enclosing boundary elements. Type G - with a setback of up to 1.5 meters - is the most frequent, followed by Type C, which shares a similar layout but includes an open boundary element. In contrast, isolated spaces enclosed by high, impermeable borders (A) occur only rarely. This indicates that the need for privacy and safety is often already met by the building setback, whereas direct and abrupt transitions between private and public space (D) are not very common. Instead, the varying sizes of the resulting PPTS provide diverse conditions for spatial practices that are visible through the presence of objects and plants.

The practice diagram reveals a clear orientation towards necessity: approximately two-thirds of the space is defined by functional activities (1 + 5) or no activities at all (0), while only one-third is actively use-oriented with daily goods partly mixed with flower pots (2+3+4). The ecological value is in the middle range at around 40%. Part of the greenery consists of high-maintenance potted plants (4) that support social interaction. Other areas – featuring a mix of potted plants, shrubs, and trees (5), or

primarily shrubs and trees (6) – are more low-maintenance or serve as spaces of retreat. While these areas show higher ecological qualities, their level of social activity is relatively low.

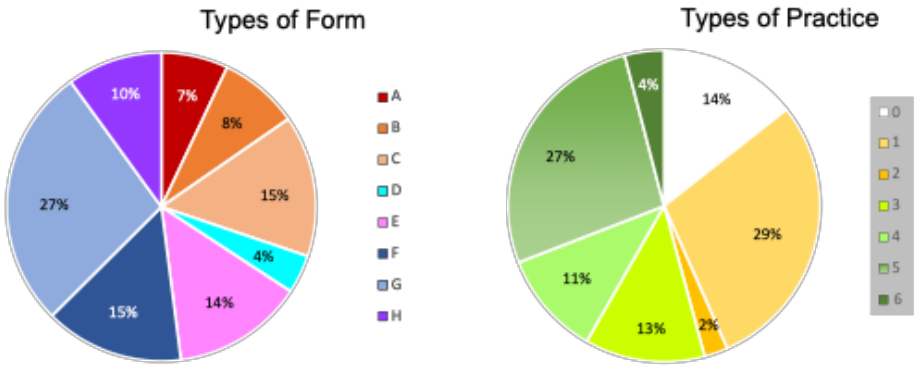


Figure 5. Distribution of Types of Form and Types of Practice by author

Public-Private Transition Spaces

Finally, the PPTS and their typology emerge from the interplay of the identified spatial forms and spatial practices demonstrating Lefebvre's theory. In the case of Taishido, 24 representative types of PPTS (fig. 6) were derived from 48 existing types by setting a threshold of at least five occurrences. This allowed recurring patterns to be identified and distinguished from individual cases.

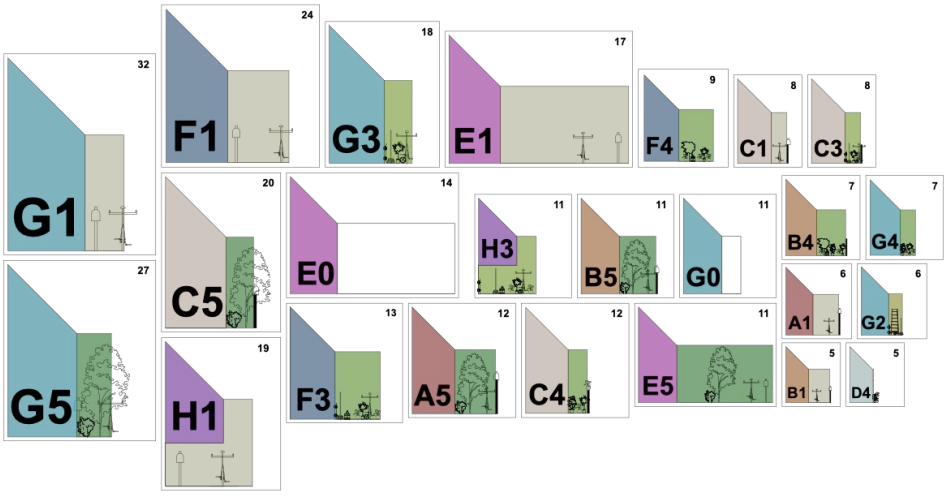


Figure 6. Amount of 24 representative PPTS 3-chome Taishido by author

The illustration of representative PPTS also visualizes the high number of open transition spaces without any borders carrying at least necessary activities with social and ecological value. Types G and C show the highest diversity in spatial practices. Types G and B are dominated by functional activities (1,5) followed by diverse socio-ecological practices (2,3,4). In contrast C, F and H present more balance between functional activities and socio-ecological practices. Type E is mostly empty or limited to necessary activities with low social value (0,1), while type A tends towards functional activities with ecological value and type D demonstrates good socio-ecological qualities.

These diverse combinations among types of form and types of practice indicate that neither form nor especially size is decisive for the use of PPTS, supporting the idea that form is serving as a frame allowing different practices.

Figure 7. Distribution of 24 representative PPTS in 3-chome Taishido by author

The distribution of types of PPTS in the area of 3-chome Taishido is illustrated by colored frames representing the types of form with colored fillings representing the types of practice.
The map shows a wide variety of well-mixed transitional spaces, providing a diverse and interesting environment to the residents. Clustering the various PPTS according to their components of form and practice is intended to make connections between the types as well as social and ecological distribution in the area visible.

Figure 8. Distribution of cluster groups in 3-chome Taishido by author

The individual form types are layered with practice types, which are divided into three categories according to their functional, socio-ecological and ecological behavior (015, 234, 456). Due to overly individual results with few connections, the grouping of individual practice types did not prove to be effective.

The low correlation between form type and practice type is also reflected in the clustering. Similarly, the predominance of functional activities is evident in the map. These activities are evenly spread across the area and occasionally complemented by a smaller number of ecologically oriented activities. A small socio-ecological cluster can be clearly identified in the central part of the area, characterized by houses with fewer residential buildings.

CONCLUSION

The paper highlights PPTS as significant modules for livability in LRHDRA in Tokyo. Based on Lefebvre's triad, a typology was developed to reveal social and ecological qualities, showing that PPTS emerge from interplay of spatial form (conceived space) and spatial practice (perceived space). It was found that form provides a flexible frame for objects and plants with social and ecological abilities.

The analysis of 3-chome Taishido confirms this presenting a variety of combinations of form types and practice types. Only through higher-level clustering of several types of practice, correlations in the distribution of social and ecological characteristics can be identified.

Further insights into PPTS abilities can be gained through detailed analysis of spatial practice in selected sections, like observation of people´s behaviors and ecological measurements such as temperatures and biodiversity.

This study was limited to one representative case. Comparing multiple cases would facilitate classification of cases and support assessment of larger urban areas. This combined typology is neither limited to 3-chome Taishido nor to specific abilities, but can be adapted to other contexts and attributes, offering a tool for targeted urban analysis.

By understanding PPTS as multi-layered and flexible spaces, the study demonstrates how they can meet different social needs and ecological requirements, contributing to livability in their immediate surroundings.

AKNOWLEDGEMENTS

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NOTES

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RETHINKING URBAN PERSPECTIVES THROUGH THE NEIGHBORHOOD PROXIMITY FRAMEWORK APPROACH

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INTRODUCTION

In urban contexts, sustainable regeneration processes are becoming increasingly central to addressing the challenges posed by the climate emergency, the energy transition, and the improvement of quality of life. These issues are of crucial importance and generate significant impacts, particularly at the neighborhood scale. The recent COVID-19 pandemic has highlighted the strategic value of the "small urban scale" as a vital microcosm for meeting the everyday needs of the population. However, these challenges go beyond environmental dimensions, as they intersect with social, cultural, and economic aspects, thereby requiring an interdisciplinary and integrated approach.[1]

Building on the recognition of neighborhoods as critical arenas for implementing sustainable and resilient urban strategies, this study introduces a methodological framework designed to operationalize these principles within planning practices. While global agendas provide overarching objectives, their effective translation into local action requires tools that are both context-sensitive and analytically robust. In this regard, the following section presents the conceptualization and development of a structured evaluation and monitoring tool that supports informed decision-making and fosters adaptive governance at the neighborhood scale.

This research proposes the development of an operational framework aimed at the evaluation and monitoring of design proposals during the planning phase. In a context where the ability to integrate global objectives into local planning processes represents a key challenge,[2] the formulation of an assessment structure aligned with international agendas is of strategic importance. Such a framework not only guides decision-making practices but also fosters virtuous cycles of institutional learning.[3]

Designed to be adaptable across diverse urban contexts, the framework evolved over the course of the research. Initially conceived at the urban scale, it was later recalibrated to focus on the neighborhood level and is now referred to as the *Neighborhood Proximity Framework*, from now called NPF. The NPF seeks to translate the principles of sustainability and resilience into actionable, measurable interventions at the local scale. Its purpose is to bridge the gap between global theoretical models and context-sensitive applications, with particular attention to the specificities of the Italian urban environment.

To ensure the effective implementation of the *NPF*, the research defines a structured roadmap that articulates the methodological process into distinct, sequential phases. This roadmap is conceived as a dynamic and adaptive tool that guides the transition from theoretical principles to practical design applications at the neighborhood scale.

STATE OF THE ART: CHALLENGES, CRITICALITIES AND RESEARCH PERSPECTIVE

Urban regeneration represents one of the most complex and indispensable challenges for promoting balanced and sustainable urban development. It is no longer understood merely as a physical transformation of the built environment, but as an integrated and multidimensional process, grounded in a strategic vision and operationalized through concrete actions aimed at ensuring a level of urban quality still lacking in many evolving cities.

A key interpretative lens for understanding the current meaning of urban regeneration is the integration of the principle of *sustainability*, conceived in its threefold dimension—environmental, economic, and socio-cultural.[4] However, as Evans and Jones[5] emphasize, the semantic plurality of the term *sustainability* often leads to practical ambiguities, with uneven emphasis on its various components depending on the interests and priorities of the actors involved. This issue had already been highlighted by Davies,[6] who warned against the instrumental use of the concept in support of specific political or economic agendas.

Another critical aspect concerns the adaptive capacity of urban systems in the face of change and unexpected crises, as dramatically demonstrated by the global impact of the COVID-19 pandemic. In this context, urban regeneration must promote forms of *urban resilience* capable of absorbing shocks and responding with flexibility and innovation.[7]

According to United Nations estimates,[8] today, cities host over 56% of the world's population a percentage projected to reach nearly 68% by 2050. They are at the center of complex dynamics related to climate change, demographic growth, social inequality, and the ecological transition. In this context, urban regeneration emerges not only as a response to the dysfunctions generated by the uncontrolled urbanization of the 20th century and the effects of post-industrial decline, but also as a strategic tool for promoting resilience and reinforcing local community cohesion.[9]

Focusing on the Italian context, data show that approximately 71% of the resident population lives in urban areas, particularly within metropolitan zones, medium-sized cities, and peri-urban poles.[10] This indicates a consolidated urbanization process which, despite developing with different intensities and features compared to other European countries, has led to the predominance of high-density settlements. Consequently, cities have become central to addressing key challenges related to environmental sustainability, social cohesion, and ecological transition.

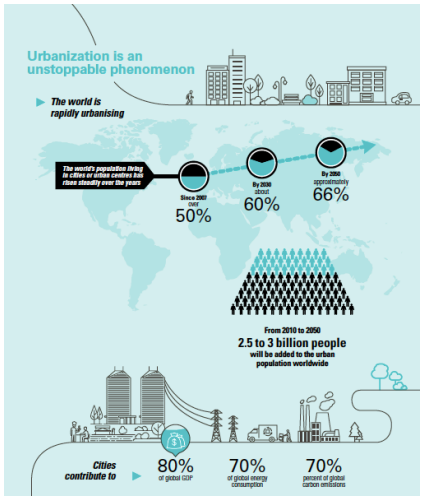

Figure 1. Urbanization phenomena. SDGs Syntesis report – 2018

Particularly critical are the areas referred to as the *Recent City* —urban expansions developed between the 1950s and 1970s in response to demographic growth, industrial development, and the functionalist

planning paradigm. This urban model, marked by strong functional compartmentalization, limited attention to public space quality, and a quantitative, rather than qualitative approach to urban planning,[11] has resulted in a built and infrastructural heritage with significant structural and social weaknesses. Among the most pressing issues are the absence of centrality, lack of proximity services, poor pedestrian and cycling accessibility, fragmentation of open spaces, and the progressive loss of local identity.

In recent years, urban regeneration, particularly in the most disadvantaged neighborhoods, has increasingly lost its centrality as a public policy driver, even within the European Union, which historically has played a leading role in welfare-related dimensions.[12] At the EU level, the effectiveness of urban regeneration policies has diminished within political discourse and the urban component of the Cohesion Policy, which had previously supported their implementation through the European Regional Development Fund (ERDF).

It is precisely in these contexts that the need arises for a regeneration model oriented toward *the quality of everyday living,*[13] capable of restoring meaning and functionality to the spaces of daily life. Cities are no longer merely places of residence; they are now the primary settings for individual and collective practices, hosting the majority of activities related to work, education, care, consumption, mobility, and leisure.

The urban landscape, and in particular public space, has become the true material and symbolic infrastructure of contemporary life. These are spaces that are crossed, inhabited, and perceived on a daily basis, and which play a fundamental role in social relationships, collective identity, and psycho-social *well-being.*[14]

The regeneration of the *Recent City*, therefore, cannot rely on sectoral, episodic, or merely aesthetic interventions. Rather, it demands a strategic and systemic vision capable of guiding public action through an integrated reading of spatial, social, economic, and cultural dynamics. In this framework, it becomes essential to construct a shared conceptual structure that clearly defines what is to be regenerated, with which tools, and according to what temporal priorities.

At the center of this approach lies the *quality of spaces uses* and the capacity of urban territories to respond proactively and adaptively to the challenges posed by contemporary transformations.

The following research want to contributes with a contemporary urban regeneration faces increasing challenges linked to sustainability, inclusion, and resilience, especially in the face of rapid urbanisation and climate change. Despite formal commitments of the cities to global frameworks such as the 2030 Agenda[15] and the New Urban Agenda,[16] many cities still struggle to translate these principles into effective local actions. There are significant methodological gaps in assessing the real impact of urban strategies and in integrating dimensions in a coherent way. This study aims to fill these gaps by providing an adaptive and evaluative framework capable of supporting proximity-based urban models and improving the quality of life in complex urban environments.

METHODOLOGICAL APPROACH

As previously outlined, the proposed methodology seeks to operationalize the concept of *urban proximity* through an evaluative and adaptive framework. The framework has also been renamed to better reflect its dimensional scope, and is now referred to as the *NPF*. Its structure is articulated through a roadmap that combines established methodological principles from the literature with empirical examples, interpreted through a systemic and adaptive lens in relation to the selected urban scale.

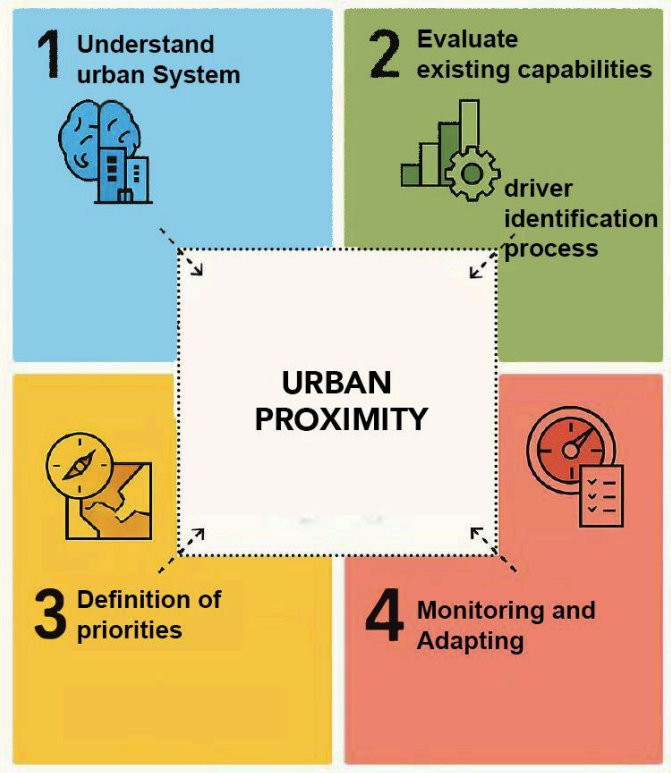

Figure 2. Roadmap. Draw by author

The methodology is rooted in a multi-scalar reference system. At the global level, it draws inspiration from the guiding principles of the *2030 Agenda for Sustainable Development* and the *New Urban Agenda*, both of which emphasize the integration of sustainability, inclusiveness, and resilience into urban policies and planning. At the national level, it takes as a case study the construction of the *Agenda Urbana Española,*[17] which represents an exemplary model of translating international principles into a coherent policy framework adapted to the specificities of a national context. Finally, at the operational level, the NPF builds also upon the adaptive logic of the *City Resilience Framework.*[18] These references provide both a conceptual foundation and a methodological orientation, enabling the proposed framework to combine strategic vision with operational applicability:

1| The first stage of the NPF involves a systemic analysis of the urban context, conceptualized as both a vertical system (institutional functions, infrastructure, population) and a horizontal network (spatially distributed, polycentric, and relational). This approach goes beyond simple socio-economic or morphological data collection, offering a dynamic reading of the city as an interconnected system of spaces, functions, relations, and local identities. The aim is to identify deficits of proximity and inequalities in access to services, sustainable mobility, and quality public spaces.

2| The second stage identifies *local drivers of proximity*—coherent sets of factors capable of activating, supporting, or amplifying improvements in the urban environment. In contrast to traditional sectoral assessments, the NPF adopts a cross-cutting and multifunctional perspective, recognizing the interdependencies across the urban system. Each action is connected to proximity indicators selected according to measurability, relevance, and replicability. This ensures a more efficient allocation of resources and promotes adaptive mechanisms crucial for long-term success.

3| Based on the preceding analyses, the framework develops a strategic matrix of actions differentiated by short-, medium-, and long-term horizons. Prioritization is not determined solely by functional or thematic criteria but also by the transformative capacity of interventions—that is, their potential to

enhance quality of life, well-being, and territorial *equity.*[19] Each intervention is linked to synthetic indicators, which in turn feed into a continuous monitoring system to ensure alignment between objectives, processes, and outcomes.

4| The final stage of the NPF is a monitoring process designed to be continuous and adaptive, encompassing ex-ante, ongoing, and ex-post evaluations. This cyclical approach enables strategic learning and adjustment, rather than merely certifying results. A set of dynamic and updatable metrics ensures coherence with international sustainability agendas.

The Adaptive Structure of the NPF

The adaptive nature and versatility of the *NPF* become particularly evident when applied to diverse urban contexts. The model is grounded in the premise that every urban reality is unique, characterized by distinct socio-spatial dynamics, infrastructural conditions, and community needs. Consequently, regeneration strategies cannot be based on rigid, one-size-fits-all solutions, but must instead rely on adaptive mechanisms capable of responding to local specificities.

This holistic approach is conceived as both an analytical and operational tool, capable of translating the conceptual complexity of urban proximity into observable and measurable elements. The effectiveness of such an assessment framework lies in its ability to clearly articulate not only *what* is being measured, but also *how* this measurement is structured and justified. In this regard, two guiding questions are central to clarifying the intended role of urban proximity in everyday life: (1) how proximity can concretely enhance accessibility, equity, and quality of life? and (2) how urban systems can operationalize these principles through measurable and adaptive interventions?

The strength of the NPF lies precisely in its capacity to integrate universal sustainability and resilience principles with the differentiated requirements of individual neighborhoods. This adaptability allows the framework to serve both as a conceptual guide and as an operational tool, ensuring relevance across diverse urban contexts.

In practical terms, the framework is progressively structured by selecting and combining key elements essential to the evaluation process. These elements are organized into an incremental sequence that reflects the logical construction of the methodology from chose until measurement mecanism: *dimension*, *system of drivers, themes, objectives, and tactics* (fig.3).

The following section illustrates this progressive construction, highlighting how each selected component contributes to the overall coherence and effectiveness of the NPF. In this way, the framework demonstrates not only methodological robustness, but also operational flexibility, positioning itself as a scalable and replicable tool for guiding context-sensitive urban regeneration processes.

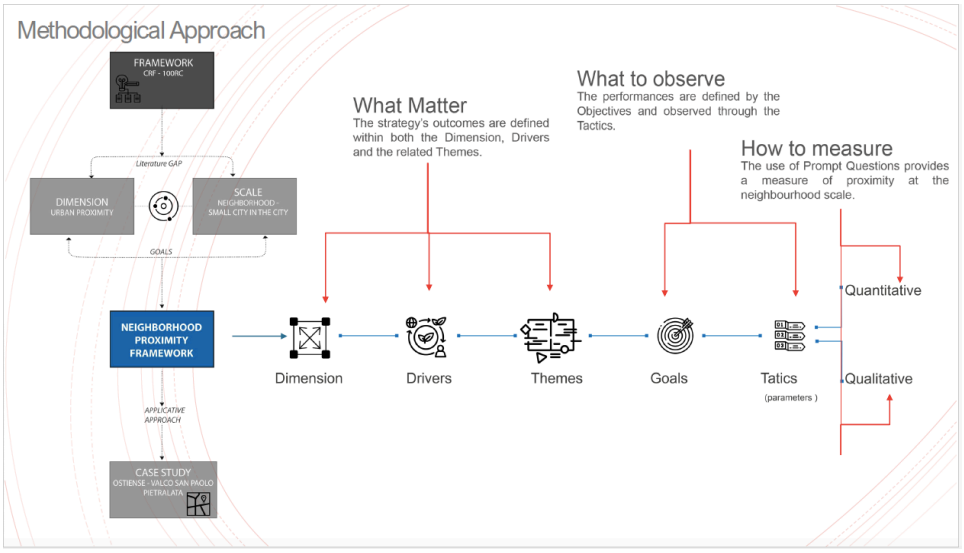

Figure 3. Neighborhood Proximity Framework (NPF) -Methodological approach. Draw by author

A tool that is proposed for introduction during the preliminary phase of project consultation is also intended to be validated by the public administration before its effective application.

The starting point of the NPF is the dimension of proximity, understood as a guiding principle for the *quality of dwelling* and the organization of neighborhood-scale services. This dimension is articulated around two fundamental drivers: *Good Dwelling,*[20] which emphasizes quality and urban spaces uses, well-being, and social inclusion, and *Integrated Governance*, which highlights the importance of participatory and coordinated decision-making processes involving multiple institutional levels and local actors. Together, these two macro-themes form the methodological foundation upon which the framework develops and adapts to diverse urban contexts.

Building on this foundation, the structure of the NPF expands through the identification of several micro-themes, selected for their relevance to both research and design practice. Among them are accessibility and mobility, ecosystems, public spaces, natural resources, and energy (fig.4). The inclusion of these thematic areas reflects the need to address in an integrated way the factors that shape urban quality. At the same time, the flexibility of the framework allows these themes to be adapted or expanded according to local specificities, thereby reinforcing its adaptive nature.

Each micro-theme is further specified through a series of objectives that guide both evaluation and design. General objectives are broken down into specific objectives, which are then articulated into macro- and micro-objectives. This layered structure ensures a level of detail capable of precisely orienting the actions to be undertaken. Importantly, this process is not purely descriptive: it is intended to build a reference system that links each objective to measurable indicators, thus enabling comparability and replicability across different contexts.

Alongside objectives, the framework introduces the concept of *tactics* (fig.3), conceived as operational tools that support the evaluation process. Tactics play a dual role: on the one hand, they provide a means to measure the performance level of a project, offering a clear understanding of its alignment with the principles of urban proximity; on the other, they function as a repertoire of suggestions and guidelines to improve projects where shortcomings are detected. In this sense, tactics are not limited to recording deficiencies but also propose potential solutions, thereby fostering continuous learning and incremental adaptation.

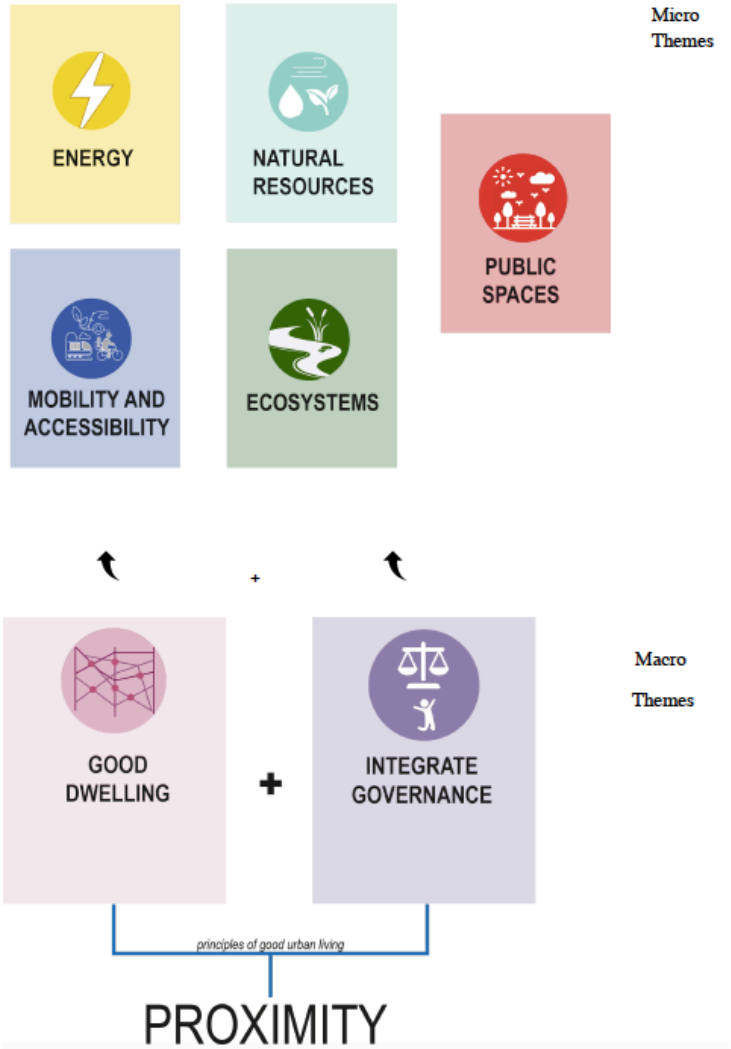

Figure 4. Neighborhood Proximity Framework (NPF) - structure. Draw by author

The overall functioning of the NPF rests on the principle that a project can be deemed satisfactory when it achieves a predetermined share of objectives within a defined range. If this threshold is not met, the framework activates tactics that serve as corrective instruments, strengthening the project and addressing the identified shortcomings. In this perspective, the NPF operates not merely as an evaluative mechanism, but as a dynamic and generative framework, capable of stimulating continuous improvements in design processes and fostering a culture of proximity. By means of this integrated evaluation system, it becomes possible to identify, monitor, and refine strategies that are not only effective in operational terms but also transformative strategies that enhance quality of life and reinforce the overall resilience of the urban environment.

CONCLUSION AND FUTURE PERSPECTIVES

The NPF approach as an adaptive and integrated methodology to support urban regeneration strategies grounded in the principle of proximity, is designed to translate the conceptual complexity of proximity into measurable and operational components, enabling the monitoring and refinement of strategies aimed at enhancing quality of life and strengthening urban resilience.

But how can the experimentation of the framework be assessed in order to attribute concrete values to urban projects? The evaluation models for the NPF operates through the definition of minimum performance thresholds (e.g., a required percentage of objectives achieved). Only projects that surpass

this threshold are considered "satisfactory," while those that fall below it are directed toward corrective tactics and improvements. This is made possible using a digital platform currently under development, designed to enable the interactive validation of individual projects.

The NPF Platform: Functioning and Expected Outcomes

To operationalize the proposed methodology, a dedicated digital platform has been developed to support the interactive validation of urban projects against the principles of the *NPF*. The platform is designed both as an analytical tool, capable of measuring the alignment of a masterplan with the criteria of urban proximity, and as an operational guide, providing targeted recommendations for project improvement.

At its core, the platform assesses projects through the lens of proximity. The framework is organized around four pre-defined thematic areas (fig.4) each articulated into a set of observable parameters.

During the evaluation process, users assign one of four options to each parameter: *Not Applicable (N/A)*, *No*, *Partial*, or *Yes*. The overall performance score updates in real time as selections are made, generating a global compliance index expressed as a percentage. This score is complemented by an automatically generated list of improvement actions, the taticts grouped by theme and linked to the parameters where compliance is lacking.

The scoring model is based on a normalized scale (0 for *No*, 0.6 for *Partial*, and 1 for *Yes*), with the overall index calculated as the average of applicable parameters. Thresholds are predefined for interpretability: projects scoring above 80% are considered well aligned, those between 50–79% partially aligned, while projects below 50% require significant redesign. This explicit and transparent system ensures that evaluation outcomes are both reproducible and comparable across different cases.

The platform's outputs include:

- a percentage-based global index visualized through interactive charts,
- a structured "*What to improve*" section listing targeted recommendations,

At the same time, its adaptability allows the catalog of tatics and actions to be expanded or refined according to local regulations, project contexts, or emerging sustainability goals.

Nevertheless, the current version also presents some limitations: parameters are equally weighted, which simplifies comparability but may not fully capture priority hierarchies—future versions could incorporate weighted systems. Some limitations must be acknowledged: the outcomes are influenced by context-specific conditions, making adaptations necessary before applying the model in different urban settings. Finally, while input is currently based on manual selection, advanced integrations with GIS and transport models could automate the measurement of distances, travel times, or environmental indicators, enhancing precision and scalability.

Overall, the NPF platform provides an innovative and practical means of applying the proposed methodology. By combining quantitative assessment with qualitative guidance, it supports administrations, practitioners, and communities in designing projects that are not only compliant with sustainability and resilience principles, but also more inclusive, adaptive, and responsive to the everyday needs of urban life.

Looking ahead, the proposed methodology will be applied to the city of Rome, *15-Minute City* programme[21] with a focus on neighborhoods where proximity-based projects are already underway two masterplan with different elements and thematic to solve. This application will also provide the opportunity to test the operational effectiveness of the framework, refining its capacity to guide inclusive, resilient, and sustainability-aligned urban strategies.

In conclusion, the NPF represents a step forward in operationalizing the concept of proximity in urban regeneration, offering both a theoretical contribution and practical guidance. While refinements and

further applications are needed, its adaptive nature and integrated structure position it as a valuable tool for advancing more inclusive, resilient, and sustainable urban futures.

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AGRICULTURAL LANDSCAPES WITH CAFÉS AND RESTAURANTS: A CASE OF THAI ORCHARDS IN SUBURBAN AREAS

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INTRODUCTION

Bangkok and Nonthaburi are situated on the once fertile alluvial plain, serving as a place for settlement and cultivation for over 500 years. The unique agricultural landscape, a so-called orchard, employs a ditch and berm structure (similar to ridge-furrow planting) and supports mixed crop cultivation, renowned for its diverse fruit products. During the past 40-50 years, urban areas expanded and changed in the way of life, causing these orchards to gradually disappear. The surroundings of the existing orchards have become urbanised with more streets, shops, and residential areas. Some of the owners have taken the challenge of maintaining their inherited orchards and seeking opportunities in the suburban locations by establishing cafés and restaurants. The paper aims to investigate cafés and restaurants situated in the orchards through detailed observation of three sites and analysis from the view of landscape architecture with a livable city approach. The results show that the value of the new business is to bring a lively atmosphere to the place, help generate income, and promote their orchard heritage. People can have access to places for leisure activities that are not far from the city. They can also appreciate the nature as well as the cultural heritage of the orchard. These orchards provide the city with green spaces, food sources, cultural landscapes, and ecological benefits. These examples indicate the coexistence of traditional orchards in modern suburban areas and the benefits of agricultural landscapes to the city.

Agricultural landscapes are a testimony to humanity's long interaction with the land, often unique examples of people and nature coexisting and influencing each other. They demonstrate a rich cultural and landscape diversity, sustainable land-use systems and in some cases people's daily struggle for survival under extreme climatic and environmental conditions.[1] There are several kind of agricultural landscapes in Thailand owing to their settings. The lower Chao Phraya basin area in the central part of the country is a young delta formed by various rivers. The area along the Chao Phraya River has been an important settlement and agricultural area since the middle Ayutthaya period (AD 1448-1688) dues to the fertile soil and the waterways scattered throughout the area. This makes the area a place for community settlement along the river and a place for growing many kinds of delicious fruits.[2] The agricultural landscape character, a so-called orchard, employs a ditch and berm structure and supports mixed crop planting. The orchard structure is similar to ridge-furrow planting, with the raised plant beds and ditches that utilise the environments with many interconnected waterways including water level

control from the influence of sea tides.[3] This agricultural landscape has been typical scene of the area for many years.

However, the inevitably changing in way of life, land use, and ecological system along with the economic recession, have caused the disappearance of some orchards. The area on the eastern bank of the Chao Phraya River has changed into an urban community causing almost all the orchards disappearance while the western side still has a lot of orchard areas.[4] Among the existing orchards, some of the owners have taken the challenge of maintaining their inherited orchards and seeking opportunities in the suburban locations by establishing cafés and restaurants. Therefore, the objective of this paper is to investigate cafés and restaurants situated in the orchards through detailed observation of three sites and analysis from the view of landscape architecture with a livable city approach. Aiming to find the relation between the agricultural landscape, people, and the city in this specific context.

METHODOLOGY

The paper aims to investigate cafés and restaurants in the orchards for the extended function of agricultural landscapes in the suburban areas. The fieldwork sites are selected by searching for information on cafés and restaurants in Bangkok and Nonthaburi Province that advertise on social media using the atmosphere of the orchard as a promotional material, which shows the continuity of the business as well as the intention of maintaining the orchard.

The three selected sites are located in Thonburi (Bangkok), Bang Yai (Nonthaburi), and Bang Kruai (Nonthaburi), which is consistent with the study of Jindamaneerojana, who found that during the Ayutthaya period, there were famous agricultural settlements, namely the orchards in the area of Bangkok, Thonburi, Bang Yai, and Bang Kruai, which have now begun to disappear.[5] These sites are also located not far from the urban areas of modern Bangkok and Nonthaburi, which enables the analysis of spatial and function associations with urban and suburban contexts.

After observing in detail the space and function of cafés and restaurants and the conditions of the orchards, data collected is then analysed with the view of landscape architecture consisting of users, activities, location, surroundings, access, planning and zoning, circulations, buildings and structures, open spaces, plants, and landscape elements. In terms of a livable city approach, the analysis focuses on the benefits of these café and restaurant orchards to the owners, visitors, and the cities.

AGRICULTURAL LANDSCAPE OF THAI ORCHARD

Agricultural landscapes play an important role in human life and well-being. It is described in terms of the three elements: (i) structure – the interaction between environmental features, land use patterns and man-made objects; (ii) functions – the provision of landscape functions for farmers and for society (environmental services); and (iii) value – concerning the value the society places on agricultural landscape and the costs of maintaining and enhancing landscape provisions by agriculture.[6] Human cultural development is inexorably linked to the development of agriculture, because it is essentially the cultivation of nature, of the physical environment, which has historically shaped and engendered present-day landscapes.[7]

The western part of Bangkok (Thonburi) including Nonthaburi, Nakhon Pathom, Samut Sakhon, and Samut Songkhram Province, located on the alluvial plains of the Gulf of Thailand, consists of the Chao Phraya River, Tha Chin River, and Mae Klong River. It is fertile land with alluvial soil from the young delta. There are many canals and waterways connecting throughout the area. There is evidence of settlement and cultivation since the Ayutthaya period (AD 1350-1767) and it continues to the present day. The area has been adjusted to allow for better cultivation in line with the environment, becoming a unique landscape character called Suan (orchard) Yok (ridge or berm) Rong (furrow or ditch). Songsiri indicates that fruit farming requires accumulated wisdom in observing the various plant species that are

suitable for the ebb and flow of the tides. And rely on a brackish and freshwater ecosystem that must be in balance to allow plants to obtain fertilizer from natural sediments and brackish water pushed in from the sea. This is a natural ecosystem that people have been able to adapt to and utilise for their daily lives.[8]

Physical characteristics of the orchards are; one side is usually adjacent to a canal, ditches were dug and soil was used to fill berms to raise the planting area and prevent saltwater from seeping up from underground, pipes are installed to connect the ditches to the canal outside to bring water into the orchard or drain water out of the orchard. Around the orchard there are berms (a narrow raised area) that help prevent flooding. In terms of cultivation, a variety of crops is cultivated in mixed combination with different heights and types such as fruit trees, herbaceous plant, vegetable; for example, banana, jackfruit, mango, durian, pomelo, tangerine, areca palm, coconut, rose apple, betel, lime, cotton fruit, etc.[9] Some orchards raise fish in the ditches, which can be consumed by the family or sold as an additional source of income.[10]

Later on, due to various factors such as the expansion of urban areas, land use changes, changing agricultural patterns, dam construction, sandbar dredging, and irrigation policy, causing these original orchards to deteriorate and gradually disappear.[11] This phenomenon is generally happening as World Heritage Centre states that these landscapes of outstanding consistency and vigour face numerous threats: these include the loss of specialized labour associated with a specific crop but also when changes in lifestyle brought on.[12]

AGRICULTURAL LANDSCAPE AND LIVABLE CITY

Agricultural landscape is inevitably related to the place where people live as World Heritage Centre states that in addition to the necessary infrastructure to sustain the lands, the implementation of any agricultural production system required a connection to the dwellings of the population that ensured its subsistence.[13] Agricultural activities within city limits have existed since the first urban populations were established thousands years ago.[14]

A livable city or community is commonly recognized as a place with qualities that are suitable or good for human life.[15] Economic Intelligence Unit (EIU) conducts the Global Liveability Index every year. The main five categories comprise of stability, healthcare, culture and environment, education, and infrastructure.[16] These are the categories under which each city is judged and given a final score on their liveability index. In terms of culture and environment, it includes availability of cultural amenities such as museums, theaters, and restaurants, as well as environmental factors such as pollution levels, green spaces, and access to nature.[17] Therefore, agricultural landscape can play significant role to enhance the liveability of city.

Many researches and studies indicate the benefits of agricultural landscape to the city. For example, there are direct benefits to produce food locally which can contribute to improve nutritional status, food security, and income. Indirect economic benefits include waste-management, use of under-used resources, economic diversity/stability, changes in economic value of the land, and possible multiplier effects (business attracted by urban agriculture, such as input services or restaurants).[18] Urban agriculture or productive urban landscapes ensure adequate provision of green and open spaces for the sake of the well-being of the citizens, emphasizing the concept of livable cities.[19] As human beings yearn for nature, cities need to be green. More and more cities take livable cities as the development model and integrate the productive agricultural landscape into cities, which reflects the harmonious relationship between human and nature and is a sustainable model.[20]

There is a need to incorporate both urban agriculture and civil society organisations in creating livable cities.[21] Urban livability is focused on basic goods and services and experiences essential for human life. This is including food access and clean environment. Urban livability is enhanced by strong

connections to nature, through parks, vistas, street trees, proximity to natural areas.[22] The introduction of productive agricultural landscape, especially in urban residential areas, making people feel that they are a part of nature.[23] Agriculture needs to be considered an integral part of making cities sustainable.[24] In conclusion, the existence of agricultural landscape in the city can contribute to its liveability.

FINDINGS

Site 1: the Orchard Café and Restaurant in Thonburi, Bangkok

The site is located in suburban areas (Figure 1) which is accessible by private vehicle. There is a parking available in the front. The total area is approximately 4,570 square metres (Figure 2). A tropical architectural style restaurant building is located in front with decorated outdoor spaces including outdoor dining area. In addition, there is a separated small café with outdoor seating spaces. The café is situated along the canal allowing visitors to enjoy the waterfront open view. There is a gravel walkway connected the restaurant and the café.

Figure 1. Suburban areas around Site 1 (revised from https://www.google.co.th/maps)

Visitors include both Thais and foreigners, mostly adults or young adults, who come as couples or groups, as well as Thai families with members of various ages. There are activities that involve eating, drinking, socialising, chatting, relaxing, visiting the orchard, walking around the area, taking photos, and purchasing orchard products. The learning classes and workshops in traditional orchards are available for interested groups, such as schools, to visit.

Figure 2. Site 1 (revised from https://www.google.co.th/maps)

The area around the café and restaurant was adjusted to serve new functions. However, the original orchard conditions are well-preserved and still produce a good crop. Those interested can walk in and appreciate the orchard. The berm is accessible for walking. There is a stepping walkway to accommodate visitors (Figure 3).

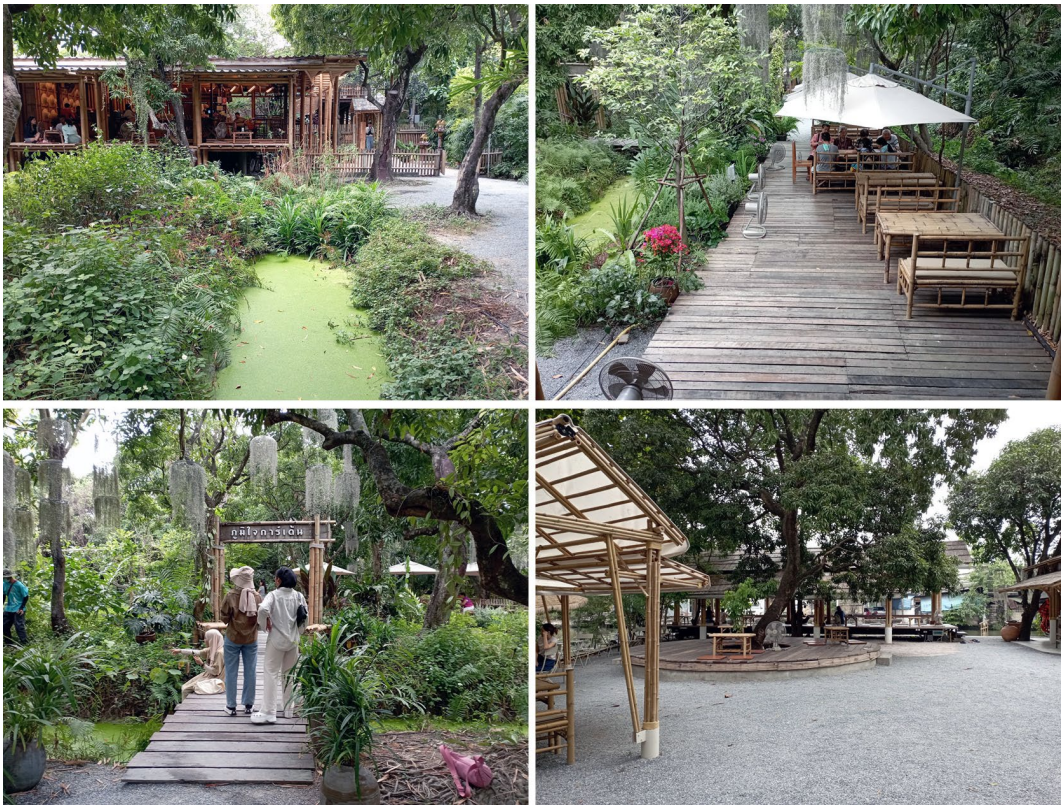

Figure 3. Tropical architectural style café and restaurant with outdoor spaces

Site 2: the Orchard Café and Restaurant in Bang Kruai, Nonthaburi

The site is located in suburban areas (Figure 4) which is accessible by private vehicle. There is a parking available outside. Visitors have to walk approximately 140 metres from the parking to the site. The total area is approximately 4,047 square metres (Figure 5). There is a café and restaurant in front with decorated outdoor spaces. The building has a contemporary architectural style with air-conditioned and glass windows that allows visitors to observe the orchard through the windows. There are also outdoor seating spaces.

Figure 4. Suburban areas around Site 2 (revised from https://www.google.co.th/maps)

Figure 5. Site 2 (revised from https://www.google.co.th/maps)

Visitors are Thais, mostly adults or young adults, who come alone as well as couples or groups. There are activities that involve eating, drinking, socialising, chatting, relaxing, working (the café provides co-working space), visiting the orchard, walking around the area, taking photos, and purchasing orchard products.

The original orchard conditions are well-preserved and still produce a good crop. Those interested can walk in and appreciate the orchard. The berm is accessible for walking but there is no walkway to accommodate visitors (Figure 6).

Figure 6. Contemporary architectural style café and orchard space

Site 3: the Orchard Café and Restaurant in Bang Yai, Nonthaburi

The site is located in suburban areas (Figure 7) which is accessible by private vehicle. There is a parking available along the road in front of the entrance. The total area is approximately 3,404 square metres (Figure 8). The original 2-storied house was renovated to include a kitchen and a small office on the ground floor, while the upper floor accommodates the caretaker's residence. The café and restaurant area is simply decorated, with a convenient walkway, pavilions and dining seats in a contemporary rural architectural style. From the dining seats, visitors can see the orchard area.

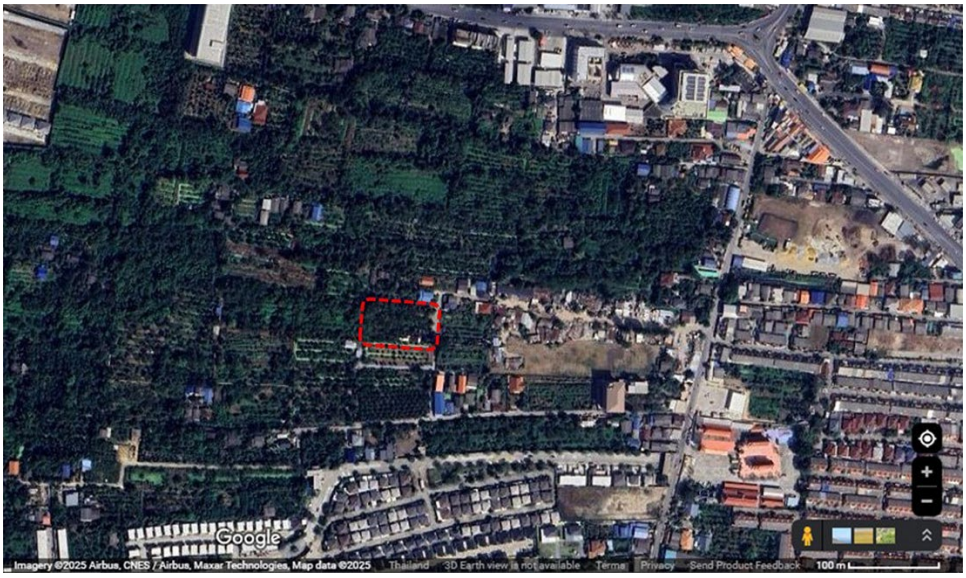

Figure 7. Suburban areas around Site 3 (revised from https://www.google.co.th/maps)

Figure 8. Site 3 (revised from https://www.google.co.th/maps)

Visitors are Thais, mostly adults or young adults, who come as couples or groups including families with members of various ages. There are activities that involve eating, drinking, socialising, chatting, relaxing, visiting the orchard, walking around the area, taking photos, and purchasing seedlings or juvenile fruit trees. The learning class of traditional orchards and fruit tree propagation is available for interested groups, such as schools, to visit.

The original orchard conditions are well-preserved and still produce a good crop, especially the famous Nonthaburi durian. Those interested can walk in and appreciate the orchard. The berm is accessible for walking but there is no walkway to accommodate visitors (Figure 9).

Figure 9. Contemporary rural architectural style restaurant and orchard space

DISCUSSION AND CONCLUSION

According to the investigation of space and function of threes orchards with cafés and restaurants located in suburban areas of Bangkok and Nonthaburi, their benefits can be categorised into 3 types as following;

(1) Benefits to the owners; the findings point out that by establishing cafés and restaurants in their inherited orchards, the owners are able to maintain their land and consequently preserve their heritage. Not only to generate more income, have the arrangements for cafés and restaurants in the orchards also allow the owners to present their family legacy to the public.

(2) Benefits to the visitors; the orchard cafés and restaurants are a place for leisure activities closed to urban and suburban area. The visitors can relax, eat, drink, take a photo, stroll, gather with family and friends, and purchase fresh products. It is a great opportunity to appreciate agricultural landscape and cultural landscape as well.

(3) Benefits to the city; the orchards with cafés and restaurants can enhance the benefits of ecological systems, nature areas, habitat for small animals, storm water management e.g. reservoir, irrigation, greenspace, cultural landscapes and cultural heritage, leisure space, and learning space particularly for younger generations.

These examples indicate the coexistence of traditional orchards in modern suburban areas and the benefits of agricultural landscapes to the city. As World Heritage Centre states that maintaining these landscapes enhances the quality of life of communities and of the planet and addresses critical issues such as adaptation to climate change and risks.[25] It can be an alternative model for other orchard owners to facilitate their land.

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URBAN CREATIVITY, SYMBOLIC SPACES AND LUSOPHONE IDENTITY IN LISBON

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INTRODUCTION

Due to the decline of heavy industry, the development of the information society and the emergence of the creative economy theory, cities have undergone a functional transformation. As an example, several brownfield developments have been launched. In Lisbon, a similar trend can be observed in the 2010s: the abandoned boat and textile factories and other industrial areas have been converted into hubs of creativity used by actors of the creative industries. Around this time, Lisbon began to be referred to as the "new Barcelona" or the "new Berlin." The Portuguese capital has become a popular destination for travelers, partly due to the creative atmosphere that prevails among its historic buildings. After the 2008 global financial crisis, the city's creative industries started to flourish. One example is the street art activities coordinated by the Galeria de Arte Urbana (GAU), a division of the City Council.[1] During this period, the city's leadership underwent a shift in perspective, focusing on improving public spaces, the urban landscape, and city image, as well as on education and community building through art. City administration and leaders have discovered the importance of the knowledge society, innovation, and artistic cooperation as core aspects of the creative economy and industries, which can contribute positively tot he economy, competitiveness, and development of the city. The roots of the open, inclusive, innovative, and constructive local governance can be traced back to cultural and historical traditions and the position of the city in the Lusophone World. New qualities were created regarding the city's image, the use of its symbolic spaces, and the development of place attachment and place identity. These characteristics can represent a local advantage in a global context. The paper aims to observe Lisbon from a complex and interdisciplinary approach, and to explore and present forms of Lusophone identity beyond the Portuguese language, in practical examples of urban creativity in Lisbon. While the concept of the creative city is associated with Richard Florida's theory of the creative class, this paper adopts a critical approach to its local application. Instead of treating creativity solely as an economic development strategy, the study emphasizes its symbolic, cultural, and postcolonial dimensions. In the case of Lisbon, creative urban policies intersect with historical memory, Lusophone identity, and the processes of inclusion and exclusion.[2]

Urban Creativity in the Lusophone Context

The creative cities of the 21st century are those where knowledge and innovation accumulate and contribute to the formation and attraction of the creative class to the city, through a focus on the triad of technology, knowledge, and tolerance (3T).[3] The question is how the common historical past affects

these factors. The objective of the research is to show how Portuguese heritage and historical-cultural-economic-social development promoted the formation and strengthening of the creative economy in the cities studied in terms of path dependence, and how these places – hubs of urban creativity – are becoming symbolic places with their dynamic meaning and significance, influencing the city's image, economy, tourism, and international relations.[4]

Creativity in the city

Florida discusses a society that uses knowledge and information creatively and is thus able to create innovation, introducing the terms *creative class* and *creative city*.[5] The city, as a location has accumulated the 3Ts model: technology, tolerance, and talent. Technology refers to the development of the technological economy, talent means the quality of available human resources, and tolerance marks the degree of acceptance within a socio-cultural environment. Aspects that can boost the settlement of the creative class in a city include the quality of urban environment, cultural milieu, city image and attractiveness, rich history and traditions, diversity of living and working environments, mentally inspiring cultural settings, quality of services, tolerance, and social inclusion.[6]

The study by Costa, Seixas, and Roldão points out that creativity cuts across the economy, society, and urban life, assuming that it represents a strong source of value creation in 21st-century economies.[7] Creative activities are based on the notion of cultural and creative industries and are expressed in aesthetic and symbolic forms. In their study, urban creativity is identified as the result of collective activities and projects that take place in the city, which are related to people and imply public participation in social processes. Dimensions of urban creativity include creative neighborhoods, alternative or emerging areas, cultural and knowledge centers, large-scale urban investments, social and cultural projects, and creative social and professional classes.[8]

Symbolic space

Symbolic space refers to a place that, beyond its practical function, embodies socially constructed meanings related to power, identity, and collective memory. Such spaces emerge through cultural practices, narratives, and everyday use, linking the material city to symbolic systems of belonging. These spaces connect space, power, and identity through collectively shared meanings. Bourdieu claims that cultural practices, lifestyle, taste create a symbolic map of social differentiation, and embody the structure of social hierarchies. Symbolic space itself is not limited to monuments or iconic landmarks, neighborhoods, cultural venues or other landscapes can narrate symbolic significance through historical events, artistic movements, or other community practices.[9] Brockmeier argues that both personal and collective narratives interact with space, turning spaces into symbolic sites of identity construction.[10]

Lusophony in Portugal

Lusophony has a broader vision that is larger and more complex than a common language and literature. According to Sieber, a common language and the resulting forms of cultural expression connect Portugal to Portuguese-speaking countries.[11] To understand the social and political structures, it is important to study the production and consumption of music, arts, dance, literature, and other forms of cultural expression, as these media use special language and help to create a common identity. They are related to globalization, the legacies of colonialism and marginalization, political underrepresentation, and the neoliberal economy, thus establishing an interaction between global and local policies.[12] Sieber highlights that after 1974, promoting dialogue and communication between cultures became an important issue in Portugal, emphasizing the country's transculturality, its mediating role, and the wider world of Portuguese speakers.[13]

Beyond the political and institutional level, Lusophony is also evident in other ways in the city of Lisbon. A good example is EXPO '98 (the 1998 Lisbon International Exhibition), organized around the symbolism of *Vasco da Gama* and the Portuguese Discoveries, which also served to promote Portugal's mediating role in the Portuguese-speaking world. In addition to the cultural events of this exhibition, a new neighborhood emerged in the city – *Parque das Nações* – focusing on Portugal's past and its contemporary relationships with European, African, and Asian territories, while highlighting Lisbon's cosmopolitan character.[14]

Creativity in Lisbon

Since 2008, when the Urban Art Gallery (GAU) project was launched following a rehabilitation plan implemented by Lisbon City Council in the historic neighborhood of *Bairro Alto*, urban art has gained increasing visibility and importance. Among other measures – including increased police surveillance and the regulation of restaurant, bar, and club opening hours – graffiti on main streets removes, with some historic exceptions (see Figure 1). As a result, the City Council felt the need to create a space dedicated to street art and graffiti: an open-air gallery on *Calçada da Glória* (see Figure 2), publicly acknowledging the importance of these forms of expression. Due to this policy shift, street art has been used for social and community purposes, contributing to community building and the reshaping of the cityscape.

Figure 1. One of the historic street art works in Bairro Alto, depicting of the legacy of the Carnation Revolution of 1974. Source: Author (2025).

Figure 2. Open-air street art gallery on Calçada da Glória created by Galeria de Arte Urbana (GAU). Source: Author (2025).

In 2013, a creative economy strategy for Lisbon was drawn up and developed by the Municipal Directorate for Economy and Innovation, in collaboration with various actors in this sector. The strategy document details economic development related to the dynamism of tourism and creative operators, emphasizing that Lisbon is a multicultural, inclusive, and tolerant city, in line with Florida's 3Ts theory.[15] In terms of the number of companies and organizations active in the creative economy, there is a strong concentration in the city center – in the neighborhoods of *Baixa*, *Cais do Sodré*, *Mouraria*, and *Campo de Ourique* – as well as westward along the river *Tejo*, in neighborhoods such as *Santos*, *Alcântara*, and *Belém*, where former industrial buildings have been converted into offices. These investments have had spillover and gentrification effect on the affected neighborhoods.[16]

After the 2008 crisis, special attention was given to the reconstruction and conversion of historic buildings. Examples of this municipal initiatives include the *Forno do Tijolo* Market (see Figure 3), which was one of the first sites to offer co-working spaces through its FabLab, and an incubator in the city center called *Startup Lisboa*. At the initiative of private investors, creative centers were established in former industrial buildings, such as the *LX Factory* in *Alcântara* (see Figure 4) or the *Fábrica do Braço de Prata in Poço do Bispo*, in the eastern part of the city. In addition, entertainment venues such as *Pensão Amor* and *MusicBox* were established in historic buildings in the city center. In terms of urban regeneration, the *Santos Design District* initiative in the western part of the city center stands out. Other examples include *MUDE* (Museum of Design and Fashion), housed in a former bank headquarters, the *Experimenta Design Biennial*, the *Architecture Triennial*, *Moda Lisboa*, the *Lisboa & Estoril Film Festival*, *Time Out Market* (Figure 5), and *Casa Independente*, located in the renovated square of *Largo do Intendente*. These examples serve as references for a movement that values creativity and are significant from an architectural and urban perspective. They contribute to strengthening the city's creative image while also increasing its tourist and commercial appeal.[17]

Figure 3. The former market Forno do Tijolo, transformed to community workshop space and FabLab. Source: Author (2016).

Figure 4. Street art on the former factory building, transformed into a creative center named LX Factory. Source: Author (2025).

Figure 5. The former Ribeira Market was transformed into a unique concept, Time Out Market, a showcasing the gastronomic diversity of Lisbon. Source: Author (2025).

RESEARCH METHODOLOGY

The research methodology includes fieldwork and documentation, as well as information gathered through interviews. Twelve semi-structured were conducted in Lisbon with key local actors who have experience in the local creative economy and are members of the local creative class, as defined by Florida.[18] The organizations they represent are related to the dimensions of urban creativity, and are important and decisive actors in local cultural life. The projects they represent serve as reference in the field of the creative economy.[19] The interviews were conducted in English and Portuguese, recorded, transcribed, and analyzed in writing. The material was coded manually and used as the basis for content and discourse analysis. Interview questions were grouped around creativity, identity, and colonial heritage, examining their relationship.

Results

A total of 224 codes were generated during the processing of the interviews and were categorized into ten main categories (Table 1). The highest number of mentions (139) belonged to the "identity" category, followed by the "institutions" category (66), elements of "urban planning and architecture" (49), "public art" (42), "historical, social, and cultural factors" (40), "governmental aspects" (28), the "Lusophone world" (15), elements of "cultural and artistic events" (10), and finally, elements from the categories "tourism aspects" (9) and "livable city" (7). Based on the interviews responses, urban creativity appears across all categories, with considerable overlap between them. The most frequently occurring codes are presented and classified separately (see Table 2).

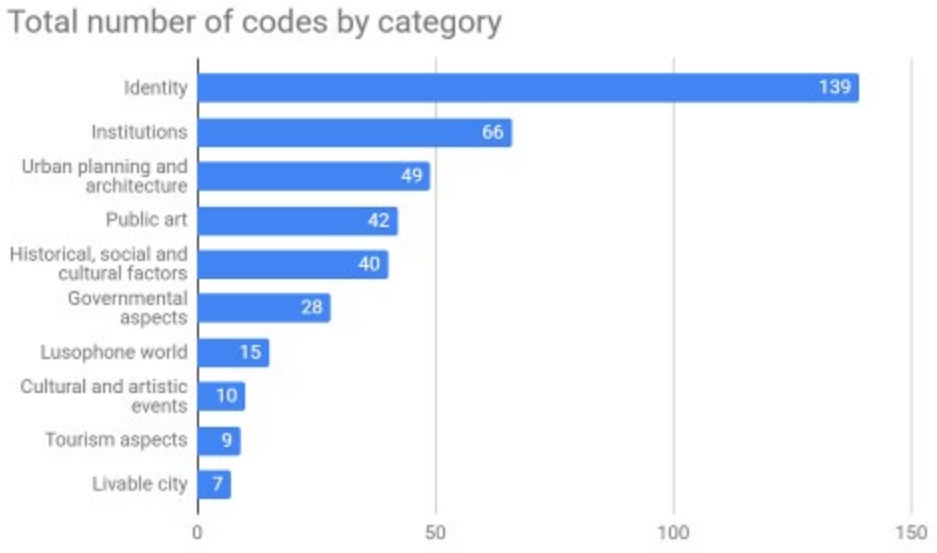

Table 1. Total number of code categories identified in the interviews conducted in Lisbon, listed in descending order by classification, code, frequency (number of mentions). Source: Author's own compilation (2025).

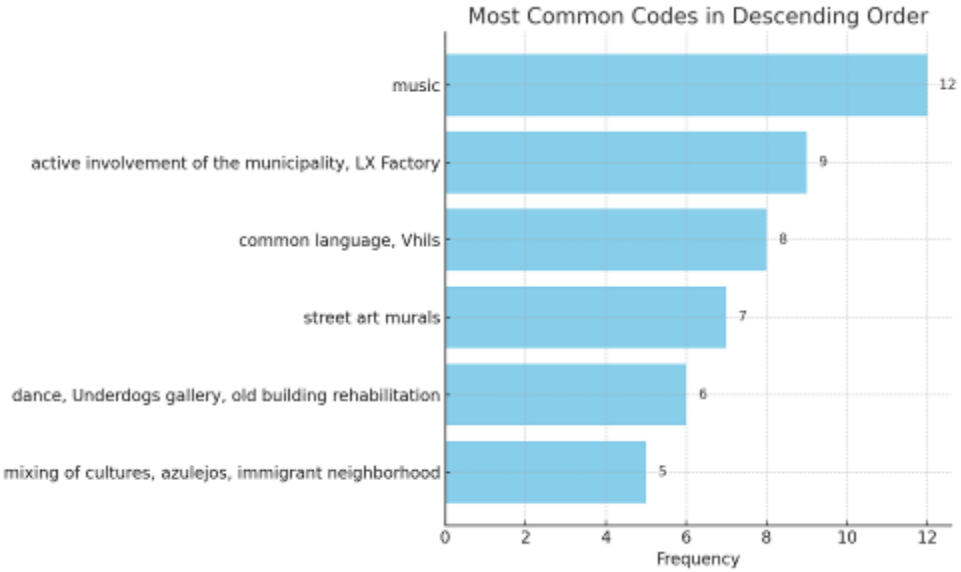

Table 2. Most common codes in descending order by classification, code, frequency (number of mentions). Source: Author's own compilation (2025).

According to respondents, Lisbon is a creative, open, and tolerant city, characterized by lively street life and a multicultural atmosphere, as exemplified by neighborhoods such as *Mouraria*, *Bairro Alto*, *Intendente*, and *Anjos*, as well by community projects including *Cozinha Popular da Mouraria*, *Fábrica do Gelado*. As a result of the 2008 economic crisis, the municipality's active involvement has been characterized by creative (top-down) processes, such as the introduction of participatory bottom-up budget (example: *BipZip*) and support for start-ups (*Fábrica Braço de Prata*, *Startup Lisboa*). The projects and processes supported by the municipality contribute to the creation of a creative urban image. The legalization of street art and municipal support play an important role in this process. The driving force behind the creation of murals and the implementation of street art projects is a municipal

organization, GAU. The most successful street art initiatives are those aimed at community building among marginalized groups (*Quinta do Mocho* – a segregated community originating from former colonies; *Lata65* – seniors) and these were also implemented with municipal support. Among street art creators, *Vhils* stands out: among other initiatives, he founded the *Underdogs Gallery* in a revitalized building in an industrial neighborhood. Rehabilitated buildings are typically examples of urban creativity due to their creative functions and architectural qualities, such as *LX Factory*, *Underdogs Gallery*, *Time Out Market*, *FabLab*, and *MUDE*. Other architectural examples include the *Centro Cultural de Belém* (*CCB* – Belém Cultural Centre) and *Village Underground*. Some creative neighborhoods have emerged through gentrification processes, such as *Parque das Nações*, which developed after *EXPO '98*. Certain examples of urban creativity are characterized by a spillover effect, notably *LX Factory* in *Alcântara*. In addition, system of community gardens and bike lanes reinforce community experience, freedom of movement, and leisure.

Creativity also has a significant impact on the development of tourism and the city's economy. In this context, the role of revitalized buildings should be emphasized. As a creative center, *LX Factory* houses numerous companies operating in the creative industries and has become a key tourist destination. Other examples include the *Time Out Market* food hall, the FabLab community workshop, and the *Underdogs Gallery*. The creative preservation and reinterpretation of *azulejo* tiles, a Portuguese national symbol, as well as themed street art tours and open-air galleries (*Quinta do Mocho*, *Calçada da Glória*) or the Portuguese sidewalk (*calçada portuguesa*), have touristic values.

The city's reliance on its history can be explained through the relationship between its colonial past and its creative image. The Portuguese are largely cosmopolitan, which has historically positioned migration – especially within Portuguese-speaking countries – as a viable option. At the same time, the rediscovery of traditions is reflected in handicrafts and the use of local raw materials, such as cork. Lisbon is traditionally a multi-ethnic city, and this cultural diversity is also visible in public spaces. The colonial past appears in street art themes, including portraits of *Amílcar Cabral*, *Eusébio*, *Agostinho Neto*, as well as murals in *Quinta do Mocho*. Cultural and artistic expressions have included projects such as the street art initiative *40 years 40 murals*.

Creativity is also evident in the rehabilitation of historic buildings and monuments and in the city's image as an inclusive, creative, tolerant, open city. The historical past is reflected in urban creativity, dance, music, gastronomy, and institutions such as *LX Factory*, *FabLab* community workshop, *A Vida Portuguesa* stores, bistros selling traditional fish preserves (e.g., *Sol e Pesca*) and *Start Up Lisboa*.

The creative urban image is achieved primarily through street art, but it is also present in art forms such as music and dance. The creative city is reinforced through cultural and artistic events, including the *Architecture Triennial* or the *Web Summit*, as well as through institutions such as museums, the *ARCO School of Art*, and start-ups.

The common denominator of Lusophone identity is not only the Portuguese language, but also the cultural proximity to the former colonies and the resulting cultural hybridity. This identity is expressed in art forms such as music and dance. In particular, African-rooted music (such as *kuduro* from Angola) and the national symbol, *fado*, stand out thematically. An important dimension of Lusophone identity migration between former colonies and the issue of dual citizenship. Lisbon, as a traditionally multi-ethnic city, has long integrated Portuguese-speaking populations, resulting in form of cultural sensitivity rooted in shared history and culture. Knowledge of a common language and cultural background also facilitates economic relations between countries, contributing to the presence of Angolan and Brazilian investors in Portuguese companies. Students from Portuguese-speaking regions are likewise presented in the education system.

The Lusophone identity is also manifested in urban creativity through music, dance, and gastronomy. Lively street life in public places incorporates music and dance with African and Brazilian roots, visible

in both instruments (such as the flute, typical of Brazil) and styles such as *kuduro* (Angolan music, and dance) and *capoeira* (a Brazilian martial art combining movement, music, and dance). Portuguese cultural elements are also referenced as symbols and brands Lusophone roots, including *fado*, coffee culture, and craft traditions, as well as in the work of street art creators such as *AddFuel*, who reinterprets traditional Portuguese tiles. The *A Vida Portuguesa* chain of stores has an important role in rediscovering craft traditions. Lusophone identity is further reflected in built heritage (churches, crosses, tiles) and in building renovations (*Time Out Market*, *Carpe Diem Arts Center*, *Casa Independente*, *Underdogs Gallery*, *Casa do Alentejo*, *MUDE*, or the University of Fine Arts, which is housed in a former convent).

CONCLUSION

For more than a decade, Lisbon has been recognized as a creative city, a reputation reflected in its urban image. This creative transformation is inseparable from the city's history and path dependency as a melting pot of the cultures from former colonies and beyond. Flagship projects such as *LX Factory*, *Time Out Market*, *FabLab Forno do Tijolo*, and *Underdogs Gallery* exemplify how former industrial spaces have been transformed into creative hubs and symbolic spaces, linking innovation with memory, tradition, multiculturalism, and top-down strategies with bottom-up participation. In this sense, the activity of GAU needs to be underlined, as is supported by the City Council, and as a result, street art in Lisbon – and in Portugal generally – has become one of the main elements in creating a new urban identity and image, as well as in strengthening community building. The data reveal that identity emerged as the most frequently mentioned theme, confirming that urban creativity in Lisbon functions as a key vehicle for negotiating belonging and cultural proximity across Portuguese-speaking communities. The reinterpretation of traditional forms – such as azulejos, fado, and gastronomy – alongside African- and Brazilian-rooted music and dance, illustrates how Lusophone identity is continuously redefined in the urban landscape.

At the same time, the research shows that symbolic spaces in Lisbon are not neutral. They are shaped by gentrification, economic strategies, and municipal policies that deliberately promote a creative image of the city. This image is attractive for tourism and investment, but it also raises questions about inclusion and representation. Nevertheless, the interplay of history, colonial legacies, and multicultural practices gives Lisbon a unique position: it is both a European capital and a hub in the Lusophone world, where creativity acts as a bridge across continents. In this way, Lisbon demonstrates how symbolic spaces and urban creativity can sustain cultural hybridity and cosmopolitan openness, while contributing to the city's economic and political resilience. This tension suggests that creative city policies must be evaluated not only through economic indicators, but also through their social consequences, particularly in relation to displacement, accessibility, and cultural representation.

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FROM “BOXES” TO “PLACE”: A MULTIDISCIPLINARY CASE STUDY OF REIZENSOU RENOVATION MUSEUM IN FUKUOKA CITY, JAPAN.

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INTRODUCTION

This research examines placemaking as a transformative practice that redefines post-war Japanese housing from standardized “boxes” into dynamic and meaningful “places,” where inhabitants' experiences are shaped by social interactions and everyday practices.

Placemaking is conceptualized not as a one-time intervention but as an ongoing process. Drawing on theories of place, placemaking, and the open building approach, this study highlights the significance of human relationships and shared experiences in shaping a meaningful place.

Landscape of boxes: Mass housing development in post-war Japan

During the post-war period, Japan faced an urgent need for rapid national growth and a large-scale supply of mass housing. Matsumura points out how the availability of land, government support, and the need for mass housing created the ideal conditions for the so-called “box delivery industry” to develop.[1] This box industry left a Japanese urban landscape shaped by “box” buildings as seen in Figure 01.[2] The main characteristics of these “boxes” are:

- Designed to meet basic daily necessities.
- Comply with safety standards.
- Be built as quickly as possible at an affordable cost.

Figure 1. Danchi (Apartment building) complex, built during post-war period in the mid 60s.Sabukura. https://sabukaru.online/articles/hana-yori-danchi-soviet-chic-to-house-the-corporate-samurais

This rapid growth in the post-war period, followed by a decline in population,[3] left Japan with an excessive surplus of housing and new challenges in achieving a meaningful use and repurposing of the existing built stock. According to the Housing and Land Survey conducted by the Ministry of Internal Affairs and Communications in 2023, there were 9,381,700 unoccupied dwellings, representing 14.42% of the total building stock.[4]

Changing the mindset from building more to reusing more

The current surplus of built stock creates a unique opportunity to rethink and transform these "boxes." Real estate companies and architecture studios are discovering new business opportunities in the reuse and renovation of the boxes.[5] Urban renewal is often promoted as a response to climate change, safety concerns, and energy efficiency, furthermore, renovating or repurposing existing buildings can be an equally sustainable strategy for mitigating climate change.[6]

The Act on Promotion of Long-Life Quality Housing (2009) reflects the Japanese government's current vision to extend the lifespan and adaptability of both existing stock and new developments.[7]

Objectives of this study

This shift in mindset, from building more to reusing more, raised new questions. As Matsumura highlights, expert knowledge and architectural technology have played a significant role in the construction of "boxes," while there has been little concern for the process of transforming these "boxes" into meaningful "places."[8] Friedmann also emphasizes the need to investigate the creation of "places," looking into smaller-scale contexts such as parks, neighborhoods, mixed-use developments, and residential buildings that shape the urban experience.[9]

Repurposing the built stock demands unraveling the transition from "box" to "place" by identifying the physical and intangible assets involved in place-making. We set the following objectives for this research in an attempt to respond to this demand.

1. Discovering the tangible and intangible assets that are involved in the transition process from "box" to "place".
2. How social interactions, everyday practices, management, and residents´ creativity actively change the built environment and shape a "meaningful place" over time.

Overview of concepts

In discussing the transition from "box" to "place," it is essential to understand what we mean when we talk about place. According to Cresswell, a "place" is the product of everyday practices that make it meaningful and is part of a continuous placemaking process shaped by the experiences and interactions of the inhabitants within the built environment [10]

The complexity of "place" requires an understanding of both the tangible and intangible assets that shape the inhabitant´s experience. To understand the built environment and its viability and capacity to repurpose and reuse, the following two concepts are adopted from Open Building approach.[11] Base Building refers to the finished, immovable physical environment, encompassing not only the structure itself but also the facade, structure, and floor plan distribution. The Infill refers to the movable elements—the layout and equipment of each occupancy within the Base Building.[12]

Other relevant concept in the Japanese literature to understand inhabitants' lifestyles and decisions involved in place-making is the figure of "Aruji" as a unique type of manager, as a host and mediator, providing support, care, and guidance to all inhabitants.[13] The concept of the Aruji resonates with the concept of humanistic management, involving a comprehensive knowledge of the human being, to foster sense of belonging and community.[14]

CASE STUDY AND DATA ANALYSIS

Why Reizensou: Renovation Museum?

Located in an emblematic area in the heart of Fukuoka City, Kamikawabata-cho, Hakata-ku. Reizensou: Renovation Museum provides insight into a successful case of repurposing the original "box" into a meaningful place. Reizensou was initially built in 1958 as a residential complex and was one of the most modern housing developments of its era, because of its durable reinforced concrete structure and innovative floor layout.[15] In 2010, Reizensou was redefined as Renovation Museum, reflecting the owner's vision of reusing existing built stock as a space where tenants' creativity could flourish, by allowing them to renovate their rooms according to their own needs and lifestyles. Thanks to this vision and the owner's distinctive approach to management, Reizensou has become a notable case in Japanese literature, recognized as a pioneer in repurposing the "box" while fostering a meaningful "place" for its tenants. This provides us with a unique potential to gain specific insights that other projects would not provide, in the repurposing from "box" to "place."

Main actors in Reizensou

The participants in this study were carefully selected for their significant role in shaping Reizensou as a meaningful "place." Those included are the owner, Yoshihara Katsumi, a pioneer of the renovation business model in Fukuoka City, the Aruji, Sugiyama Kouichiro, who has been involved with Reizensou for 14 years, and has become a central figure in Reizensou. The tenants: Makoto Tanaka, Dora, and Atsushi Kuroki, all of whom have run their business in Reizensou for at least ten years, contributing substantially to its development and community life.

Data collection and analysis

Understanding placemaking involves recognizing tenants' experience, by conducting fieldwork which includes on-site observations and semi-structured interviews. Interviews were recorded and transcribed to conduct an in-depth data analysis. Other methods used include photographic documentation, and relevant materials such as magazines, websites, and architectural plans were also collected. These multiple types of data collection provide a thick description of the process of Reizensou.

Reizensou's Base Building as an integral part of Place: Identity, Safety, and Flexibility

The base building of Reizensou has undergone minimal design alterations throughout its lifetime. Rather than concealing its past, Reizensou's owner embraces it and incorporates it as part of its identity. As shown in Figure 02, the facade of Reizensou displays almost no signs of modification. This preservation reflects the owner's vision of maintaining a vintage appearance and a preference for the old and nostalgic characteristics, which is also shared by the tenants, as expressed by Dora. This suggests that aesthetic continuity contributes to the shared identity of the community.

"Dora: I found, this yuuka (floor). Floor, wooden floor. And I like old thing, yeah. This one and this one, so old thing. I looked this floor is so I thought this is special. Nothing any places. (I like old things, like this floor. It is very special, you cannot find anything like this in any other place)."(Dora Amamiya, in discussion with the author, May 2024.)

Reizensou's vintage appearance also functions as a living museum which the Aruji/Manager uses to educate tenants, new and recurrent visitors about Reizensou's history, culture, and the efforts undertaken to preserve its image, as seen in Figure 03 where the Aruji/Manager gives a tour of Reizensou to a group of visitors. In this sense, the aesthetic character of the building goes beyond mere decoration, it shows with pride the essence and history of Reizensou, serving as a cultural tool that strengthens tenants' identity, and sense of belonging.

Figure 2. Reizensou Picnic. Reizensou: Renovation Museum. https://www.reizensou.com/about/

Figure 3. Reizensou tour guided by the Aruji. Reizensou Renovation Museum. https://www.reizensou.com/about/

In the Japanese context, the reuse of old buildings and other structures raises concerns about safety, particularly given the country's high frequency of earthquakes. One of the tenants, Makoto reflects this concern, highlighting how the perception of safety plays a decisive role in considering Reizensou as a good place to run his business, compared to other options that satisfy his personal taste, but don´t fulfill his sense of safety, such as wooden houses.

“Makoto: And also, one thing, so in Japan there are sometimes big earthquake, so machiya wooden house is not strong." (Makoto Tanaka, in discussion with the author, May 2024.)

In Figure 04, located in the management office on the first floor, as indicated in Figure 05, the exposed anti-seismic steel structural frame is an essential safety requirement not only for the long-term viability and use of Reizensou, but also to strengthen tenants’ sense of safety, and trust. By making the reinforcement visible, the Owner and the Aruji transforms a technical necessity into a communicative and pedagogical resource that reassures tenants about safety while simultaneously cultivating awareness of the building’s resilience. In this way, structural safety becomes intertwined with cultural practice, reinforcing trust in the physical environment viability of Reizensou.

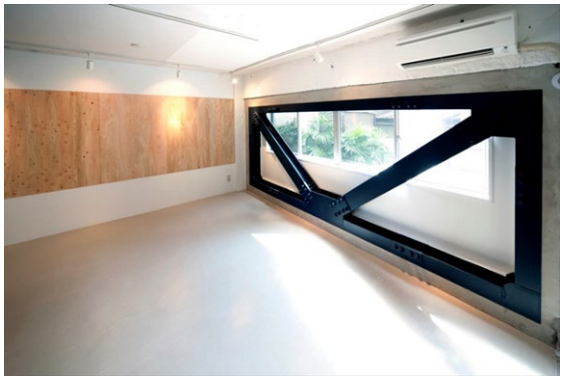

Figure 4. Reizensou´s reinforcement seismic structure located in the management office. Reizensou Renovation Museum. https://www.reizensou.com/about/

As we can see in Figure 05, the simplicity of Reizensou´s base building plays an important role in nurturing placemaking, allowing the built environment to adapt to tenants' needs, and creativity. The reinforced concrete structure enables interior walls to be modified, allowing rooms to expand, contract, or be subdivided in various ways. For example, the multipurpose rental room located on the first floor, as indicated in Figure 05, offers different-sized rental options along with a variety of prices, as we can see in Figure 06, to accommodate each customer's needs. This financial and spatial flexibility makes Reizensou a competitive choice in the market, attracting a wide range of users, from amateur art clubs to collaborations with museums. Such adaptability allows a dialogue with different communities and social layers of Fukuoka City, displaying Reizensou's unique management approach, which emphasizes prioritizing people's needs while maintaining a viable business model.

Figure 5. Reizensou´s base building first floor plan. Courtesy of Reizensou Renovation Museum. Edited by author.

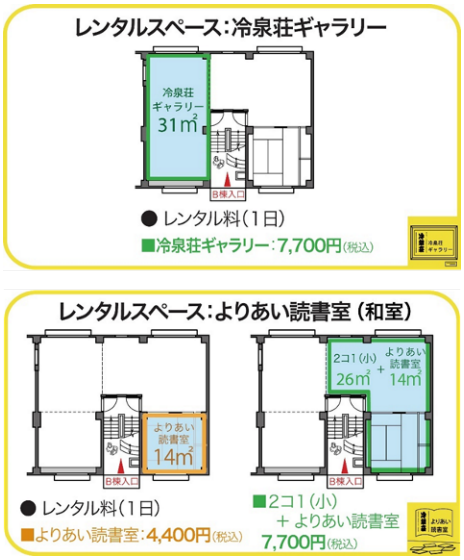

Figure 6. Reizensou´s multipurpose room rental packages. Reizensou Renovation Museum. https://www.reizensou.com/share/rentalspace/

Reizensou's unique infills: Crafting Place through Creativity and Collaboration

Management / Aruji's room

In Figure 05, located on the first floor, we can observe the Aruji's room, which functions as a meeting point not only for tenants but also for old and new visitors. It can be considered Reizensou's entrance, serving as the first point of contact with visitors. Although the official function of this room is as a business office, Aruji's appropriation of the space has diversified the function of the room. The basic square layout of the base building, combined with the absence of structural walls, allows the Aruji to adapt the interior infill to his needs. As shown in Figure 07, once a month, in a matter of minutes, the management office transforms into a living room for movie nights, welcoming friends and any visitors who wish to join.

Figure 7. Movie nights in Reizensou at the Management office. Reizensou Renovation Museum. https://www.reizensou.com/blog/20240823/

Tetragraph photo studio

Dora has been in Reizensou for 15 years, positioning her as a key figure for understanding the building's social and spatial dynamics. She has addressed the inconveniences of the built environment in a distinctive way. For instance, she didn´t have a private toilet, as repairs were difficult. Rather than resolving the physical inconvenience by repairing the toilet, she strengthened her relationships with neighbors, reaching an agreement to share the toilet with a resident on the floor below. In doing so, she not only found a practical solution but also fostered a stronger sense of community, transforming a limitation into an opportunity to connect with other tenants and nurturing Reizensou as a meaningful place for social interaction.

Dora's decision to live in Reizensou is also influenced by her personal appreciation for a vintage aesthetic, which aligns with the owner's vision of valuing vintage buildings. Even though older buildings often present inherent physical inconveniences, her perception of Reizensou as a meaningful place is influenced by her personal taste, where beauty can be found in what others might consider inconvenient, as Dora mentioned during the interview.

"Dora: not convenience, not complete, sometimes I have a problem, so in summer hot, in winter cold, but… Sore ga suki (I like that), you know, you know. Not perfect, I like. (Even when is not convenient, or incomplete. During summer is hot, and in winter is cold, but I like that. I like that imperfection)." (Dora Amamiya, in discussion with the author, May 2024.)

Figure 8. Dora in her photography studio. What is the secret behind the community created by Reizenso? Think Local. 2025. https://think-local.dmdepart.jp/story/20250624fukuoka1/

Noppo Shoe Lab

Atsushi Kuroki has been in Reizensou since 2014. Although his room is small, about 36 square meters, he has managed to utilize every available centimeter, adapting it to his needs. Through creativity and craftsmanship, he continuously shapes the built environment into a meaningful place, by integrating leather made products into the interior design, and making his own furniture. This process has taken years to develop and continues to evolve. In Figure 09, we can observe the care and effort he has put into every centimeter available, as everything is meticulously arranged to meet his needs.

Shoemaking is a noisy process, due to the tools and machinery used. Working in collaboration with the Aruji, they came up with a solution to decrease the noise, using rubber pads in the machinery and the working table. In this way, not only are the physical inconveniences being diminished, but there is also an acknowledgement of how this problem might have impacted on the comfort of other tenants. In other places Kuroki might have been rejected for the noise of the workshop, but this was not the case in

Reizensou. The Owner and the Aruji took the responsibility of taking the risk into an opportunity, believing in the positive impact of having a craftsman like Kuroki as part of Reizensou´s community.

Figure 9. Atsushi Kuroki at his workshop. What is the secret behind the community created by Reizenso? Think Local. 2025. https://think-local.dmdepart.jp/story/20250624fukuoka1/

Reizensou's unique management approach

Reizensou's unique management has become part of its identity. The Aruji´s care and understanding of tenants and visitors is fundamental in shaping Reizensou as a meaningful place. During the interviews, the role of Aruji as a mediator in problem-solving came to light, in all cases. In the case of Kuroki, as seen previously he worked together with the Aruji to solve the noise problem. Allowing him to keep his business in Reizensou, and to develop a good relationship with the tenants. In the case of Dora, during the interview she mentioned that if there is a problem, she communicates always and firstly to Sugiyama/Aruji, as observed in the following interview fragment.

"Author: What do you in case you have a problem? Any type of problem.

DA: Ah so, first Sanda San (Sugiyama) ni soudan shimasu. So, first time, all the time. I ask to Mr Sanda. (First of all, if I have a problem, or a consultation, I always ask to Sugiyama)" (Dora Amamiya, in discussion with the author, May 2024.)

Also Makoto expressed his awareness of the Aruji into problem solving, and how this way of management is unique, as we can see in the following interview section.

"Author: So you think he (Sugiyama) is beyond business?

Makoto: Yeah, yeah, yeah. He can imagine, so the person's problem. How the tenant owner has a problem. " Makoto Tanaka, in discussion with the author, May 2024.

In addition to caring for the tenants, Sugiyama/Aruji maintains a daily cleaning routine that addresses both the physical and intangible assets of Reizensou. Each day, he starts by cleaning the front street and common areas, such as stairways and hallways. This practice not only preserves the building's appearance but also creates opportunities for everyday interaction with tenants, fostering trust and reinforcing a sense of community. In this way, Sugiyama's routine exemplifies a management style that integrates practical maintenance with relationship-building, ensuring both the physical maintenance of Reizensou and the well-being of its inhabitants. From the data collected it can be said that the function of the Aruji involves as follows:

- Caring and guidance of tenants, and visitors.
- Developing daily routines that nurture emotional engagement with Reizensou and tenants.
- Promotion of cultural and social events.
- Complement the financial business with a humanistic approach.

CONCLUSION

The mass supply of housing in the post-war period by the "box delivery industry", followed by a declining population, left Japan with a significant surplus of unoccupied "boxes." Therefore, discussing and addressing the reuse and repurposing of existing surplus of built stock into meaningful places is needed. The case of Reizensou: Renovation Museum demonstrates that placemaking emerges from a shared vision among all the actors involved in Reizensou. The physical assets, such as structural reformations, spatial flexibility, and preservation of vintage aesthetics, are intertwined with intangible assets, such as a sense of safety, creativity, trust, and a sense of belonging.

Central to this process is the Aruji/Manager, whose management tasks extend beyond conventional business practices. By integrating constant care of tenants and visitors, daily routines, and a humanistic management approach, the Aruji nurtures both the physical environment and the social fabric of Reizensou. This demonstrates how incorporating and caring about tenants' needs can turn "boxes" into meaningful places, while still sustaining a viable business model. The tenants' creative practices further reinforce this transformation, showing how limitations of the built environment can be reinterpreted as opportunities for collaboration and to nurture a resilient community.

Reizensou exemplifies a pioneering model of reuse and repurposing in Japan. It shows that meaningful places emerge when physical, social, and management practices converge under a shared vision. By framing placemaking as an ongoing, collaborative process, this study highlights the importance of integrating human relationships, creativity, and management into the sustainable transformation of existing built environments into meaningful places.

Even though Reizensou's uniqueness is recognized, further case studies are needed to fully understand the tangible and intangible assets involved in placemaking.

NOTES

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[3] Juichiro Asano et al. Akiya no Taizen[Complete Guide to Vacant Houses]. (Kyoto: Gakugei Publishing, 2024),24
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“A PLACE” FOR ALL: QUALIFYING THE EMPTINESS OF URBAN VOIDS FOR PUBLIC LIFE

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INTRODUCTION

For centuries, cities have evolved through the intuitive understanding of human scale, rhythm and the sensory experience, resulting in environments that sustain deep connection between people and place. Medieval cities, shaped through generations of practical knowledge, where everyday life and public spaces were closely interconnected. However, with the industrialization and modern planning disrupted this balance resulting fragmented, vehicular centered spaces that neglected urban life.

Streets are not only pathways of movement and commerce. They function as the “lungs” and “arteries” of the city spaces where multifunctional spaces for cultural expression, social interaction and everyday life. In this sense, livability becomes a central feature of urban design, particularly for commercial streets where constant flows of people demand a careful balance between utility and human experience. Yet, in many contemporary cities, streets are reduced to transit corridors. Although there have been advances in sustainable design, urban branding and walkability, still the quality of life remains overlooked. Cities invest in iconic landmarks and skyline aesthetics while the everyday lived experiences of streets fragmented or neglected.

This imbalance creates “Urban Voids”, underutilized or neglected spaces. Such voids reveal the persistent gap between design intentions and actual human needs. Even if they appear empty, they carry significant hidden potential. Berlin represents a compelling case study for scholarly examination. Friedrichstraße in Berlin is historically one of the city's main commercial arteries, representing the vibrancy of urban life. In 2021, Friedrichstraße underwent traffic experiment in which the street was closed to cars for six months. Although the intention was to create a more attractive pedestrian environment, the outcome was mixed: retail activity declined, and the street often appeared emptier than before.[1]

This paper explores the hidden potentials of urban voids in Friedrichstraße by examining how underutilized spaces can enhance social interaction and livability. By bridging the gap between design intentions and lived experiences, the study highlights opportunities to rethink urban spaces in ways that respond to human needs. Friedrichstraße serves as a case study to investigate how layered observations of urban life can transform into more inclusive, culturally vibrant and participatory approaches to future urban planning in global cities.

RESEARCH AIMS & OBJECTIVES

The aim of this study is to explore the transformative potential of urban voids as a catalyst for community driven urban regeneration. The objectives are to develop practical human centered planning strategies that activate underutilized urban spaces, to promote inclusive, socially vibrant and participatory urban spaces and to reframe urban design approaches around the lived experiences and everyday needs of the city residents. The research's objectives are underlined by the following questions.

1. In what ways have modern urban development priorities affected the decline of vibrant public life in cities? (To Examine)
2. How can underutilized urban voids be reimagined through human centered design to strengthen public life and improve livability? (To Explore)
3. What place-making tools can effectively activate urban voids as inclusive and socially vibrant spaces in contemporary cities? (To Propose)

LITERATURE REVIEW

Urban environments are shaped not only by their physical structures but also by how people inhabit and adapt them. In this context, urban voids, underutilized, neglected or disconnected spaces become important areas for study and potential interventions. In urban studies, the concept of the void has been defined in many ways based on its complexity. Roger Trancik describes urban voids as "disruptive spaces" disconnected from both public and private realms, often the result of outdated planning, social changes or poor design.[2] Similarly, Kevin Lynch identifies them as "neglected" or "residual areas", often adjacent to infrastructure like highways or railways highlighting their latent potential for reuse.[3] Wouter Nefs mention that literature often refers voids as "unoccupied areas", "abandoned land" or "unclear land", where all of which signal a lack of function but necessarily a lack of value.[4] Based on this, Lucia Bravo emphasizes the importance of revitalization and adaptability,[5] while Valeria Mariani and Patric Barron suggest that ambiguity and evasiveness of urban voids are precisely what gives their transformative potential.[6]

Identifying typologies of voids makes it possible to better understand their nature and transformative possibilities .Roger Trancik classified urban voids into three categories, as planning voids (caused by inefficient planning),functional voids (created when spaces fail to fulfill their designed purpose) and geographical voids (spaces that are unusable due to unaddressed natural features).[7] Osmar M. Hashem expanded this classification based on their scale and ownership into transport voids, edge and buffer voids, infrastructure voids and large- scale voids.[8] By referring these definitions, urban voids are seen as hidden potentials, if properly understood, they can be transformed into places that enhance livability, community and social interaction.

To unlock this potential, scholars emphasize the importance of understanding how people interact with their physical surroundings. Jan Gehl and Birgitte Svarre, in *How to Study Public Life, presents* a systematic framework for observing public life, based on simple yet fundamental questions: How many? Who? Where? What? How long?.[9] These questions help to capture patterns of behavior, social interaction and temporal rhythms of urban spaces. Furthermore, they proposed practical tools such as counting, mapping, tracking, photographing, test walks and maintaining diaries, which allow researchers to connect abstract urban design with lived experiences.

Evaluation of livability in public spaces extends beyond observation to structured design assessment. Jan Gehl, in *Cities for People,* introduces 12 Urban Quality Criteria grouped into three categories: protection, comfort and enjoyment.[10] Protection addresses safety from traffic, accidents and crime. Comfort focuses on opportunities for seating, lingering, walking, seeing, taking/listening and play /activities. Enjoyment emphasizes opportunities to enjoy the positive aspects of climate and experience

of aesthetic qualities and positive sensory experience. Together, these criteria extend urban analysis beyond the abstract design intentions by making it possible to evaluate public spaces that genuinely support a livable and human centered city.

When evaluating public spaces, it is essential to consider not only the designer's intentions but also the perspective and experience of the public who use them. The Placemaking Attributes framework by Projects for Public Spaces (PPS) evaluates public spaces quality through the lived experience of users.[11] It addresses four core attributes: Access and Linkage, Comfort and Image, Uses and Activities and Sociability. Access and Linkages evaluate physical and visual connectivity, while Comfort and Image concerns cleanliness, safety and perception of welcoming amenities. Uses and activities consider whether the space supports different functions and encourages sustained engagement. Sociability measures inclusivity, social interaction and sense of belonging to space. This evaluation further integrates open feedback which highlights the importance of participatory input to validate observations and ensure inclusive evaluation.

Building on these insights, this study seeks to explore how urban voids can be strategically transformed through human centered design to foster inclusive, socially vibrant and livable urban spaces.

RESEARCH CONTEXT

Friedrichstraße is one of Berlin's most prominent commercial streets with a significant cultural historical value. Originating in the 17th century as a hub for shops, theaters, cafes and social life, it was heavily damaged in World War II and later symbolized Cold War division, leaving lasting impacts on its urban form and social character.[12] In 2021,the Berlin Senate initiated a six month car-free traffic experiment to enhance its attractiveness for Berliners and tourists while boosting retail activity.[13] However, sales and foot traffic declined, highlighting a recurring challenge in contemporary urbanism: policies that focus narrowly on mobility or aesthetics often fail to generate the vibrant public life that they are intended to create.

Comparable cases such as Copenhagen's pedestrianization of Strøget, shows that prioritizing people can create vibrant public spaces.[14] Friedrichstraße reveals, however, that removing cars alone is insufficient. Successful urban design must bridge the gap between design intentions and lived experiences. In this context urban voids, underutilized or fragmented spaces in Friedrichstraße caused by poor planning or unmet human needs represent key opportunities to promote inclusive, livable and people centered urban environments. The identified five zones and urban voids present in each zone area along Friedrichstraße are illustrated in Figure 1.

Figure 1. Friedrichstraße, Berlin (images adapted from Google maps,2025 and own photographs)

RESEARCH METHODOLOGY

To evaluate the existing condition of Friedrichstraße, the research consists of a combined approach based on two methods of Place Performance Evaluation, grounded in the frameworks identified in the literature review. (Figure 2)

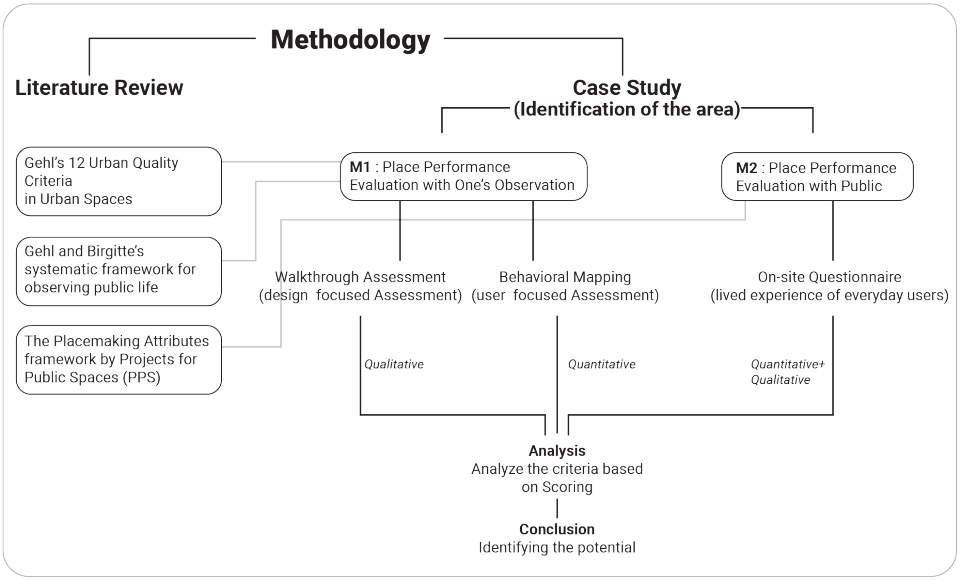


Figure 2. Methodological Process (By the Author)

Method 1 (M1): Place Performance Evaluation with One's Own Observations

This method of analysis focused on assessing Friedrichstraße's livability through direct on-site observations that explore both its designed qualities and actual user patterns. This integrated framework, based on Jan Gehl's *12 Urban Quality Criteria,*[15] combined a walk-through assessment (design focused evaluation) with behavioral mapping (user focused evaluation). Together, these two assessments

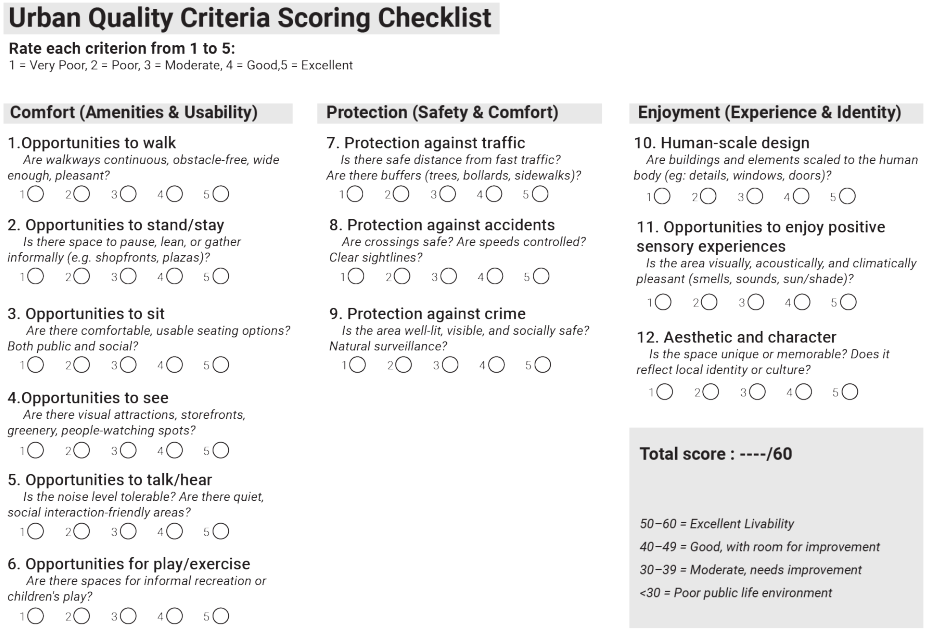
provide a comprehensive understanding of how the street performs as a public space, not only in terms of physical character but also with the lived experience it supports.

Walkthrough Assessment

This evaluation was carried out by researchers and a small team of four architecture students through systematic walkthrough conducted on December 22,2023 and March 9,2024. During each walkthrough, the team observed and recorded entire length of Friedrichstraße focusing on three key dimensions:

1. Comfort: amenities and usability
2. Protection: safety and comfort
3. Enjoyment: experience and identity

Each zone along the street was scored against these criteria using rating scales and field notes. Findings were documented through photographs, sketches and written observations. Walkthrough assessment, the data were synthesized to identify five zones with low livability scores, subsequently recognized as urban voids with latent potential for improvement. (Figure 3)



Urban Quality Criteria Scoring Checklist

Rate each criterion from 1 to 5:
1 = Very Poor, 2 = Poor, 3 = Moderate, 4 = Good,5 = Excellent

Comfort (Amenities & Usability)

1.Opportunities to walk
Are walkways continuous, obstacle-free, wide enough, pleasant?
1 ○ 2 ○ 3 ○ 4 ○ 5 ○

2. Opportunities to stand/stay
Is there space to pause, lean, or gather informally (e.g. shopfronts, plazas)?
1 ○ 2 ○ 3 ○ 4 ○ 5 ○

3. Opportunities to sit
Are there comfortable, usable seating options? Both public and social?
1 ○ 2 ○ 3 ○ 4 ○ 5 ○

4.Opportunities to see
Are there visual attractions, storefronts, greenery, people-watching spots?
1 ○ 2 ○ 3 ○ 4 ○ 5 ○

5. Opportunities to talk/hear
Is the noise level tolerable? Are there quiet, social interaction-friendly areas?
1 ○ 2 ○ 3 ○ 4 ○ 5 ○

6. Opportunities for play/exercise
Are there spaces for informal recreation or children's play?
1 ○ 2 ○ 3 ○ 4 ○ 5 ○

Protection (Safety & Comfort)

7. Protection against traffic
Is there safe distance from fast traffic? Are there buffers (trees, bollards, sidewalks)?
1 ○ 2 ○ 3 ○ 4 ○ 5 ○

8. Protection against accidents
Are crossings safe? Are speeds controlled? Clear sightlines?
1 ○ 2 ○ 3 ○ 4 ○ 5 ○

9. Protection against crime
Is the area well-lit, visible, and socially safe? Natural surveillance?
1 ○ 2 ○ 3 ○ 4 ○ 5 ○

Enjoyment (Experience & Identity)

10. Human-scale design
Are buildings and elements scaled to the human body (eg: details, windows, doors)?
1 ○ 2 ○ 3 ○ 4 ○ 5 ○

11. Opportunities to enjoy positive sensory experiences
Is the area visually, acoustically, and climatically pleasant (smells, sounds, sun/shade)?
1 ○ 2 ○ 3 ○ 4 ○ 5 ○

12. Aesthetic and character
Is the space unique or memorable? Does it reflect local identity or culture?
1 ○ 2 ○ 3 ○ 4 ○ 5 ○

Total score : ----/60

50–60 = Excellent Livability
40–49 = Good, with room for improvement
30–39 = Moderate, needs improvement
<30 = Poor public life environment

Figure 3. Walkthrough analysis checklist (By the Author)

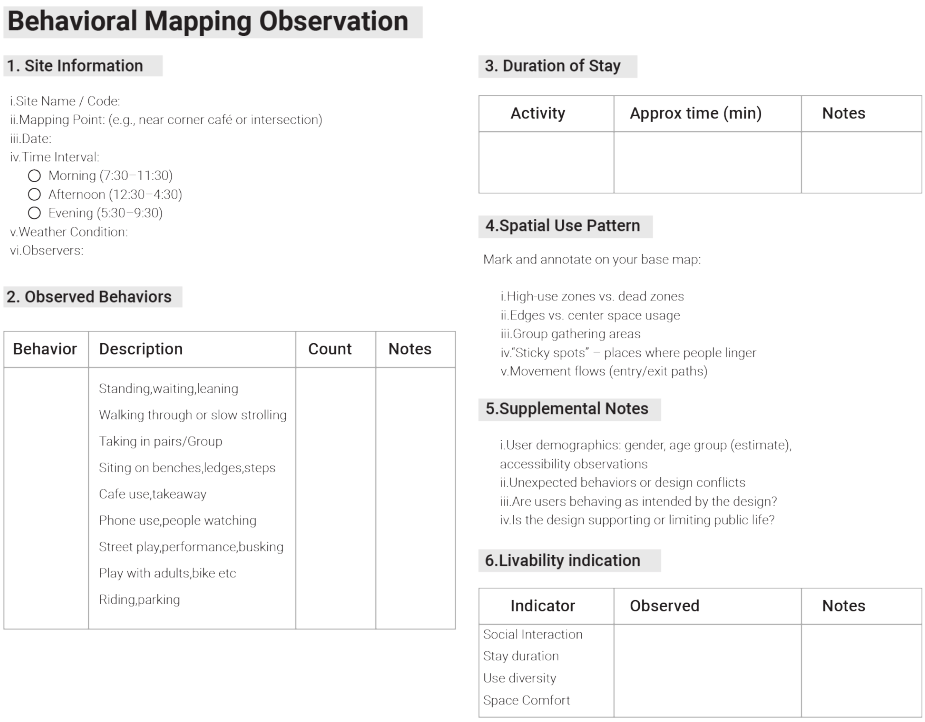
Behavioral Mapping

To complement the design focused walkthroughs, a behavioral mapping was performed to understand how people use Friedrichstraße in real time. This aims to reveal patterns of user presence, activity, diversity, duration of stay and social interactions to highlight gaps between the intended design and actual use.

1. Mapping process: For each of the five selected zones, two fixed observation points were established. Teams of two architecture students per site carried out observations in three daily time blocks: morning (7.30 -11.30), afternoon (12.30-16.30) and evening (17.30pm-21.30).

2. Data Collection: Observers documented the number of people, type of activity, duration of stay and forms of social interaction. (Figure 4) Further, supplementary materials such as sketches, field notes and photographs were also collected.

Behavioral maps were generated to visualize density and diversity of use, and the observed patterns were then compared with the design intent scores from the walkthrough study.



Behavioral Mapping Observation

1. Site Information

i.Site Name / Code:
ii.Mapping Point: (e.g., near corner café or intersection)
iii.Date:
iv.Time Interval:
- ○ Morning (7:30–11:30)
- ○ Afternoon (12:30–4:30)
- ○ Evening (5:30–9.30)

v.Weather Condition:
vi.Observers:

2. Observed Behaviors

Behavior	Description	Count	Notes
	Standing,waiting,leaning Walking through or slow strolling Taking in pairs/Group Siting on benches,ledges,steps Cafe use,takeaway Phone use,people watching Street play,performance,busking Play with adults,bike etc Riding,parking		

3. Duration of Stay

Activity	Approx time (min)	Notes

4.Spatial Use Pattern

Mark and annotate on your base map:

i.High-use zones vs. dead zones
ii.Edges vs. center space usage
iii.Group gathering areas
iv."Sticky spots" – places where people linger
v.Movement flows (entry/exit paths)

5.Supplemental Notes

i.User demographics: gender, age group (estimate), accessibility observations
ii.Unexpected behaviors or design conflicts
iii.Are users behaving as intended by the design?
iv.Is the design supporting or limiting public life?

6.Livability indication

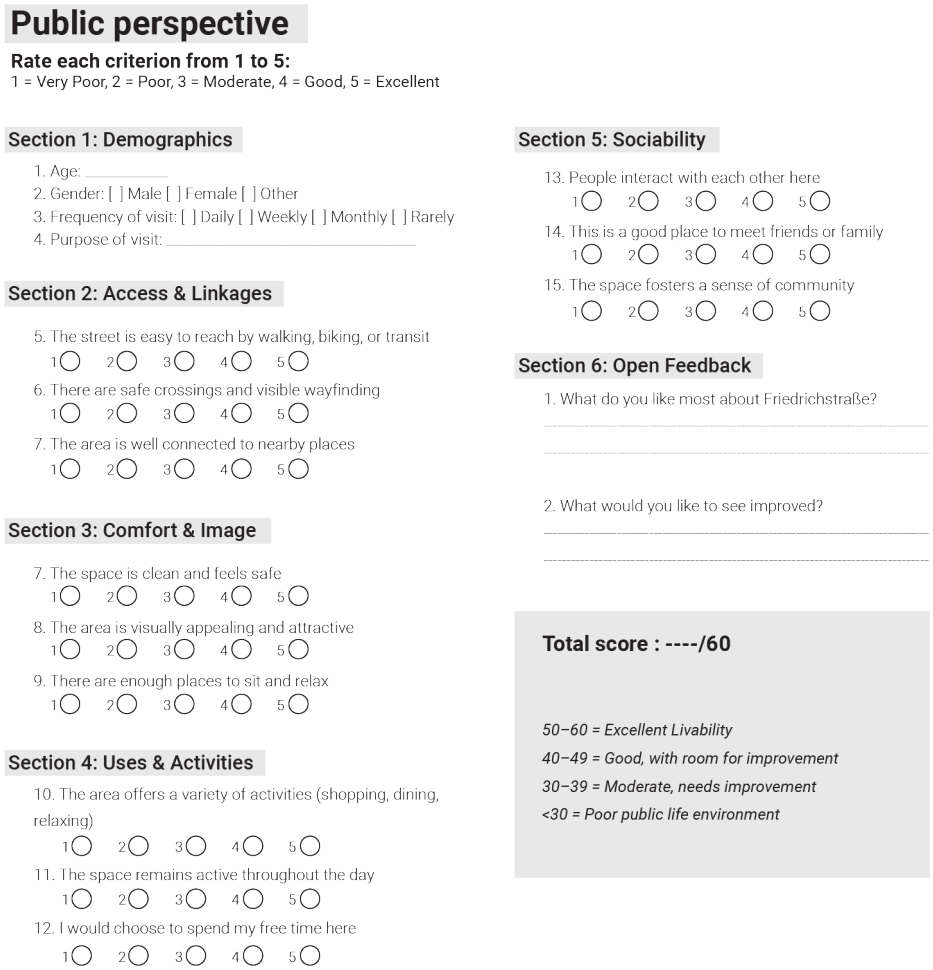
Indicator	Observed	Notes
Social Interaction Stay duration Use diversity Space Comfort		

Figure 4. Behavioral mapping analysis template (By the Author)

Method 2 (M2): Place Performance Evaluation with Public Perspective

This methodology consisted of the Placemaking Attributes framework developed by Project for Public Spaces (PPS),[16] which is a user centered analysis that evaluates how people perceive and experience a place using a Public Perspective Questionnaire (Figure 5) focusing on five interrelated attributes:

1. Access and Linkage: street connectivity and ease of navigation
2. Comfort and Image: perception of safety, cleanliness and aesthetics
3. Uses and Activities: variety and quality of function provided
4. Sociability: Opportunities for interaction and sense of community
5. Open Feedback: Collection of user opinions on strengths and weaknesses of the space



Public perspective

Rate each criterion from 1 to 5:
1 = Very Poor, 2 = Poor, 3 = Moderate, 4 = Good, 5 = Excellent

Section 1: Demographics

1. Age: _____
2. Gender: [ ] Male [ ] Female [ ] Other
3. Frequency of visit: [ ] Daily [ ] Weekly [ ] Monthly [ ] Rarely
4. Purpose of visit: _____

Section 2: Access & Linkages

5. The street is easy to reach by walking, biking, or transit
   1◯ 2◯ 3◯ 4◯ 5◯
6. There are safe crossings and visible wayfinding
   1◯ 2◯ 3◯ 4◯ 5◯
7. The area is well connected to nearby places
   1◯ 2◯ 3◯ 4◯ 5◯

Section 3: Comfort & Image

7. The space is clean and feels safe
   1◯ 2◯ 3◯ 4◯ 5◯
8. The area is visually appealing and attractive
   1◯ 2◯ 3◯ 4◯ 5◯
9. There are enough places to sit and relax
   1◯ 2◯ 3◯ 4◯ 5◯

Section 4: Uses & Activities

10. The area offers a variety of activities (shopping, dining, relaxing)
    1◯ 2◯ 3◯ 4◯ 5◯
11. The space remains active throughout the day
    1◯ 2◯ 3◯ 4◯ 5◯
12. I would choose to spend my free time here
    1◯ 2◯ 3◯ 4◯ 5◯

Section 5: Sociability

13. People interact with each other here
    1◯ 2◯ 3◯ 4◯ 5◯
14. This is a good place to meet friends or family
    1◯ 2◯ 3◯ 4◯ 5◯
15. The space fosters a sense of community
    1◯ 2◯ 3◯ 4◯ 5◯

Section 6: Open Feedback

1. What do you like most about Friedrichstraße?

2. What would you like to see improved?

Total score : ----/60

50–60 = Excellent Livability
40–49 = Good, with room for improvement
30–39 = Moderate, needs improvement
<30 = Poor public life environment

Figure 5. Public Perspective analysis questionnaire (By the Author)

M2 was used to identify the lived experiences and perceptions of everyday users, complementing the structured observational assessment of M1. Together, M1 and M2 enabled a holistic evaluation of Friedrichstraße by combining design intent, observed behavior and public perception.

RESULTS

The combined findings from walkthrough and behavioral mapping in M1 reveal a consistent gap between spatial design provisions and actual livability outcomes. Walkthrough scores ranged from 24/60 to 45/60. Zone 3 (Unter den Linden Area) performed best due to its strong visual identity and activity diversity. In contrast zone 4 (Leipzigerstraße to Zimmerstraße) and zone 5 (Kochstraße to Zimmerstraße) scored the lowest (26/60 and 24/60), indicating poor comfort, accessibility and aesthetics. (Figure 6)

Category	Criteria	Observations Summary				
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Comfort	1.Opportunities to walk	Sidewalks present but narrow and often obstructed	Narrow pedestrian paths on bridge, limited freedom	Excellent pedestrian path	Space available, but circulation disrupted	Continuous sidewalks but tight near curbside parking
	2. Opportunities to stand/stay	No designated areas to pause safely	No designated areas to pause safely	Few ledges or leaning spots	Mostly people waiting or taking photos, not staying	No real thresholds or edges to linger
	3. Opportunities to sit	Very limited seating, mostly commercial/private	No seating infrastructure at all	Sparse benches; uninviting	Almost no seating options	Minimal seating, few built-in surfaces or benches
	4.Opportunities to see	Historic buildings nearby, but visual interest low at eye level aesthetics	Scenic river views, but lacking human-scale aesthetics	Grand boulevard, strong axis, but static	Strong symbolism, limited visual diversity	Monotonous facades, signage-heavy, lacks human-scale detail
	5. Opportunities to talk/hear	Traffic noise dominates, low acoustic comfort	Loud traffic noise, echo from bridge structure	Wide spaces make conversation difficult	Noisy due to traffic; few calm zones	High ambient noise from traffic; not socially
	6. Opportunities for play/exercise	None observed; not child-friendly	None, purely functional space	No playful or interactive elements	No elements supporting playful use	No child friendly or flexible recreational spaces
Protection	7.Protection against elements	Few awnings or covered walkways	No shelter, exposed walkway	Limited shade, minimal shelter	Very limited trees/shade/shelter	No shaded paths, minimal shelter
	8. Protection against accidents	Heavy vehicular traffic, limited pedestrian barriers	Cars dominate both bridge access and nearby streets	Wide sidewalks, but high-speed bike lanes nearby	Well-lit, but feels impersonal at night	Narrow sidewalks, cars dominate intersections
	9. Protection against crime	Well-lit, moderate foot traffic, but inactive zones at night	Less footfall at night, underpasses nearby	Well-lit, but feels impersonal at night	Heavy car traffic close to pedestrian areas	Passive surveillance limited at night, moderate activity during day
Enjoyment	10.Human-scale design	Some potential with surrounding built form, but over shadowed by roads	Exposed, car-oriented; low pedestrian comfort	Too monumental, lacks intimacy	Wide street, lacks intimacy	Over-scaled buildings, lacks intimacy
	11.Opportunities to enjoy positive sensory	Transit-oriented node, but lacks social function or distinctiveness	Iconic bridge, but underused as public space	Historic, but not "owned" by the public	Generic signage, less visual richness	Poor identity, functions as a pass through zone
	12.Aesthetic and character	Low greenery, limited artistic or local identity features	Views are good, but physical space lacks charm	High architectural quality, but cold	Generic signage, little visual richness	Bland, transitional space with few aesthetic qualities
	Score	**30/60**	**35/60**	**45/60**	**26/60**	**24/60**

Figure 6. Evaluation summary of walkthrough (By the Author)

However, behavioral mapping data revealed even sharper weaknesses across all zones. Social interaction was limited with average stay time rarely exceeding five minutes and livability scores dropping as low as 4/15 in Zone 5. Although the design-based assessment showed some potential, actual user patterns indicated low engagement, limited functions and lack of inviting places for social interaction. (Figure 7) This highlights that infrastructure alone cannot ensure vibrancy; successful urban life depends on design features translating into real social activity. In Friedrichstraße, this transformation was missing, especially in the sections that in lower scored lowest.

Figure 7. Evaluation summary of behavioral mapping (By the Author)

Results from the public perception scores confirmed the findings of M1 while adding insight into lived perceptions of comfort and sociability. Scores ranged from 14/60 to 51/60, reflecting clear disparities along Friedrichstraße. Zone 3 again performed best (51/60), confirming its status as the most active and attractive stretch, while zone 5 collapsed to just 14/60, reflecting poor seating, limited activities and weak sense of place. (Figure 8) Public ratings closely aligned with observational based results, particularly in areas where design failed to translate into meaningful social use. While Access and Linkage were rated relatively well in some zones, Comfort, Sociability and Activities scored consistently low, highlighting the absence of inviting amenities and opportunities for interaction.

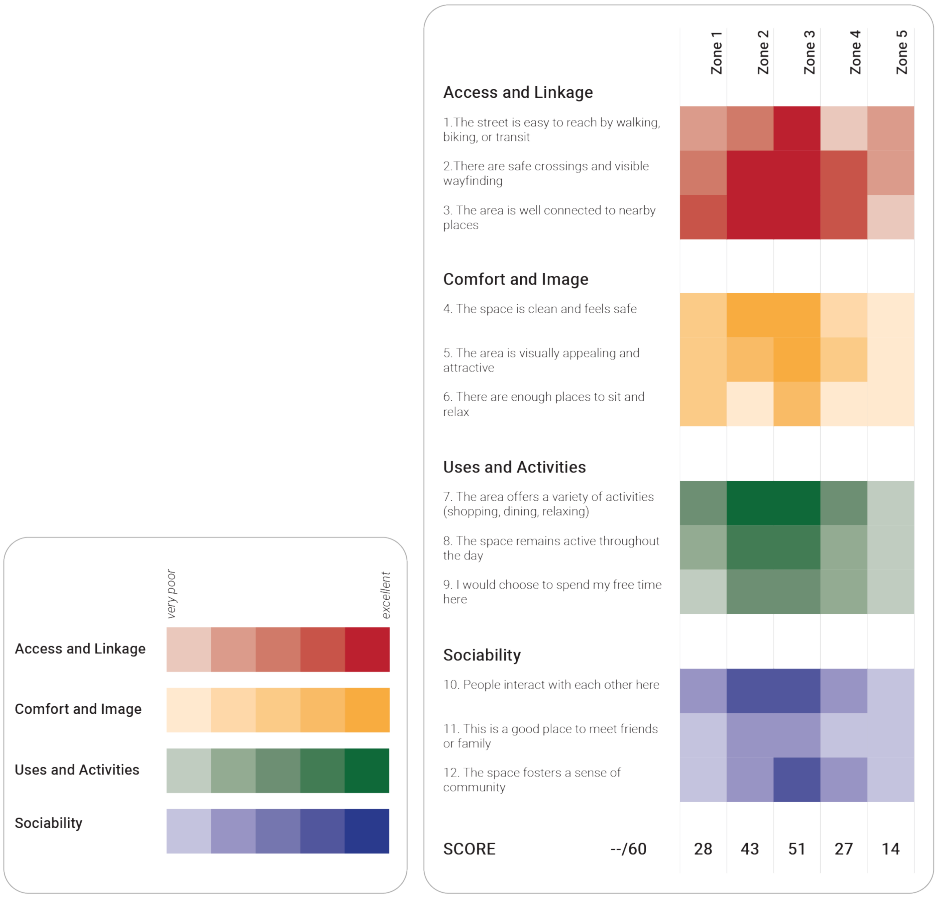


Figure 8. Evaluation summary of Public Perception (By the Author)

The synthesis of M1 and M2 reveals a clear and converging narrative: Friedrichstraße struggles to balance its role as a transit-oriented corridor with its potential as a vibrant urban space. While walkthrough observations indicated modest design qualities (score averaging 32/60), behavioral mapping showed limited actual engagement (average 8/15) and short stay duration. Public perspective aligned with these shortcomings with two zones (4 and 5) recording critically low livability scores (27/60 and 14/60). Only zone 3 consistently performed well across all methods, showing that where design, activity diversity and user perception align with livability thrives. (Figure 9)

Zones	M1: Place Performance Evaluation with one's own observations		M2: Place Performance Evaluation with Public perspective
	Walk through	Behavioral Mapping	
Zone 1	**30/60**	**07/15**	**28/60**
Zone 2	**35/60**	**10/15**	**43/60**
Zone 3	**45/60**	**13/15**	**51/60**
Zone 4	**26/60**	**6/15**	**27/60**
Zone 5	**24/60**	**4/15**	**14/60**

Figure 9. Place Performance Evaluation (By the Author)

DISCUSSION

Berlin's *Berlin Strategy-Urban Development Concept 2030* outlines its long-term development priorities, structured through core values, strategic fields and spatial transformation areas.[17] The strategy aims to guide the city toward becoming a sustainable, cosmopolitan, socially inclusive and mobility connected metropolis. The key strategies include enhancing city friendly accessibility and mobility by ensuring that the urban street network supports multiple modes of movement while remaining inclusive and resilient; promoting green and livable neighborhood that foster social inclusion, diversity and ecological balance; and encouraging participatory planning and collaborative governance through transparent and inclusive development processes.

Aligned with the Berlin Strategy 2030, this study explores urban voids within Friedrichstraße as a micro-testbed for activating the overlooked city spaces in service of mobility integration, social vitality and ecological resilience. The street's transformation and particularly its underutilized voids reflect a broader municipal vision of sustainable, people centered urban transformation. By addressing these voids through human centered and participatory approaches, the research supports Berlin's strategic objective of improving accessibility, enhancing neighborhood livability and promoting collaborative public space design.

CONCLUSION

This research demonstrates that Friedrichstraße's urban voids often overlooked as residual or transitional spaces that hold untapped potential to enhance livability, inclusivity and community life. Through a combination of design focused observations, behavioral mapping and public evaluation, the study identified critical shortcomings in accessibility, comfort and sociability. These voids are not simply empty plots; they reflect planning approaches that prioritize infrastructure and symbolic landmarks over everyday needs of people. In aligned with Berlin's Urban Development strategy 2030, the findings highlight the importance of transforming these neglected spaces into dynamic assets that support mobility, sustainability and social vitality.

To bridge this gap between policy goals and lived experience, the study proposes a practical toolkit of seven, offering a step-by-step framework to transform voids into meaningful and activity places. These tools are organized into three overarching stages: Assessment, Co-Design and Implementation.

Assessment

1. Understanding Placemaking: reframing voids from “leftover” to “potential”
2. Void Mapping and Assessment: exposing invisibility and highlighting opportunities
3. Public Life Observation: centering user’s lived realities
4. Design Element Identification: layering comfort, safety and aesthetics

Co-Design

5. Co-Creation and Engagement: fostering community ownership
6. Prototype: testing ideas through low risk, experimental interventions

Implementation

7. Implementation of the Plan (Short term and long term): ensuring sustainable transformation

These tools aim to inspire human-centered planning strategies that extend beyond Friedrichstraße, providing a replicable framework adaptable to cities worldwide. By inviting urban planners, policy makers and scholars in inclusive, experience driven design, the toolkit promotes the transformation of neglected urban voids into culturally vibrant, socially connected and resilient public places. Furthermore, the research identifies potential areas for future design interventions, providing a practical pathway for designers to develop context specific solutions build up on the findings. Ultimately, this research promotes a shift in urban practice from designing cities as static infrastructure to shaping them as evolving, human-centered environments where public life thrives.

NOTES

[1] Bettina Restle, “Berlin Reopens Friedrichstraße Boulevard to Cars,” *DW News*, November 21, 2022, https://www.dw.com/en/berlin-reopens-friedrichstrasse-boulevard-to-cars/a-63812425.
[2] Roger Trancik, *Finding Lost Space: Theories of Urban Design* (New York: Van Nostrand Reinhold, 1986), 1–37.
[3] Kevin Lynch, *Good City Form* (Cambridge, MA: MIT Press, 1984), 111–120.
[4] Wouter Nefs, “Unused Urban Space: Conservation or Transformation? Polemics about the Future of Urban Wastelands and Abandoned Buildings,” *City & Time* 2, no. 1 (2006): 47–57.
[5] Luisa Bravo, “Open Spaces, Public Spaces, Publics, Open-minded Places,” *Open Spaces*, May 2013, 1–3, doi:10.6092/issn.2036-1602/3708.
[6] Valeria Mariani and Patrick Barron, *Terrain Vague* (New York: Routledge, 2014), 89–104.
[7] Trancik, *Finding Lost Space*, 1–37.
[8] Omnia Mamdouh Hashem, Sherine Mohy-Eldin Wahba, and Tarek Ibrahim Nasr-Eldin, “Urban Voids: Identifying and Optimizing Urban Voids’ Potential as a Revitalization Source in Enhancing Developing Countries’ City Income,” *Journal of Engineering and Applied Science* 69 (2022): 7–13.
[9] Jan Gehl and Birgitte Svarre, *How to Study Public Life* (Washington, DC: Island Press, 2013), 1–36.
[10] Jan Gehl, *Cities for People* (Washington, DC: Island Press, 2010), 32–36.
[11] Project for Public Spaces, *Placemaking: What If We Built Our Cities Around Places. A Placemaking Primer* (New York: Project for Public Spaces, 2022), 2–10.
[12] Andreas Huyssen, “The Voids of Berlin,” in *Future City: Experiment and Utopia in Architecture*, ed. Jane Alison (New York: Routledge, 2005), 57–81.
[13] Restle, “Berlin Reopens Friedrichstraße Boulevard to Cars.”
[14] Gehl and Svarre, *How to Study Public Life*, 1–36.
[15] Gehl, *Cities for People*, 32–36
[16] Project for Public Spaces, *Placemaking*, 2–10.
[17] Senate Department for Urban Development and the Environment, *Berlin Strategy: Urban Development Concept 2030* (Berlin: Senate Department, 2015), 23–57, https://backend.use.metropolis.org/system/images/1935/original/BerlinStrategie_Broschuere_en.pdf.

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REVALUATING LIVABILITY THROUGH THE CONCEPT OF THE IN-BETWEEN REALM

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INTRODUCTION

Urban livability is frequently evaluated through a range of indices that give emphasis to the quantitative indicators such as transportation efficiency, infrastructural development, access to education, and the quality of healthcare services. While these metrics provide valuable insights into the functional dimensions of urban life, their dominance tends to overshadow the invisible but significant web of everyday relationships that shape urban experience.

Rather than approaching livability through these measurable elements, this paper highlights qualitative aspects, particularly how things relate to one another. The emphasis is given to the concept of the in-between realm developed by Aldo van Eyck and later interpreted by Herman Hertzberger. Drawing on insights from my doctoral research,[1] the paper critically examines selected projects by van Eyck and Hertzberger to uncover the multiple meanings and implications of this very concept.

A Paradigm Shift within CIAM Meetings

Starting at La Sarraz, Switzerland in 1928, CIAM (*Congrès Internationaux d'Architecture Moderne*) meetings are organized in order to find solutions to the problems of architecture and planning and to spread the modern movement throughout the world. The first CIAM meeting issues a declaration reflecting its concern with addressing the shortcomings of 19th-century cities and meeting people's physical needs. The second meeting (Frankfurt, 1929) concentrates on affordable housing types; the third (Brussels, 1930) examines issues of urban planning; and the fifth (Paris, 1937) turns to housing, leisure, and rural planning.

The fourth CIAM (Athens, 1933) has a significant influence on the built environment and everyday practices due to the fact that it presents an urban scheme that offers a separation of different functions. These functions are: dwelling, work, leisure, and transportation. The aim of this separation is to improve living conditions of people; yet, due to that separation, the automobile starts to dominate the built environment by surpassing the value of the human.

After the second world war, with the sixth CIAM meeting (Bridgwater, 1947), it is possible to see the first traces of the coming paradigm shift.[2] At CIAM 6, the Dutch architect Aldo van Eyck brings up the idea of the relationship between things by referring to Piet Mondrian's statement: "the culture of particular form is approaching its end. The culture of determined relations has begun." Van Eyck is the first to raise the significance of relations in the world of modern architecture.[3] This idea of the relationship between things is further developed at the forthcoming CIAM meetings by various architects including Jacob Bakema and Alison-Peter Smithsons.

THE IN-BETWEEN REALM IN ALDO VAN EYCK'S ARCHITECTURAL THINKING

These early discussions of the relationship between things can be seen as laying the groundwork for Aldo van Eyck's later articulation of the in-between realm. Van Eyck, indeed, creates a network of relations by bringing together a wide range of sources, including poetry, philosophy, anthropology, art, science, and architecture. While Mondrian's influence is already evident at CIAM 6, van Eyck also draws from a wider circle of avant-gardists, his anthropological visits to Africa, and most significantly, the philosophy of Martin Buber.[4] Through these diverse influences, he develops the concept of the in-between realm.

He defines the in-between realm as a common ground where conflicting polarities can meet, have relations, reconcile, and become twin phenomena.[5] These polarities include but are not limited to public and private, unity and diversity, part and whole, small and large, many and few, simplicity and complexity, change and constancy, order and chaos, and individual and collective. The reconciliation of the polarities neither neutralizes each other nor creates something totally new.[6] Thus, van Eyck does not suggest a synthesis of the polarities, but rather he argues that the polarities should not lose their original identities and should stay as they are. For van Eyck, the in-between realm is a "place" that offers "multiple meaning in equipoise".[7]

It also needs to be emphasized that, unlike the recent usage of the in-between realm or in-between space, which mostly connotes the space between the public and private, van Eyck defines in-between realm as the place for various relationships.[8] One illustrative example is his reflection on walking along the shoreline, where land and sea meet. Here, the in-between realm emerges not from a forced reconciliation but from a simultaneous experience of both elements, allowing a unique relational perception to unfold.[9] Similarly, Piet Mondrian's painting named "Composition No. 10 Pier and Ocean" (1915) can be read as a visual analogy: the pier, as an extension of the land, interacts with the ocean in a way that it is neither fully land nor fully sea, creating a spatial in-between that embodies van Eyck's concept.

At the last CIAM meeting, van Eyck presents the Otterlo Circles (Figure 1), which depict the concept of the in-between realm. The circle on the left has the images of a Greek temple, Theo van Doesburg's 1911 drawing, and an Indian Pueblo, symbolizing the reconciliation of the classical, modern, and archaic traditions.[10] Van Eyck argues that these different traditions should not be considered exclusive but should be reconciled within a shared common ground. This circle, thus, illustrates the in-between realm as an area where polarities coexist without losing their distinct identities. While "by us" emphasizes the architect's role in creating this common ground, "for us" on the second circle refers to the community of citizens who inhabit it. This second circle, depicting a dancing group of Kayapo Indians,[11] highlights the dynamic and ever-changing nature of human relationships. Taken together, the Otterlo Circles express the tension between permanence and change, suggesting that architecture should provide space for both stability and transformation.

Significantly, the in-between realm does not remain a theoretical construct. Van Eyck translates it into practice through his built works. In collaboration with Sandy van Ginkel, van Eyck is commissioned to design three primary schools in Nagele, which are the schools for a Protestant-Christian, a Roman Catholic and a larger state school (Figure 2).[12] These schools are positioned in such a way that the central green is located at the center of these schools and acts as an in-between realm for these schools. This plan layout concretizes the principles expressed in the Otterlo Circles by establishing a common ground among distinct institutions.

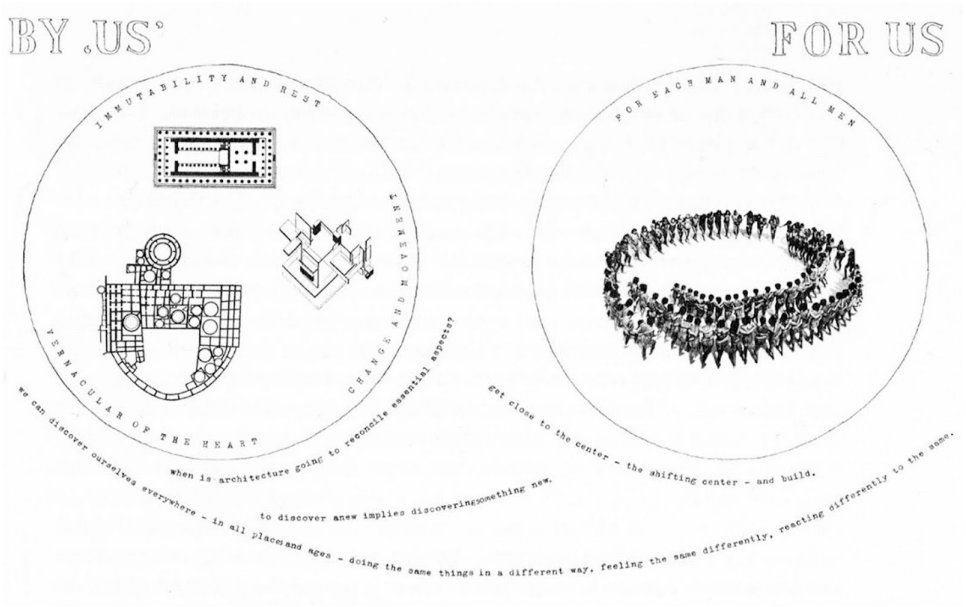

Figure 1. The Otterlo Circles.

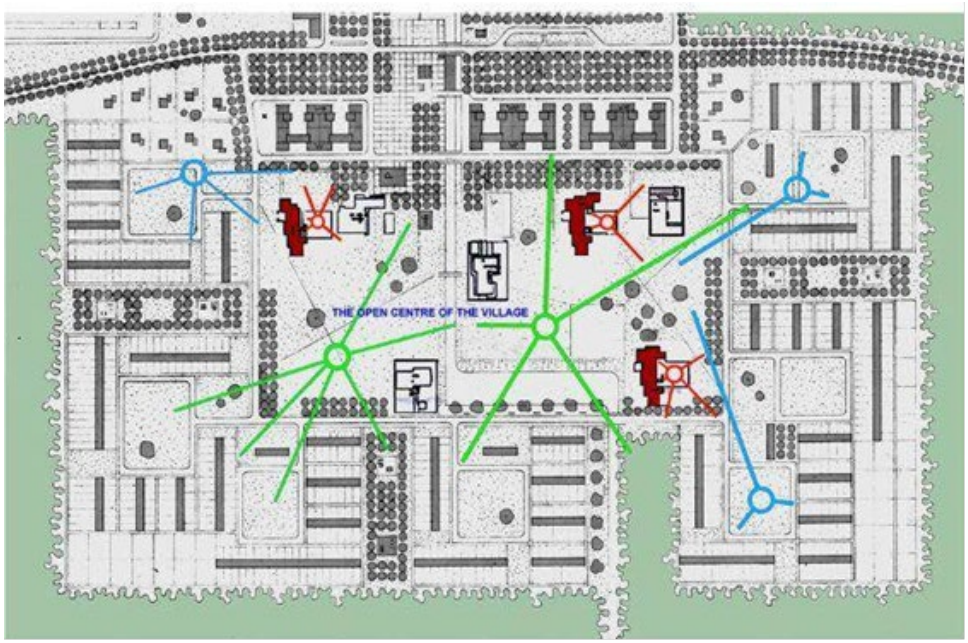

Figure 2. Nagele Plan - The Open Centre of the Village.

The schools themselves provide various forms of in-between areas as well. In the state school plan (Figure 3), the corridor connecting classrooms functions as more than a circulation area; it acts as a street, linking classrooms and creating relationships between public and private spaces even within the building.[13] The colorful spaces are designed as cloakrooms, which further serve as in-between areas between the corridor and classrooms. Each classroom features two L-shaped glazed walls, providing visual connections between inside and outside, and acting as additional in-between areas. Although regulations prohibited classroom doors opening to the exterior, van Eyck innovatively designs windows that function as doors.[14] These small doors and big windows create both accessibility and visual continuity while establishing an in-between realm between small and large. At the heart of the school, the playground further embodies the in-between realm, mediating between the central green and the school building itself.

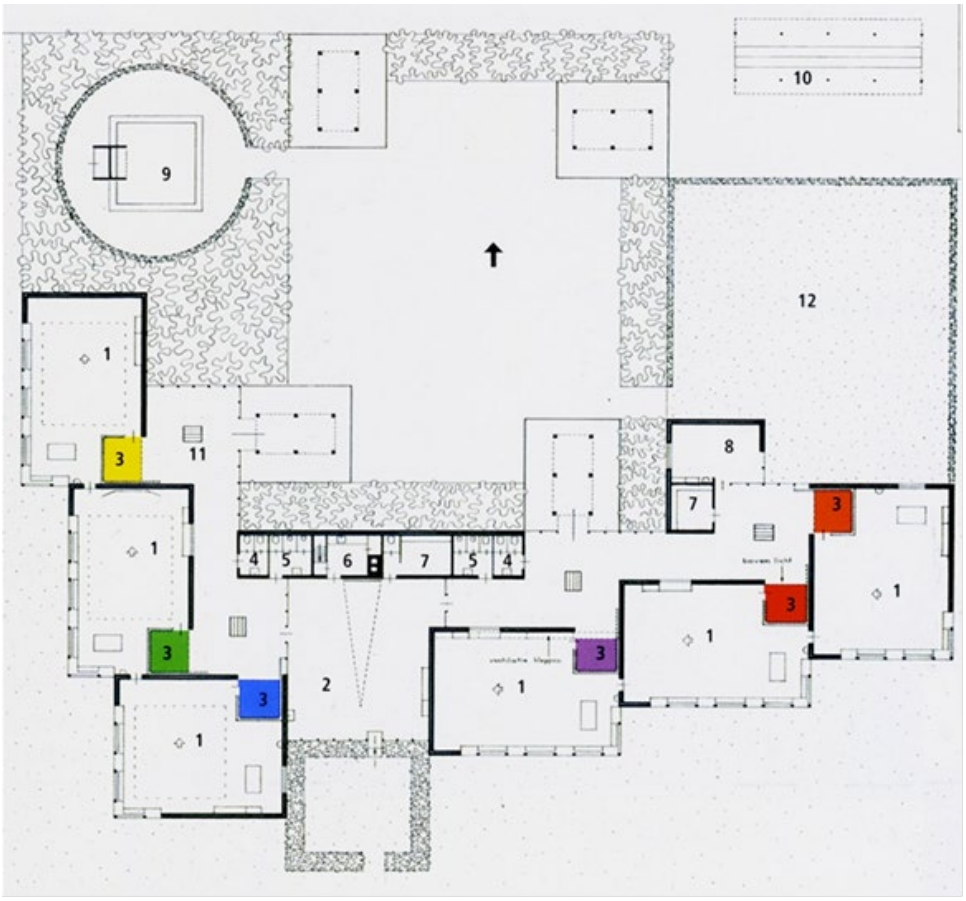

Figure 3. Nagele State School Ground Floor Plan.

It is not only the Nagele school playground that provides an in-between realm, but van Eyck designs many playgrounds in Amsterdam, which are considered to be the concrete examples of in-between areas. From 1947 to 1970, he designs more than 700 playgrounds, transforming vacant lots, forgotten areas, leftover spaces between buildings, neglected greenery, and even roundabouts into active urban spaces (Figure 4).[15] Rather than relying on standardized equipment, he employs basic archetypes such as domes, igloos, and arches, allowing children to sit, climb, hide, and explore, thereby enabling them to participate via their activities and transform space into place.[16]

Figure 4. The playground in Van Hogendorpplein, before and after [1953].

Van Eyck explicitly designs these playgrounds to be inclusive, not only for children but for all citizens, creating areas where different age groups can interact. He argues that the meaning of a playground changes with use: climbing frames can serve as seats or a tarpaulin thrown over an arch can turn it into a tent.[17] During a school break, for instance, a climbing arch can accommodate 30 girls aged 15 to 17, all sitting and eating their sandwiches, transforming the structure into an aluminium hill.[18] This demonstrates how a single piece of playground equipment can simultaneously serve multiple users and purposes, creating a flexible and participatory environment. This flexibility illustrates how everyday use can create both intended and unintended experiences, reinforcing the playground as an in-between realm where stability and spontaneity coexist.

Furthermore, van Eyck deliberately omitted fences, encouraging awareness of the surrounding urban context, slowing down traffic, and countering the dominance of the car. This subtle tension between safety and danger itself constitutes an in-between realm, emphasizing the relational nature of space and experience.

His playgrounds have a profound impact on Frans van Meurs, head of the orphanage, who commissions van Eyck to design a new municipal orphanage. The Amsterdam Orphanage (1955–60) (Figure 5), perhaps becomes the clearest expression of van Eyck's search for creating in-between areas where multiple opposites can coexist. Arguing that "a house is like a small city if it's to be a real house – a city like a large house if it's to be a real city,"[19] van Eyck designs the orphanage with the main idea of a "house like a city." He anchors the orphanage to the street through a large open square, which acts as an in-between realm that gently leads the way and thus helps to mitigate the abrupt transition between the reality outside and inside.[20] Extending the public domain, this square appears to encourage interaction between neighborhood children and the orphanage children and it also serves as a gathering place for these children.[21] Within the building, an interior street connects different functions and doubles as a playground, further reinforcing the continuity between circulation and play. Responding to van Meurs's request, van Eyck also calibrates the dimensions of the building to the children's scale not by lowering ceilings, but by embedding intimate play areas beneath the larger domed spaces.[22] In this way, small and large coexist, allowing both scales to be experienced simultaneously and enriching the spatial complexity of the orphanage.

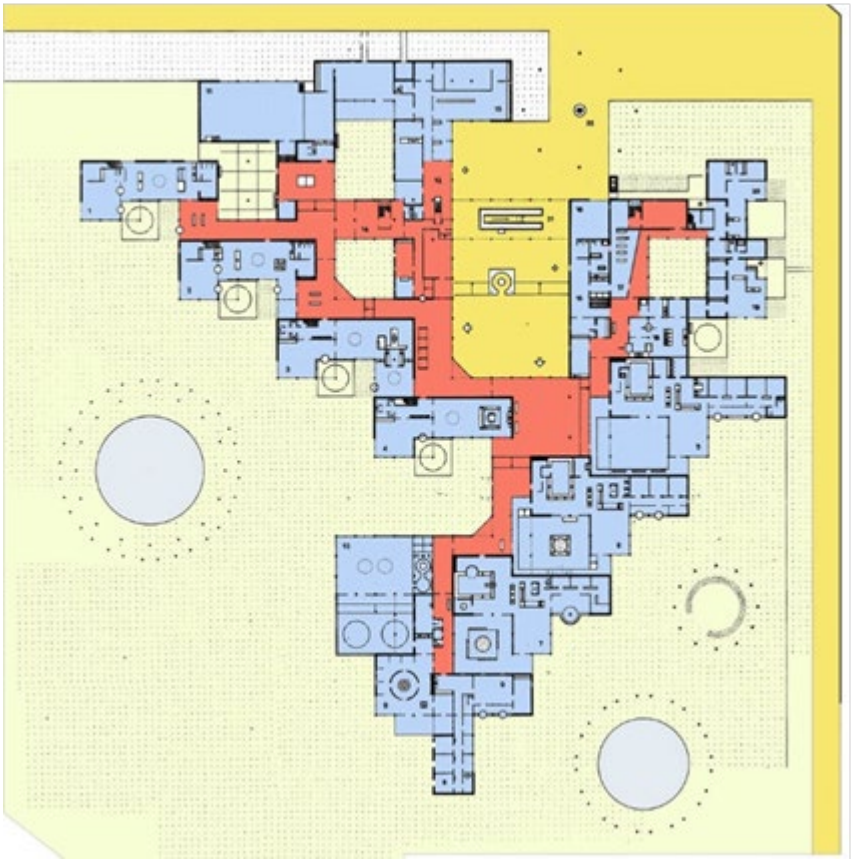

Figure 5. Amsterdam Orphanage Ground Floor Plan.

THE IN-BETWEEN REALM IN HERMAN HERTZBERGER'S ARCHITECTURAL THINKING

The in-between realm is also a significant concept in Herman Hertzberger's architectural thinking. Deeply influenced by Aldo van Eyck, whom he regards as his "architectural father," Hertzberger reinterprets the concept with various meanings, but his particular emphasis is on the relation between public and private. For him, "public" and "private" are the spatial translations of "collective" and "individual."[23] He defines the public as the area accessible to everyone who is held responsible for the maintenance whereas the private is defined as an area whose accessibility and responsibility are rather restricted to a small group or one individual.[24]

Hertzberger's contribution lies in recognizing the gradations between these two poles. He argues that spaces can be semi-public or semi-private, depending on their accessibility, their users, and the responsibilities attached to them.[25] By slightly adjusting the qualities of public and private areas, architects can create in-between areas that allow users to appropriate and transform space over time.

Diagoon Dwellings (1967-70) exemplifies this approach. The areas in front of the dwellings are not distributed to the dwellings, but they are paved with concrete tiles as if they are part of the public domain. In fact, the intention is to leave these areas in the hands of the residents so that they can decide on how to utilize these areas. As Hertzberger aimed at, in time, the residents remove some of the tiles in order to plant plants and leave the rest to the public domain. According to Hertzberger, if the design proposed a layout of separate and private areas given to the dwellings, there would be a separation between public and private areas. With this layout, the users are given a suitable condition to appropriate; thus, an in-between realm, an intermediary zone between public and private, emerges.[26]

Similarly, in *De Drie Hoven* (1964–74), a home for the elderly, Hertzberger allows users to appropriate their living environments. Like van Eyck, he conceives the buildings as a city, where in-between areas

can emerge within. Placed along the hallways that serve as streets, all the dwelling units have porch-like areas, which are personalized by the inhabitants with their plants or personal belongings (Figure 6).[27] Since there is no parapet or fence between these porch-like areas and the streets, these areas are both part of the street and the dwellings, forming in-between areas. Additionally, these dwelling units have two-part doors, whose upper can be left open like a window. With their porous quality, these doors create opportunities for spontaneous chats (Figure 6).[28] Through such details, the hallway becomes more than a passage, serving as a social and transitional space.

Figure 6. The porch-like area in De Drie Hoven (L), Two-part doors (R).

The same logic shapes educational projects such as the Montessori School in Delft (1960-66). Acting as a small city, the school contains entrances that double as social spaces, hallways that function as gathering places, and classrooms conceived as autonomous houses along a street. Outdoor extensions of classrooms allow work to spill outside (Figure 7), while movable wooden blocks can be used for gathering, sitting, doing homework, playing games, or even performing dance and music performances.[29] In every case, space is left open-ended, enabling multiple uses and encouraging appropriation.

Figure 7. The hallway in Montessori School accommodating multiple functions.

Hertzberger extends this principle to larger programs like the Centraal Beheer office building (1970–72). Conceived as a city composed of small, open elements, the layout offers workspaces for both individuals and groups for various purposes. While it provides an area for both private and public, it also allows the users to use the spaces in many different functions. In section as well as in plan, voids allowed visual connections between users across different levels, reinforcing the sense of community through spatial relationships.

CONCLUDING REMARKS

This paper has argued for a reconsideration of livability through the concept of the in-between realm. By examining the works of Aldo van Eyck and Herman Hertzberger, it has highlighted how architecture can transcend purely functional provision and contribute to the qualitative dimensions of urban life. Both architects demonstrate that livability is not reducible to quantitative indicators but is deeply rooted in the relational fabric of everyday experience. Their projects suggest that the in-between realm is not an incidental by-product of design but a deliberate and critical tool for cultivating livability.

In contemporary cities, where efficiency, density, and economic imperatives often dominate planning agendas, the insights offered by the in-between realm become increasingly urgent. Revaluating livability through this lens draws attention to the necessity of designing spaces that embrace multiplicity, foster social interaction, and allow for flexibility and appropriation. Such an approach reasserts that livability cannot be fully captured by indices or standards but must be understood as an ongoing process of negotiation between people, spaces, and the relationships they engender.

NOTES

[1] Tuğba Özer, “From Relationlessness to Relatedness: Alienation and the In-Between Realm Revisited,” PhD Thesis (Middle East Technical University, 2022).
[2] Özer, *From Relationlessness to Relatedness*, 64.
[3] Francis Strauven, *Aldo van Eyck: The Shape of the Relativity* (Amsterdam: Architectura & Natura, 1998), 471.
[4] Strauven, *Aldo van Eyck: The Shape of the Relativity*, 352.
[5] Aldo van Eyck, *The Child, The City and the Artist: An essay on architecture: The in-between realm*, ed. Vincent Ligtelijn and Francis Strauven (Amsterdam: SUN, 2008), 55, 61, 63, 220.
[6] Nathaniel Coleman, "Aldo van Eyck’s utopian discipline," in *Utopias and Architecture* (New York: Routledge, 2005), 201-202.
[7] Aldo van Eyck, *The Child, The City and the Artist*, 55.
[8] Tuğba Özer, “Revisiting Aldo van Eyck’s Concept of the In-Between Realm,” *METU Journal of the Faculty of Architecture* 40, no. 1 (2023): 53, doi: 10.4305/METU.JFA.2023.1.2.
[9] Aldo van Eyck, *The Child, The City and the Artist*, 56.
[10] Aldo van Eyck, *Aldo van Eyck, works,* ed. Vincent Ligtelijn, trans. by Gregory Ball (Basel; Boston; Berlin: Birkhäuser Publishers, 1999), 13.
[11] Aldo van Eyck, *Collected Articles and Other Writings 1947-1998*, ed. by Vincent Ligtelijn and Francis Strauven (Amsterdam: SUN, 2008), 468.
[12] “The 2013 Nagele Exhibition,” accessed May 1, 2024, https://vaneyckfoundation.nl/2018/11/21/the-2013-nagele-exhibition/.
[13] “The 2013 Nagele Exhibition,” accessed May 1, 2024, https://vaneyckfoundation.nl/2018/11/21/the-2013-nagele-exhibition/.
[14] “The 2013 Nagele Exhibition,”.
[15] Aldo van Eyck, *Aldo van Eyck, works*, 68, 70.
[16] Aldo van Eyck, *Collected Articles and Other Writings 1947-1998*, 115.
[17] Aldo van Eyck, *Collected Articles and Other Writings*, 113.
[18] Aldo van Eyck, *Collected Articles and Other Writings*, 113.
[19] Aldo van Eyck, *The Child, The City and the Artist: An essay on architecture: The in-between realm*, ed. Vincent Ligtelijn and Francis Strauven (Amsterdam: SUN, 2008), 10, 60.
[20] Aldo van Eyck, *Collected Articles and Other Writings*, 318.
[21] Francis Strauven, *Aldo van Eyck: The Shape of the Relativity* (Amsterdam: Architectura & Natura, 1998), 289.
[22] Strauven, *Aldo van Eyck*, 297.
[23] Herman Hertzberger, *Lessons for Students in Architecture*, trans. by Ina Rike (Rotterdam: 010 Publishers, 2001), 12.
[24] Hertzberger, *Lessons for Students in Architecture*, 12.
[25] Hertzberger, *Lessons for Students in Architecture*, 13-14.
[26] Hertzberger, *Lessons for Students in Architecture*, 41.
[27] Hertzberger, *Lessons for Students in Architecture*, 40.
[28] Hertzberger, *Lessons for Students in Architecture*, 35.
[29] Hertzberger, *Lessons for Students in Architecture*, 153-154.

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WHAT WE MEAN WHEN WE TALK ABOUT PLACE – THE WORK OF THE PLACE COMMISSION FOR GLASGOW

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INTRODUCTION

In 2017, Glasgow's city administration made the decision to appoint a city architect using the model adopted in many European cities whereby a leading practitioner is invited to provide independent strategic design advice about the city and its places. Following consultation and discussion about the role, the title was changed to city urbanist.[1] In the United Kingdom, the term Urbanism has come into common usage in the 21st century as an all-embracing term covering city-design and place-making, and embracing the combined skills of urban planning, architecture, economic development and community engagement. Widespread use of the term urbanist to connote a practitioner of urbanism is more recent.[2]

CITY URBANIST & THE PLACE COMMISSION

"*cities have the capability of providing something for everybody, only because, and only when, they are created by everybody*." [3]

Upon appointment in 2019, the City Urbanist sought to establish an independent commission to examine the nature of place as a construct in Glasgow.[4] Seven highly respected individuals representing the different strands of urbanism were appointed as independent commissioners. The Commission took as its leitmotif this quotation from Jane Jacobs – to bring a vision of people-centred, community-orientated and bottom-up thinking to planning and development to complement top-down strategic planning of a city.[5]

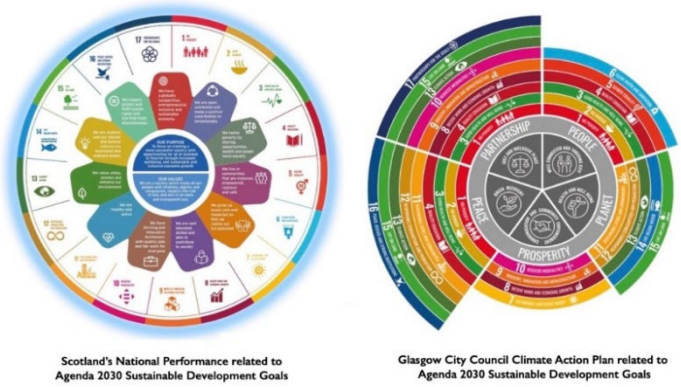

Figure 1. Scotland's National Performance Framework, the SDGs and the city of Glasgow's climate action plan.

The Place Commission would not, however, function in a policy vacuum. In 2018, the Scottish Government adopted a policy for place – The Place Principle – that was "*developed collaboratively with a range of organisations to provide a shared context for work to be undertaken in local places*".[6] The Scottish Government policy definition states that "*place is where people, location and resources combine to create a sense of identity and purpose, and is at the heart of addressing the needs and realising the full potential of communities*". The policy emphasises the importance of a "*shared understanding (and) collaborative approach to services and assets to achieve better outcomes for people and communities* (*through*) *joined-up, collaborative and participative approach to services, land and buildings*."[7] In 2019, the body politic in Scotland was debating how this policy might be operationalised. Glasgow's City Urbanist appointment and the Place Commission was therefore timely. The Scottish Government place policy is far-sighted, enshrines a 'Jacobean' ethic, and provided a launchpad for the work of the City Urbanist and the Place Commission. It places emphasis on the social and the physical and implies a need for a systems approach to delivery. Scotland's approach to place may be tracked back to the Government decision in July 2015 to became one of the first countries in the world to adopt the UN global goals for sustainable development (the SDGs).[8] Following early adoption of the SDGs, the Scottish Government established a National Performance Framework with 11 national outcomes for monitoring delivery.[9]

This work provided a coherent policy framework upon which to base the intent of the City Urbanist and the work of the Place Commission. As always, it is the granularity of policy delivery on the ground that affects the peoples' daily lives. At the community, or place, level there is a need to understand and reconcile the intent of government agencies, official bodies and service providers that have agency for, and impact on, place. The need for coordination of this system was made clear following a study undertaken to identify all those with agency to do something in, or to, a place shown graphically in Figure 2.

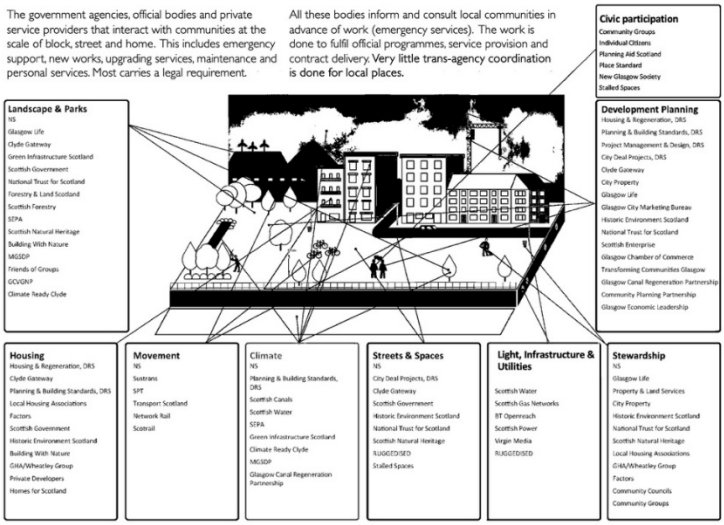

Figure 2. Place Players 'on the ground'.

PLACE IN GLASGOW

"*Place is everywhere, places are all around us. Everywhere is some place. Place is a general construct, a concept that gives everywhere some qualities and some specificity whether cultural, social, environmental or economic. And these in turn connote other qualities – ceremonial, beautiful, tranquil, vibrant, community, busy, unloved.*" [10]

To embody the proposition of place in Glasgow, it was necessary to bring some meaningful reality to the technocratic definition of place established by the Scottish Government, to coordinate and establish a system for its delivery, and put some tangible and accessible expression into the meaning of place in Glasgow. Place is multi-layered, multi-purpose and can be a contested concept. To work with communities to make interventions in their place it is necessary therefore to evolve principles around which consensus may be built, to help minimise dilemmas and challenges to be faced and overcome.

Place has been studied, loved, despised, written about and depicted for centuries. In the modern era two anthologies bookend writings on place – Swan's 1993 anthology *The Power of Place: Sacred Ground in Natural & Human Environments* through to Ellard's 2015 book *Places of the Heart: The Phychogeography of Everyday Life*. These two books, and an extensive body of work over the last 30 years, make it clear that the spiritual and psychological importance of places are every bit as important as their physical characteristics. This means that for place projects it is as important to understand the social, cultural and economic importance of place as much as the physical. This becomes viscerally important to a community when interventions in specific locations exemplify the need for explicit local principles and a narrative to explain and engage with communities. At the very least, place must be **both** a cultural and physical construct.

Place, like beauty, is a general construct that everybody knows about and everybody buys into. When it comes to intervening in place, we need to be more specific and have a clearer understanding of what we wish to do and how we can engage with communities to ensure that they themselves have agency with, and can participate in, developments in **their** place.

To understand quality of place and its relationship with the value of place, Carmona's UCL research illuminates how place quality interacts with place value, going far beyond economic value to a much broader understanding that leads to health, social, economic and environmental outcomes.[11] One of the most significant strands of this research, and development from this thinking, is the degree to which citizens do, or do not, have an attachment to their place, and how this triangle of quality, value and attachment in place maybe brought together.

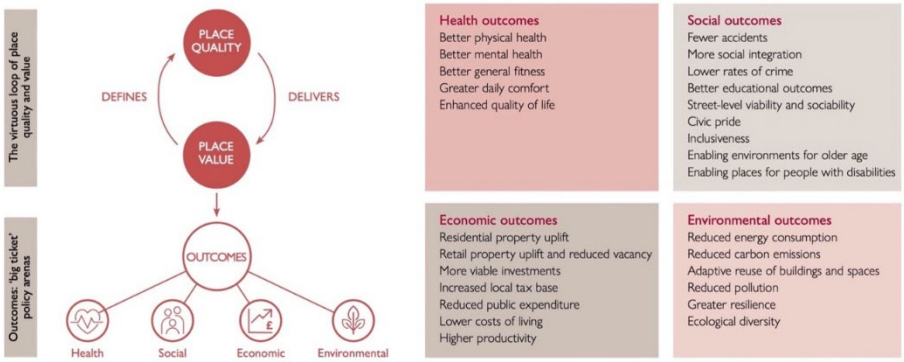

Figure 3. Place Quality, Place Value and Place Attachment

The Commission wanted to understand how Glasgow people understand and feel about their place. Normally this would involve diverse techniques for engagement with people from social and published media to focus groups and community planning weekends, to build cognitive, emotional, and behavioral understanding. But there was a problem. The first meeting of the full Commission took place in November 2019 and by the Spring of 2020 the UK was confronting a national emergency brought about by the COVID-19 pandemic and the country's cities, communities, and public life were in a period of

total lockdown. Public meetings and gatherings were banned for a period that lasted from March 2020 until June 2021.[12] The City Urbanist and the Commission faced a choice: to cancel altogether, postpone or find a creative proxy for engagement with the communities of Glasgow. In effect there was little real choice, for every senior public figure at every level was engaged either with fighting the pandemic directly or creatively applying every skill available to anticipate the outcome and recovery that would be necessary. In consultation with the City's leadership, it was resolved to establish an online engagement programme involving hundreds of professionals at local, national and international level, and whenever possible, local people.

To understand the psychology of Glasgow today it is necessary to know the modern history of a city that has seen massive change through four eras of transition and transformation in 150 years that still resonate: industrialisation and super growth (1850-1930), de-industrialisation and shrinking (1930-1975), regeneration and stability (1975-2015), and a just transition of climate awareness and modest sustainable growth (2015 – to date and on-going). It is of equal importance to understand the city's "bigness'. The city region of Glasgow is home to over one third of Scotland's population, on 5% of the country's territory.

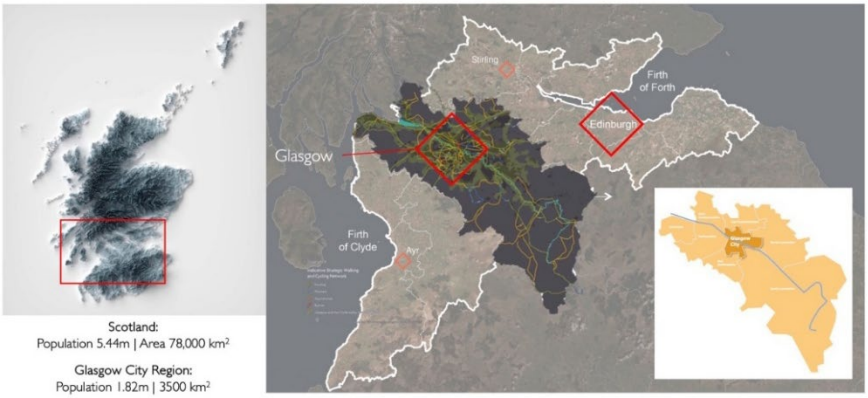

Figure 4. Metropolitan Glasgow in context

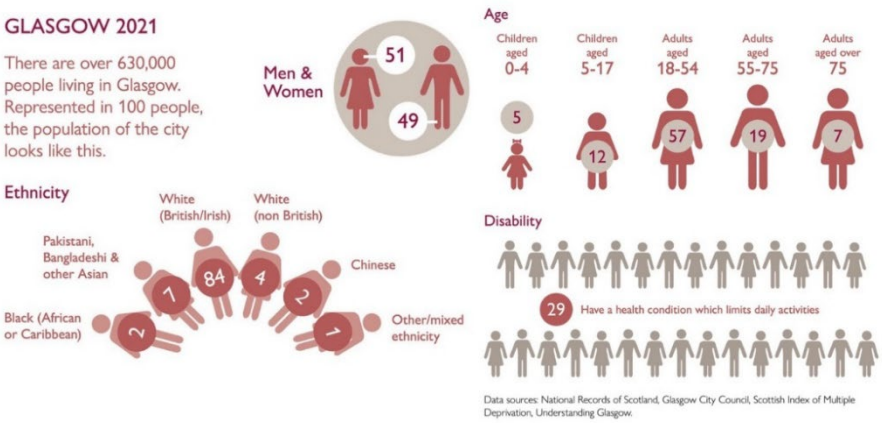

Figure 5. the demographic profile of Glasgow

The Commission mapped the spatial legacy of this change on the geography of the city.[13] To understand the psychological legacy, it is only necessary to reside in the city and spend time with its people. The other major legacy from this period is present in the demographics of the city in terms of gender balance, age cohorts, percentage of the population with a critical illness, disability or other health inhibiting conditions and the ethnic make-up of the city today.[14]

Engagement by Proxy

Real engagement remained an issue and a proxy engagement process with a very wide variety of individuals and representatives from professional, public and civic bodies with expertise across Glasgow, the UK and internationally was established to build up understanding and propositions that could be used in engagement with citizens.

The conclusions of this unique online exercise need to be reviewed with care and recognition of the heightened anxiety prevalent nationally and internationally that still ring true with the passage of some time. Glasgow has a diverse, present, active and engaged place ecosystem characterised by people, places, protagonists (the agencies and stakeholders engaged with people and place) that shape its future, and the policy environment that drives it. This ecosystem delivered a clearly stated view with shared ambition to:

- Build on Glasgow's spirit and distinctiveness;
- Deliver on social justice;
- Recover and reimagine the city following COVID;
- Turn to face the climate emergency; and,
- Nurture and develop the city's drive, innovation and productivity.

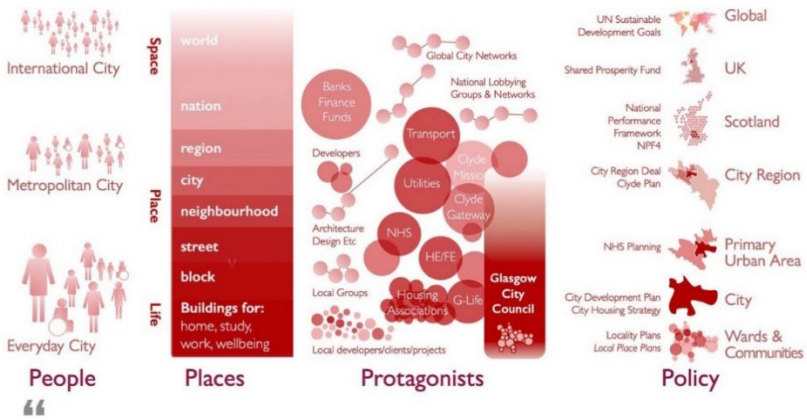

Figure 6. Glasgow's place ecosystem

This work helped validate the thematic hypothesis ventured by the City Urbanist upon appointment that Glasgow can best be appreciated as an international, metropolitan and everyday city.[15]

Place Analysis and Place Correlation

The principal focus of the City Urbanist and the Place Commission was the city itself, but Glasgow's functioning as an international, metropolitan and everyday city cannot be determined within the tight boundaries of the city itself. This is self-evident in terms of transport and natural systems but there are less obvious yet revealing findings that identified unexpected correlations within the wider city region. For example, it had been assumed that the geographies of domestic carbon retrofit and of social disadvantage in communities would be congruent and would be greatest within Glasgow City's boundary. But when these two variables were mapped, it was revealed that they had an inverse relationship. Disadvantaged communities are more prevalent within the city boundary as the affluent suburbs lie outside the city to the west and south in other local jurisdictions. However, the geography of carbon retrofit that is required across the city region to meet targets of energy performance in homes was revealed to have an inverse relationship to the geography of disadvantage across the eight municipalities of the city region. This dichotomy can be largely explained by Glasgow's housing policy

that, from the mid 1990s until the present day, has had an emphasis on energy efficient social and affordable housing in contrast with the privately owned neighbourhoods in the more affluent suburbs where there is less of a challenge with energy costs. Evidence like this underlines Glasgow's stated aspiration to pursue a policy of just transition towards net zero.[16]

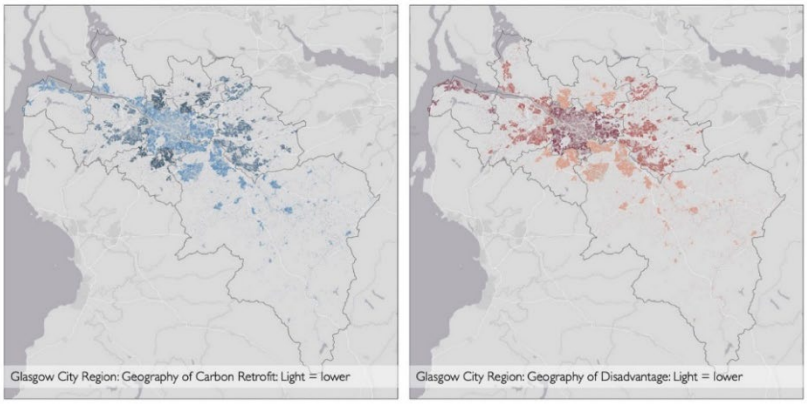

Figure 7. spatial correlations and place synergies in Glasgow City Region
Distribution of Energy efficient housing (left) and social disadvantage (right)

In *Mapping the Invisible Landscape*, Ryden makes the argument that the meaning of a place for the people who live there is best captured by their stories about what the place is and the events that take place there. By contrast, Greenfield's work on *Radical technologies in the 21st Century* clearly documents how the networks of digital information technology has become the dominant mode through which we experience the everyday.

Bringing the focus from the metropolitan to the everyday within Glasgow itself, the Commission's reviewed the spatial and human geography of Glasgow and considered exemplar place stories using the model of the 20-minute neighbourhood to identify a series of successful place projects and place stories that illustrate and exemplify a range of type, location and scale with a method for recording and analysing successful places across the city using a basket of criteria (Figure 8).

Sixteen diverse stories were selected, chosen for a very wide variety project typologies, from physical regeneration, capacity building, artistic interventions and environmental regeneration. These are what Jaime Lerner has described as urban acupuncture – the "*strategic placement of small, creative interventions, like a park or a single initiative, to revitalize 'sick' or 'worn out' areas of a city and trigger positive ripple effects for the entire system"* to support community pride and self-esteem, leading to increased community interaction". [17]

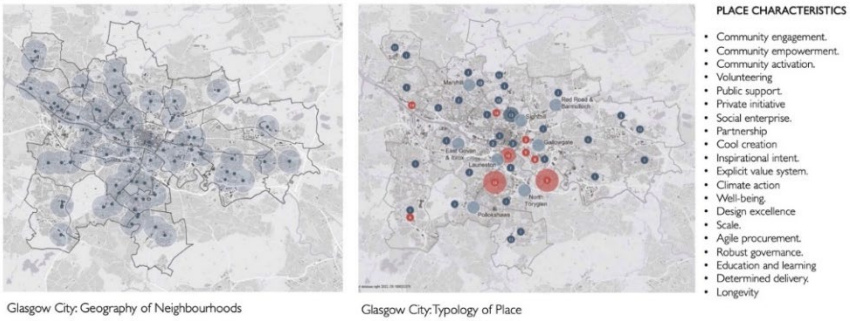

Figure 8. The geography of the 20-minute neighbourhoods in Glasgow (left) and distribution of Place Stories across the city.

FINDINGS, RECOMMENDATIONS AND REVIEW

The Place Commission advocated a shift in emphasis from plans and targets to outcomes for place and for climate learning using the success of the social and affordable housing programme as a model for a wider programme for place in the city and city region. In the first decade of this century, the publicly owned housing stock in Glasgow was, following a positive vote of tenant support, transferred to a new city wide registered social landlord, the Glasgow Housing Association.[18] The methods of asset transfer, funding, procurement and delivery, with occupant and tenant involvement has radically improved the performance of the social housing programme in the city and these lessons, including accountability and shared governance could serve as a model for transferring stranded assets to community development trusts to build a bridge between the data and the reality of place.

The Commission's report "PEOPLE make PLACES" was published in January 2023 and well received in the city and the press.[19] This was followed eighteen months later with an evaluation of the city urbanist's tenure and the work of the Place Commission including options for implementation and extension with propositions about engagement and actions that might be taken, using the data resource available to carry through into mapping, empowering, alignment, sharing and convening place.

(a) 'Now we are all thinking about the challenges we face though the unifying lens of Place.' 'If we hadn't had (this) input … we would have talked about place using the Scottish Government language and understanding rather Glasgow's language and understanding. This would have been a conversation in one direction.'

(b) 'The … approach to place has been hugely valuable internationally ... not many cities have the ability to communicate what they are doing so clearly'.

(c) 'The model of International, Metropolitan and Everyday helps understand developments in the city.' 'Nobody has ever encapsulated the meaning of Glasgow as a metropolitan city (now) acknowledged by Scottish & UK governments.'

(d) 'The place stories really do cement the idea that people make places, you can create the physical space but the life within that space comes from the human activity it inspires.'

(e) 'I think we all saw that what we need is system-shift. We all need to look up and see the system and think in new ways.'

Figure 9. Responses from participants in the review of the City Urbanist role.[20]

It can be difficult to establish quantifiable evidence for work of this nature. However, the review that was undertaken does provide a systematic analysis based on interviews with senior figures in the city and its major stakeholders. Responses reproduced at Figure 9 highlight the degree of attitudinal change to place amongst decision-makers, particularly in respect of the understanding of place (*quote a*), the value for promotion of the city (*quote b*), thinking of the city around its international, metropolitan and everyday character (*quote c*), the significance of a narrative based on place stories (*quote d*), and the importance of, and need for, systems thinking (*quote e*).

In the short term, there has been a degree of culture change in the City and a sharpening in focus on more integrated working and engagement with communities through the unifying lens of place together with a clearer understanding of systems thinking and the meaning of Glasgow as a metropolitan city. These have been reinforced through the strengthening or teams dedicated to place in the city itself and across the city-region.

NOTES

[1]See Glasgow appoints first ever city urbanist, accessed on September 1, 2025, https://glasgow.gov.uk/article/3237/Council-appoints-first-ever-City-Urbanist-for-Glasgow.

[2] In the first decade of this century, George Ferguson, then President of the Royal Institute of British Architects, together with John Thompson, the renowned community architect and urban designer, Kevin Murray, the former President of the Royal Institute of Town Planning, and the author, convened a working group to explore the practice of urbanism in the UK. This led in 2005 to the establishment of the Academy of Urbanism, publishing of a manifesto and established the Urbanism Awards to recognise places – and by extension their communities – rather than the author of their design(s). The Academy of Urbanism, accessed September 3, 2025, https://www.theaou.org/.
The manifesto was published in the AoU's first publication: *Learning from Place,* eds. Brian Evans, and Frank McDonald (London: RIBA Publishing, 2007).
https://books.google.co.uk/books/about/Learning_from_Place_1.html?id=rkIRNd1aUJUC&redir_esc=y.
Republished as *Space, Place, Life* Learning from Place 1, eds. Brian Evans, and Frank McDonald (London: Routledge, 2011).
https://www.google.co.uk/books/edition/Space_Place_Life/GnoBtAEACAAJ?hl=en.

[3]Jane Jacobs, *The Death and Life of Great American Cities* (New York: Random House, 1961), 236.
Quoted by numerous sources including for example Project for Public Spaces, accessed September 1, 2025, https://www.pps.org/article/jjacobs-2.

[4] The establishment of the Place Commission was announced at the
UNECE Glasgow Conference on City Living in September 2019, accessed September 1, 2025, (https://www.academyofurbanism.org.uk/the-glasgow-unece-conference-on-city-living/; Conference programme, accessed September 1, 2025,
https://unece.org/sites/default/files/datastore/fileadmin/DAM/hlm/Meetings/2019/09_12-13_Glasgow_Conference/GCCL_Programme.pdf andhttps://unece.org/fileadmin/DAM/hlm/Meetings/2019/09_12-13_Glasgow_Conference/Glasgow_Conference_Flyer.pdf

[5] Anthony Flint, *Wrestling with Moses—How Jane Jacobs took on New York's Master Builder and Transformed the American City* (New York: Penguin Random House, 2009).

[6] In 2018, the Scottish Government in association with COSLA (The Confederation of Scottish Local Authorities) adopted its Place Principle policy. The Place Principle, accessed September 1, 2025, https://www.gov.scot/publications/place-principle-introduction/.

[7] The introduction to the Place Principle, Scottish Government accessed September 3, 2025,
https://www.gov.scot/publications/place-principle-introduction/.

[8] accessed September 3, 2025,
https://opengovernment.org.uk/scotlands-approach-to-the-sustainable-development-goals/

[9]accessed September 3, 2025,
https://www.gov.scot/collections/national-performance-framework/
https://webarchive.nrscotland.gov.uk/20250311153853/https:/nationalperformance.gov.scot/

[10] Brian Evans, Tom Inns, John Lord, and Joseph Harvey, People Make Places (Glasgow: The Glasgow Urban Lab, 2023), 17,
https://radar.gsa.ac.uk/8842/1/People%20make%20Places.pdf.

[11] Matthew Carmona, "Place Value: Place Quality and its Impact on Health, Social, Economic and Environmental Outcomes", Journal of Urban Design Volume 24 issue 1 (2019): 1-48, doi.org/10.1080/13574809.2018.1472523.

[12] Covid-19 lockdown in Scotland, accessed September 1, 2025,
https://www.covid19inquiry.scot/covid-19-pandemic-scotland-timeline-key-dates.

[13] Brian Evans, Tom Inns, John Lord, and Joseph Harvey, People Make Places (Glasgow: The Glasgow Urban Lab, 2023), 149–150,
https://radar.gsa.ac.uk/8842/1/People%20make%20Places.pdf.

[14] Brian Evans, Tom Inns, John Lord, and Joseph Harvey, People Make Places (Glasgow: The Glasgow Urban Lab, 2023), 52–83,
https://radar.gsa.ac.uk/8842/1/People%20make%20Places.pdf.

[15] Brian Evans, Tom Inns, John Lord, and Joseph Harvey, People Make Places (Glasgow: The Glasgow Urban Lab, 2023), 90–135, https://radar.gsa.ac.uk/8842/1/People%20make%20Places.pdf.

[16] Glasgow's Just Transition policy, accessed September 3, 2025, https://www.glasgow.gov.uk/article/7754/Just-Transition; Brian Evans, Tom Inns, John Lord, and Joseph Harvey, People Make Places (Glasgow: The Glasgow Urban Lab, 2023), 105–107, https://radar.gsa.ac.uk/8842/1/People%20make%20Places.pdf.
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[18] Housing Stock Transfer twenty years on, accessed September 3, 2025, https://www.wheatleyhomes-glasgow.com/news/tenants-celebrate-20-years-since-glasgow-housing-stock-transfer.
[19] Place Commission Report and publication, accessed September 3, 2025, https://www.glasgow.gov.uk/placecommission.
[20] Tom Inns, Review of the City Urbanist initiative 2019-2023 (Glasgow: Glasgow City Council and Glasgow Urban Lab, Glasgow School of Art, 2024), https://radar.gsa.ac.uk/8842/8/GCC-CITY-URBANIST-REVIEW.pdf.

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POE ON THE REUSE AND INNOVATION OF WATERFRONT INDUSTRIAL HERITAGE

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INTRODUCTION

The renovation of waterfront industrial heritage sites represents a highly effective strategy for urban land reutilization. Such projects not only provide additional public spaces within cities but also significantly contribute to showcasing urban history and culture, fostering regional economic growth, and enhancing human well-being. Conducting post-occupancy evaluations（POE）from the user perspective is crucial for improving the sustainable management, maintenance, and design of future projects. This study focuses on the Yang Pier Historic Area, a significant waterfront industrial heritage site in Jingzhou City, China. Through 300 samples of questionnaire and calculation, user satisfaction and importance were assessed. The collected data were then analyzed using the Analytic Hierarchy Process (AHP) and the Kano model to quantitatively assess survey responses and establish an evaluation framework. The findings aim to inform the future renewal and optimization strategies for the Yang Pier's waterfront industrial heritage and offer insights for the renovation and design of similar sites.

Material

Within the domain of academic research, current studies on the reuse of waterfront industrial heritage encompass a variety of topics. Key areas include landscape transformation strategies for industrial sites that incorporate ecological remediation concepts,[1] and the complexity of heritage conservation and reuse exemplified through actual brownfield redevelopment projects.[2] In addressing the issue of sustainable development for urban and waterfront industrial heritage projects, researchers have employed objective analytical methods to model policy support for sustainable development at historic waterfronts.[3]Additionally, studies have assessed the effectiveness of adaptive reuse in the context of climate change challenges.[4]

Post-occupancy evaluation (POE) has a significant role in improving the products and processes of the construction industry and in ensuring fitness for purpose in terms of environmental and social needs over the long term.[5] The limited POE studies on waterfront industrial heritage primarily focus on landscape parks or single industrial buildings converted from such heritage sites, with an emphasis on evaluating satisfaction and thermal comfort.[6] However, in China, the growing trend of utilizing waterfront industrial heritage as a model for developing cultural and creative industrial parks necessitates the establishment of new evaluation indices for a comprehensive post-use assessment of these urban design and regional planning projects..

Since 2021, the protection and renewal of Yang Pier have advanced to the basic construction completion stage, with ongoing refinement efforts. This study employs the POE method to assess user satisfaction

and perceived importance regarding the overall built environment after renovation. Analyzing this data aims to identify critical areas requiring urgent intervention and to provide theoretical and empirical support for future development and optimization of Yang Pier. Additionally, the findings offer a reference for similar transformation projects.

Research Area and Method

The Yang Pier Historic District, located in central Jingzhou City, Hubei Province, China, is adjacent to the Yangtze River. In the late 19th and early 20th centuries, its strategic water transportation and trade environment attracted numerous foreign firms, establishing factories and trading posts. After 1949, the area evolved into a light industry hub, producing several nationally renowned chemical brands and becoming one of the ten major Yangtze River wharves in modern times.

With urbanization, many factory buildings declined, leading to neglect or demolition of valuable industrial heritage sites. Since 2016, the local government and Cultural Tourism Investment Company have invested in regeneration efforts, culminating in the district's reopening in 2021. The renovated area covers approximately 67.5 hectares along 2 kilometers of shoreline and aims to develop into a multifunctional cultural and creative industrial park, encompassing exhibitions, workshops, tourism, leisure, and sports activities. Four of the six existing wharves have been converted into sightseeing wharves. The transformed landscape and waterfront serve as public activity spaces, with key evaluation factors including waterfront enhancement, site character expression, and landscape integration.

Research Methods

The study conducts a POE of the Yang Pier Historic District using an online questionnaire distributed to participants within the study area. The questionnaire utilizes a five-point Likert scale. An evaluation index system is developed by referencing existing POE frameworks while accounting for the unique characteristics of the Yang Pier industrial heritage waterfront.[7] Field investigations and environmental analyses were conducted to develop a comprehensive evaluation factor system for the site. The Analytic Hierarchy Process (AHP) was employed to process and analyze the data, assigning weights to indicators at each level. This approach enables the quantification of qualitative issues, ensuring more objective and rational results. Additionally, the Kano model was applied to assess the importance and satisfaction levels associated with waterfront heritage space reuse, providing valuable insights for optimizing configuration elements and identifying priority areas for improvement.

AHP-Kano model

The AHP, proposed by operation researcher Sadi from the University of Pittsburgh in the 1970s, is a decision-making method for optimizing complex multi-scenario problem.[8] The Kano Model, developed by Noriaki Kano of Tokyo Institute of Technology, classifies user satisfaction into five types based on the relationship between product and service quality attributes and user perceptions.[9] The Kano model enhances the limitations of AHP by providing a clear assessment of the urgency of improvement for individual evaluation factors, and at the same time the Kano model can be well integrated with the POE in the part of the satisfaction evaluation. This understanding facilitates the adaptive reuse of industrial heritage spaces, promoting designs that align with user needs and enhance overall satisfaction.

The weights for improvement are primarily derived using the formulas outlined in Equations:

1) Demand Intensity (N) = Expectation value (Q) – Satisfaction value (M).

2) Improvement Rate (R) = Target satisfaction level / Measured satisfaction level

3) Adjusted Improvement Rate (iR) = (R) / k.

4) Improvement Importance (iH) = Importance evaluation value (H*) × Adjusted improvement rate (iR).

Since user satisfaction, importance, and demand factors are central to the Kano model, the resulting evaluation provides a more objective and rational assessment of key influencing elements. [10]

Evaluation Elements Set

This study examines five core aspects of the current conditions within the study area: transportation system space, supporting facilities system, building system space, landscape system space, and public system space. These constitute the "Basic Evaluation Elements" for assessing the reuse potential of the waterfront industrial heritage environment, designated as X1—Transportation System Space; X2—Supporting Facilities System; X3—Building System Space; X4—Landscape System Space; and X5—Public System Space. A walkthrough field investigation of the Yang Pier waterfront heritage area was conducted, including detailed observations and interviews focused on its spatial structure and environmental characteristics. This facilitated a systematic analysis of the transformation process, leading to the identification of six key components: A) Spatial Form, B) Functionality, C) Appearance and Image, D) Artistic Aesthetics, E) Historical and Cultural Aspects, and F) Management Services.
Furthermore, for the evaluation of the Yang Pier Historic Area, the "Basic Evaluation Elements" were integrated with "Primary Evaluation Elements" to derive 30 "Secondary Evaluation Elements." This process established a comprehensive evaluation framework, laying a solid foundation for subsequent assessment phases.

Basic Evaluation Elements	Primary Evaluation Elements	Secondary Evaluation Elements
X1. Transportation System Space	A. Space form	X1-1. Transportation system space spatial form
	B. Usage function	X1-2. Transportation system space use function
	C. Appearance	X1-3. Transportation system space appearance image
	D. Artistic aesthetics	X1-4. Artistic aesthetics of transportation system space
	E. History and Culture	X1-5. Transportation system space history and culture
	F.Management Services	X1-6 Transportation system space management service
X2. Auxiliary Facilities System	A. Space form	X2-1. Spatial form of Auxiliary Facilities System
	B. Usage function	X2-2. Use function of Auxiliary Facilities System
	C. Appearance	X2-3. Appearance image of Auxiliary Facilities System
	D. Artistic aesthetics	X2-4. Artistic Aesthetics of Auxiliary Facilities System
	E. History and Culture	X2-5. Historical Culture of Auxiliary Facilities System
	F.Management Services	X2-6. Ancillary facilities system management services
X3. Building System Space	A. Space form	X3-1. Spatial form of building system space
	B. Usage function	X3-2. Spatial Functions of Building Systems
	C. Appearance	X3-3. Spatial Appearance and Image of Building Systems
	D. Artistic aesthetics	X3-4. Artistic aesthetics of building system space
	E. History and Culture	X3-5. Spatial History and Culture of Building System
	F.Management Services	X3-6. Spatial Management Service of Building System
X4. Landscape System Space	Space form	X4-1. Spatial form of Landscape system
	Usage function	X4-2. Use function of Landscape system space
	C. Appearance	X4-3. Landscape system space appearance image
	D. Artistic aesthetics	X4-4. Art aesthetics of landscape system space
	E. History and Culture	X4-5. History and culture of landscape system space
	F.Management Services	X4-6 Landscape system space management service
X5. Public System Space	A. Space form	X5 Public System Space
	B. Usage function	X5-1 Spatial form of public system space
	C. Appearance	X5-2 Public system space use function
	D. Artistic aesthetics	X5-3 Public system space appearance image
	E. History and Culture	X5-4 Artistic Aesthetics of Public System Space
	F.Management Services	X5-5 Public system space history and culture

Table 1. Evaluation Elements Set.

Data Statistics

This study employed both online and offline questionnaires to collect comprehensive data. A total of 30 questionnaires were distributed to industry professionals, researchers, and personnel involved in the remodeling project. Additionally, 150 questionnaires were administered on-site, and another 150 were distributed online. A systematic screening process, based on predefined criteria, was applied to the initial 330 responses, resulting in 302 valid samples for analysis.

Using the affiliation function, indicators with an average importance value below 2.5 were classified as unimportant and considered for elimination. However, statistical analysis showed that the mean importance value for all 30 secondary evaluation factors exceeded 2.5, justifying the retention of all indicators. After consolidating and organizing similar items from the original indices, an evaluation index system was established for the transformed Yang Pier Waterfront Industrial Heritage Area.

Calculation of Evaluation Indicator Weights

Before constructing the judgment matrix, comparison standards at each hierarchical level must be quantified. Experts assess the relative importance of indicators through pairwise comparisons, assigning numerical values based on the 1–9 scale: 1 indicates equal importance, while 9 signifies a vastly more important indicator, with higher values reflecting greater disparity. In this study, 15 experts evaluated each indicator accordingly. The geometric means of their scores were calculated to enhance robustness, and the results are shown in Figures 2 to 7.

	X1	X2	X3	X4	X5
X1	1.000	1.149	0.630	1.910	2.000
X2	0.871	1.000	0.660	2.173	2.789
X3	1.587	1.516	1.000	1.320	2.297
X4	0.524	0.460	0.758	1.000	1.382
X5	0.500	0.359	0.435	0.724	1.000

Figure 2. Judgment Matrix for Tier 1 Indicators

	X1_1	X1_2	X1_3	X1_4	X1_5	X1_6
X1_1	1.000	1.203	1.260	0.602	0.758	2.867
X1_2	0.831	1.000	1.097	0.758	0.724	2.712
X1_3	0.794	0.912	1.000	0.912	0.831	2.234
X1_4	1.662	1.320	1.097	1.000	0.912	2.297
X1_5	1.320	1.382	1.203	1.097	1.000	2.362
X1_6	0.349	0.369	0.448	0.435	0.423	1.000

Figure 3. Judgement matrix of secondary indicators against X1.

	X2_1	X2_2	X2_3	X2_4	X2_5	X2_6
X2_1	1.000	1.149	1.382	0.574	0.831	3.030
X2_2	0.871	1.000	1.047	0.758	0.691	2.948
X2_3	0.724	0.955	1.000	0.955	0.794	2.114
X2_4	1.741	1.320	1.047	1.000	0.871	2.114
X2_5	1.203	1.447	1.260	1.149	1.000	2.234
X2_6	0.330	0.339	0.473	0.473	0.448	1.000

Figure 4. Judgement matrix of secondary indicators against X2.

	X3_1	X3_2	X3_3	X3_4	X3_5	X3_6
X3_1	1.000	1.097	1.149	0.602	0.871	2.948
X3_2	0.912	1.000	1.047	0.831	0.660	2.948
X3_3	0.871	0.955	1.000	0.955	0.724	2.056
X3_4	1.662	1.203	1.047	1.000	0.955	2.056
X3_5	1.149	1.516	1.382	1.047	1.000	2.173
X3_6	0.339	0.339	0.486	0.486	0.460	1.000

Figure 5. Judgement matrix of secondary indicators against X3.

	X4_1	X4_2	X4_3	X4_4	X4_5	X4_6
X4_1	1.000	1.149	1.260	0.602	0.691	2.789
X4_2	0.871	1.000	1.149	0.758	0.758	2.566
X4_3	0.794	0.871	1.000	0.955	0.831	2.173
X4_4	1.662	1.320	1.047	1.000	0.955	2.234
X4_5	1.447	1.320	1.203	1.047	1.000	2.362
X4_6	0.359	0.390	0.460	0.448	0.423	1.000

Figure 6. Judgement matrix of secondary indicators against X4.

	X5_1	X5_2	X5_3	X5_4	X5_5	X5_6
X5_1	1.000	1.149	1.320	0.630	0.758	3.030
X5_2	0.871	1.000	1.149	0.724	0.724	2.566
X5_3	0.758	0.871	1.000	0.955	0.871	2.297
X5_4	1.587	1.382	1.047	1.000	0.831	2.428
X5_5	1.320	1.382	1.149	1.203	1.000	2.428
X5_6	0.330	0.390	0.435	0.412	0.412	1.000

Figure 7. Judgement matrix of secondary indicators against X5.

Using the calculation formula in conjunction with the parameters provided in the judgment matrix, the weights of the indicators are determined, and the results are presented in Figure 8.

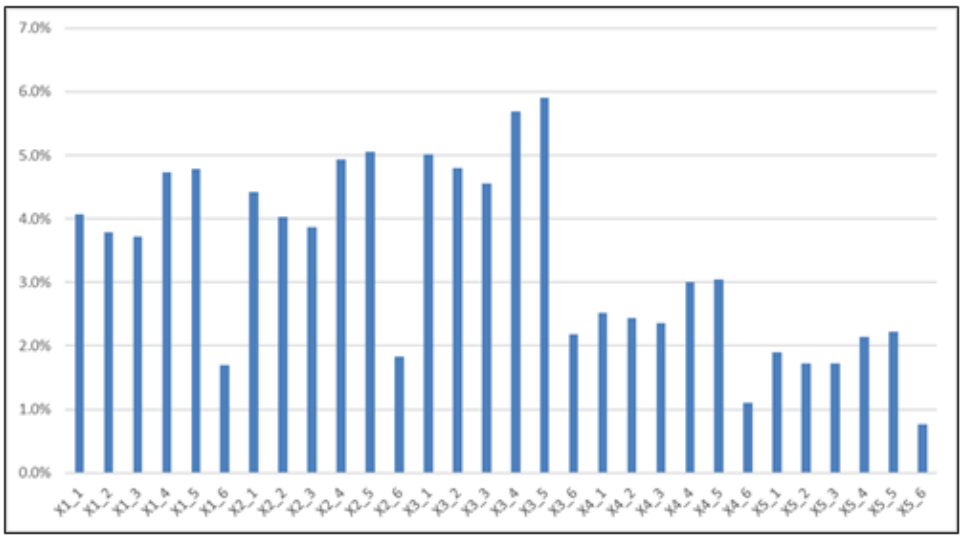

Figure 8. The weights of the indicators.

CALCULATION OF ENHANCED WEIGHTS FOR EVALUATION INDICATORS BASED ON THE KANO MODEL

In indicator evaluation, pure importance scoring can be influenced by individual assessment scales and subjective biases, which may lead to errors. To mitigate both random and systematic errors in the evaluation outcomes, the intensity of demand is utilized as a standard measure for assessing indicator demand levels. This is typically calculated as the difference between the expected value (importance score) and the actual satisfaction value (satisfaction score).

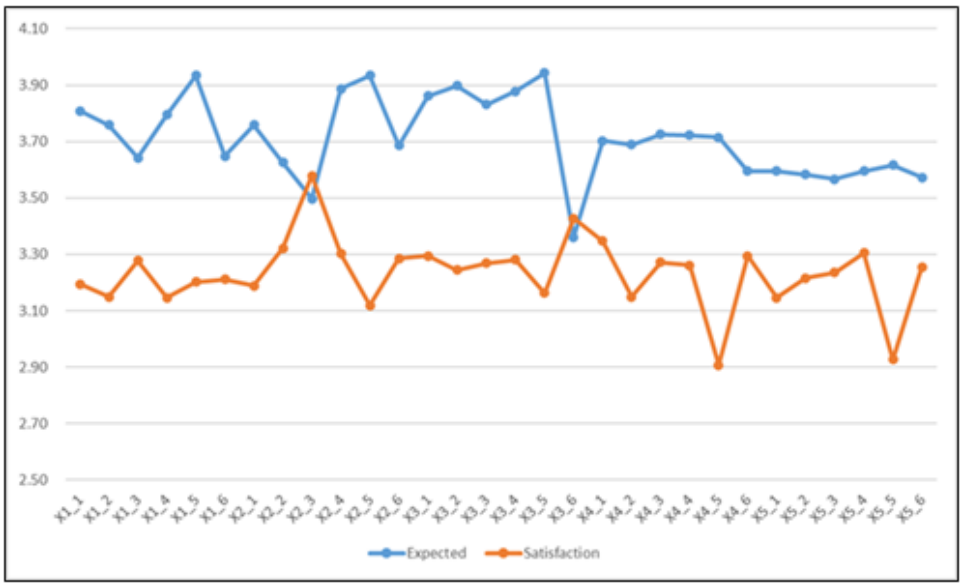

Figure 9. Intensity of Demand for the Evaluation.

The analysis shows that "E. Historical Culture" is a basic requirement among the first-level evaluation elements, while the other five are desired needs. At the second level, the following are classified as basic needs: X1-1 (Transportation Space: Spatial Form), X1-2 (Use Function), X1-4 (Art Aesthetics), X1-5 (History and Culture), X2-5 (Supporting Facilities: History and Culture), X3-2 (Building Space: Use Function), X3-5 (History and Culture), X4-5 (Landscape Space: History and Culture), and X5-5

(Public Space: History and Culture). Desired requirements include X4-1 (Spatial Form of Building), X4-2 (Landscape Function), X4-3 (Appearance and Image), X4-4 (Aesthetics), X4-6 (Management Services), X5-1 (Public Space: Spatial Form), X5-2 (Function), X5-3 (Appearance and Image), X5-4 (Management Services), X5-6 (Public Space: Management), along with 19 additional indicators. Indicators X2-3 (Ancillary Facilities: Appearance) and X3-6 (Building and Structures: Space Management) are categorized as excitement needs.

Satisfaction Target Value and Enhanced Weighting Indicator System

To address the discrepancy between actual conditions and subjective needs, this study establishes specific satisfaction target values for different need categories. The target value for basic needs is set at 4.5 (primary level), for expected needs at 4.0 (secondary level), and for excitement needs at 3.5 (tertiary level).

Using actual satisfaction scores, target values, and relevant formulas, the study calculates the improvement weights for each indicator following the transformation and utilization of the Yang Pier area. When user satisfaction exceeds the target value, it indicates higher-than-expected satisfaction; in this case, the improvement rate is recorded as 1, and the original importance remains unchanged. Subsequently, the study computes the improvement rate, adjusted improvement rate, and revised importance for each indicator. The final improved weights are determined based on these modified importance values, resulting in an enhanced weight system.

OVERALL SCORING

Using the global weights from the improved weighting system and incorporating them into the satisfaction values from the questionnaire data, the overall satisfaction score was calculated to be 3.1874. According to the Satisfaction Rating Criteria, this indicates that the overall satisfaction with the Yang Pier area after remodeling and utilization is generally satisfied.

The highest index weights are: X4-5 (Spatial History and Culture of Landscape System), X2-5 (Supporting Facilities), X3-5 (Building System), X5-5 (Public System), X1-5 (Transportation System), X1-4 (Transportation Art and Aesthetics), X3-2 (Building Use Function), X1-2 (Transportation Use Function), and X1-1 (Transportation Form). Demand analysis shows these indicators reflect basic needs, indicating the park currently falls short of user requirements post-renovation. A site survey identified the following issues:

Insufficient Historical and Cultural Presence in the Overall Space

Analysis of the improvement indicators and field research reveals that the lack of historical and cultural elements is a prevalent issue in the reuse of the heritage space. The weights of five basic elements associated with history and culture, including the transportation system space, supporting facilities system, building system space, landscape system space, and public system space, each exceed 5% after improvement. There are notable deficiencies in retaining the public memory aspects of the existing wharves, as well as in the preservation and transmission of the rich traditional culture and spirit of the waterfront industry. Additionally, the regional characteristics reflective of the Yangtze River's business environment and the unique cultural heritage of the Jingzhou area are insufficiently represented.

Inadequate Transportation System Facilities

In the transportation system space, elements such as spatial form, use function, art and aesthetics, and historical and cultural aspects exhibit higher weight values after improvement, indicating that basic needs in this area remain unmet. Research indicates that the proliferation of private retail bazaars along the riverfront has occurred without adequate guidance or standardization. While this attracts visitors, it

results in a cluttered appearance for the riverfront recreational walkway, undermining the atmosphere of the historic Yangzi Dock area. Consequently, the connectivity of shoreline spaces and overall hydrophilicity and accessibility have been diminished.

Limited Functionality of Building System Spaces

Furthermore, the analysis of improvement indicators and field research highlights that building system spaces often serve a single function. There is a notable absence of multifunctional areas for users to relax and engage with fashionable commercial and dynamic industries, leading to low functional density and efficiency. Additionally, the lack of guiding elements and clear identification within these spaces reduces their overall accessibility.

Satisfaction and Improvement Importance Analysis

Using the statistical results of indicator satisfaction and the importance of indicator improvement, we derive two graphs: one representing overall satisfaction versus the importance of improvement, and another illustrating satisfaction versus the importance of improvement for the evaluation elements at the spatial level of each system. By comparing these datasets, we can identify influencing factors with significant disparities between the importance of improvement and actual user satisfaction, allowing us to rank the urgency of reforming these factors based on the magnitude of the differences observed.

A comparison of overall satisfaction and the importance of various spatial elements across each system reveals a significant disparity between user satisfaction regarding historical and cultural aspects and the perceived importance of improvements. The urgency for improvement, ranked by the magnitude of the difference, is as follows: E) History and Culture, B) Use Function, A) Spatial Form, D) Artistic Aesthetics, C) Appearance and Image, and F) Management Services.

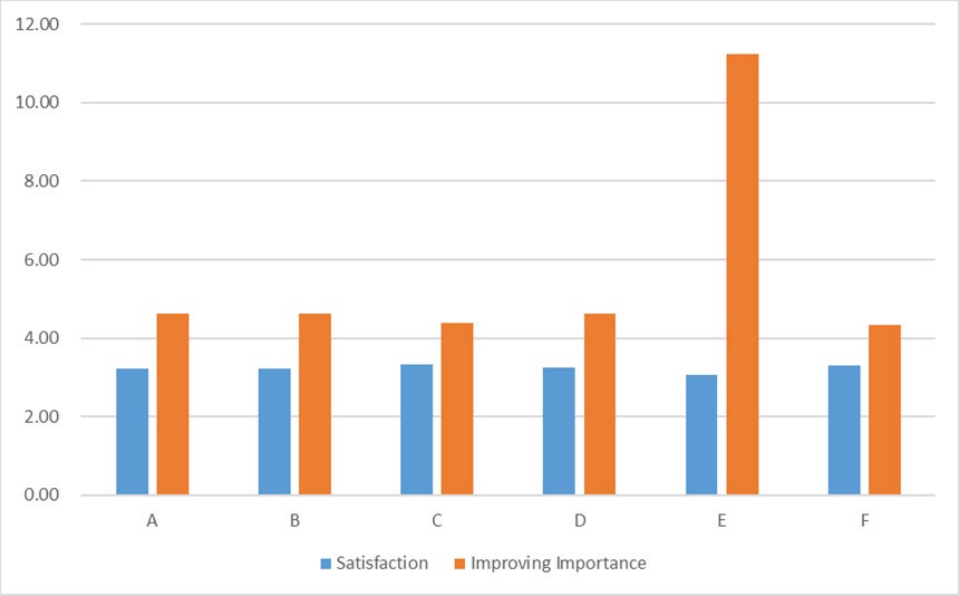

Figure 10. Overall Satisfaction and Importance of Improvement.

The above results indicate that, in the subsequent development and optimization strategy for the site, priority should be allocated to the preservation and enhancement of its historical and cultural attributes. Emphasizing these aspects is crucial for maintaining the site's authentic character and cultural identity, which are vital for fostering a sense of place and community engagement. Special attention should be given to highlighting the cultural characteristics of the overall project, enriching the historical

atmosphere of the site, and designing distinctive signage that reinforces the narrative and aesthetic coherence. Incorporating these considerations can significantly enhance the site's cultural value and support sustainable heritage conservation within the development framework.

CONCLUSION

Waterfront industrial heritage serves as a critical spatial node linking land and water, as well as a temporal bridge connecting past and present. With increasing practice in waterfront industrial heritage renewal, integrating user satisfaction and importance-based reuse evaluations enhances the credibility and efficiency of research outcomes. This approach enables more precise identification of issues and provides a solid basis for subsequent renewal planning.

The key findings of this study are as follows: (1) It summarizes the current research on waterfront industrial heritage reuse and analyzes the application of post-occupancy evaluation methods in China's renovation projects. (2) An evaluation system for reuse indicators was developed using the AHP, supporting the refinement of indicator weights through a Kano model-based improvement. Additionally, satisfaction-importance assessments were conducted for the Yang Pier Historic District post-reuse, revealing critical factors that significantly influence user satisfaction and highlighting urgent areas for enhancement. The analysis identifies the expression of overall spatial history and cultural embodiment. Urgent renovation efforts should focus on transportation and building system spaces, particularly optimizing historical and cultural elements, functional utility, and spatial form.

This study assesses the reuse of industrial heritage from a spatial perspective. However, practical observations indicate that factors such as government planning, economic development, social and cultural contexts, and legal regulations also significantly impact reuse practices. Future research should adopt a comprehensive and systemic approach, integrating multiple constraints to evaluate industrial heritage reuse from diverse perspectives. Additionally, it is essential to consider spatial reuse within a broader contextual framework to ensure more holistic and effective planning strategies.

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PORTUGAL'S HOUSING CRISIS: WILL THE 'BUILD PORTUGAL' PROGRAM MAKE A DIFFERENCE?

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INTRODUCTION

On May 10th, 2024, the Portuguese government launched the *Construir Portugal* initiative—a comprehensive housing strategy comprising 30 measures aimed at expanding the housing supply, strengthening public housing infrastructure, and improving access to housing for young people and vulnerable groups.[1] Key components of the program include regulatory simplification through Building Information Modelling (BIM) and the *Simplex* policy, as well as the repeal of ineffective measures such as rent freezes and controls.[2]

Despite these efforts, significant challenges persist. The rental market remains highly competitive, driven by strong demand from expatriates and students, which continues to exert upward pressure on prices. However, this dynamic also presents opportunities for targeted investment, particularly in housing solutions tailored to young professionals and student populations.

Lisbon has been selected as the case study for this research. The city is currently experiencing a severe housing crisis, shaped by a convergence of economic, demographic, and political factors. Between 2012 and 2022, property values in Lisbon rose by approximately 120%, while rental costs increased by over 30% in the past five years.[3] This escalation has been partly fueled by the growing influx of expatriates, digital nomads, and foreign investors, attracted by Lisbon's favorable climate, rich cultural heritage, and relatively low cost of living. Notably, foreign buyers tend to pay significantly more than local residents, with price differences reaching up to 80% per square meter.[4]

As Lisbon continues to attract international interest, the central policy challenge lies in balancing the needs of long-term residents with the demands of a growing global community, while ensuring equitable access to sustainable and affordable housing.

METHODOLOGY

This study adopts a qualitative and analytical approach to investigating the drivers and consequences of Lisbon's housing crisis. It integrates public policy analysis with a comprehensive review of housing market data sourced from both national and international institutions. Key indicators—such as property price trajectories, rental market fluctuations, and patterns of foreign investment—are examined to contextualize the crisis within broader socio-economic and urban development trends.

A core component of the methodology involves a critical evaluation of the Portuguese government's response, with particular emphasis on the *Construir Portugal* program. This initiative, consisting of 30 specific measures, is analyzed through official documents, legislative texts, and implementation reports

to assess its effectiveness in promoting accessibility, sustainability, and affordability.[5] Special attention is given to regulatory innovations such as BIM and the *Simplex* policy, which aim to streamline licensing and construction processes, thereby reducing administrative burdens. [6]

To complement the policy analysis, the study draws on secondary sources, including academic literature, media coverage, and expert commentary. This analysis provides a deeper understanding of the socio-economic impacts of the housing crisis on residents, particularly vulnerable groups such as low-income families, students, and young professionals. It also examines the interplay between foreign investment and local housing accessibility, highlighting how global urban trends are reshaping Lisbon's residential landscape.

Although the *Construir Portugal* program was launched with ambitious goals, its implementation coincided with the fall of the previous government and the transition to a new executive. As a result, the program has not yet produced measurable outcomes. Nevertheless, it is expected that the new administration will continue its implementation.

DISCUSSION

The *Construir Portugal* initiative represents a proactive governmental response to Portugal's housing crisis, aiming to increase housing supply and improve accessibility through a set of 30 targeted measures. These include regulatory simplification via Building Information Modelling (BIM) and the *Simplex* policy, which seeks to reduce bureaucratic barriers and accelerate construction processes.[7] However, despite these efforts, the persistence of high rental prices and the repeal of rent control mechanisms suggest that market forces continue to dominate the housing landscape.

Recent data from Statistics Portugal indicate that in 2024, the median price of family dwellings reached €1,777 per square meter nationally, with Greater Lisbon surpassing €2,900 per square meter.[8] Simultaneously, rents increased by over 10% year-on-year, reflecting sustained pressure on affordability. These trends are particularly concerning given that 20.8% of Portuguese households reported being unable to afford adequate heating in 2023—one of the highest rates in the EU.[9]

Investment opportunities remain strong, especially in segments targeting young professionals and students. However, the challenge lies in ensuring that housing policies do not exacerbate existing social inequalities. The influx of foreign capital and digital nomads has contributed to price inflation, often displacing local residents and intensifying gentrification processes. Eurostat data show that 8.8% of EU households spend more than 40% of their disposable income on housing, with Portugal among the countries experiencing significant affordability stress.[10]

Simplification measures such as BIM and the *Simplex* policy may streamline development, but their long-term impact on affordability and inclusivity remains uncertain. While BIM can enhance efficiency and reduce costs in construction, its benefits are often captured by developers rather than passed on to end-users. Moreover, without complementary social safeguards—such as rent regulation, public housing expansion, and targeted subsidies—technological solutions alone are unlikely to resolve structural inequalities in the housing market.[11]

Figure 1 presents a cyclical framework that guides strategic responses to urban housing challenges through five interconnected stages. The process begins with Identify Crisis, where housing shortages and affordability issues are recognized using both quantitative indicators—such as property prices, rental trends, and housing accessibility metrics—and qualitative input from public consultations and expert analyses. This diagnostic phase defines the scope and urgency of the problem.

Next, Implement Program involves the introduction of targeted policy measures in response to the identified crisis. In Portugal, this includes initiatives such as *Construir Portugal*, which aim to expand housing supply, reform regulatory frameworks, and promote inclusive development.[12]

The third stage, Increase Housing Supply, focuses on the physical expansion of housing stock. It leverages public-private partnerships and technological tools like Building Information Modelling (BIM) to streamline planning and construction processes, reduce administrative burdens, and accelerate delivery timelines.[13]

Following this, Improve Affordability addresses the financial accessibility of housing. This stage includes the implementation of subsidies, expansion of public housing, and support for vulnerable groups—such as low-income families, students, and young professionals—through targeted affordability measures.[14]

Finally, Evaluate Impact entails continuous monitoring and assessment of policy outcomes. Key indicators such as rental price evolution, housing availability, and social equity metrics are used to evaluate effectiveness. Insights from this evaluation feed back into the initial stage, allowing for the identification of new or persisting challenges and the refinement of future interventions.[15]

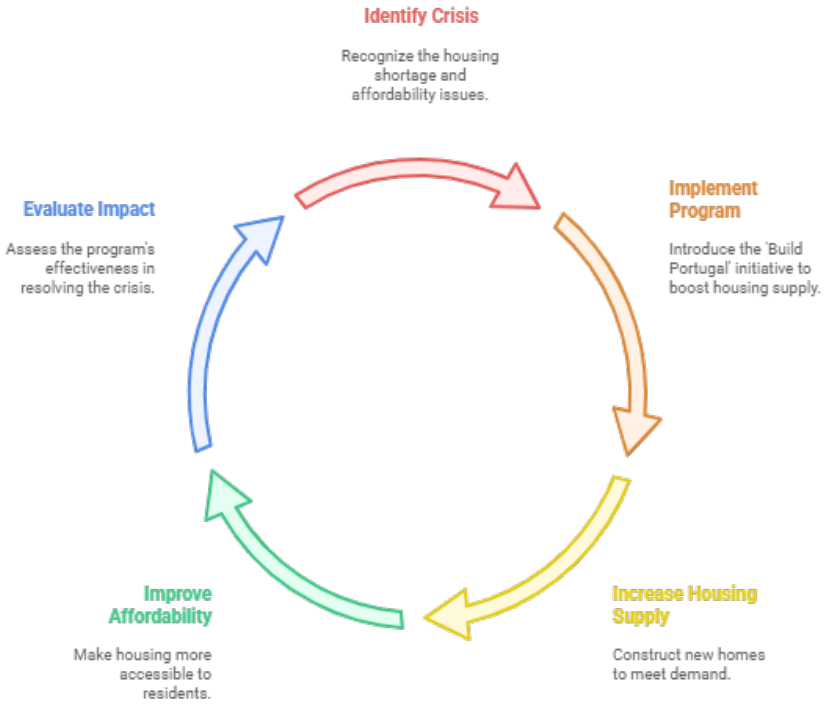

Figure 1. Strategic Housing Response Framework

This cyclical model underscores the importance of adaptability and evidence-based policymaking in addressing complex urban housing issues. While the *Construir Portugal* initiative aligns with this strategic logic, its implementation has been affected by political transitions, delaying the emergence of measurable results. Nonetheless, the framework provides a robust foundation for future housing policy development.

STRATEGIC GOALS OF THE CONSTRUIR PORTUGAL PROGRAM

Portugal's housing affordability crisis is rooted in a persistent imbalance between high property prices and limited housing supply, exacerbated by demographic pressures, urban concentration, and speculative investment.[16] In response, the *Construir Portugal* program was launched as a comprehensive strategy to promote sustainable and inclusive access to housing. It is structured around three central goals: expanding housing supply, prioritizing vulnerable groups, and streamlining bureaucratic processes.[17]

The table.1 summarizes the 30 core measures of the *Construir Portugal* housing program, organized under three strategic goals: expanding supply, supporting vulnerable groups, and streamlining administrative processes.

Pillar	Key Measures
1. Expanding Housing Supply	Mobilize 25,000 PRR homes, Use rustic land for housing, Modular/prefab construction, Accelerate licensing, Revise Land Law, Convert vacant buildings, Reduce municipal fees, Credit lines for rental housing, Incentives for affordable developers, Urban rehabilitation
2. Prioritizing Vulnerable Groups	Expand public housing, Subsidized rents, Transitional housing, Age-friendly housing, Porta 65 reform, Tax exemptions for youth, Housing for essential workers, More student housing, Social sector partnerships, Energy upgrades in public housing
3. Streamlining Bureaucracy	Implement BIM, Expand Simplex program, Digitalize municipal systems, Simplify licensing, Improve national-local coordination, Standardize procedures, Transparent planning tools, Reduce red tape, Support for faster approvals, Monitor implementation impact

Table1. compact summary of the 30 housing measures from the Construir Portugal program (2024)

Expanding housing supply

The first strategic goal focuses on increasing the overall housing stock to meet growing demand. This includes accelerating the construction of new residential units through public-private partnerships, repurposing underutilized public assets, and promoting innovative building techniques such as modular and prefabricated construction. The program aims to unlock 25,000 housing units under the Recovery and Resilience Plan (PRR) and encourages the use of rustic land for residential development.[18] These measures are designed to diversify housing options across income levels and geographic areas, addressing both urban and peri-urban needs. Additionally, the program seeks to unlock new land for development by revising the Land Law (*Lei dos Solos*) to permit the conversion of rustic land into residential zones under specific planning conditions. This reform is particularly relevant in peri-urban and rural areas, where land is more abundant but often constrained by outdated zoning regulations. By broadening the geographic scope of development, the initiative intends to alleviate pressure on urban centers while fostering more balanced territorial cohesion.

Public-private partnerships (PPPs) play a central role in this expansion effort. By leveraging private sector expertise and investment, the state can accelerate delivery while maintaining oversight over affordability and quality standards. Incentives are being introduced to attract developers to build affordable and mixed-income housing, including reduced municipal fees, streamlined licensing procedures, and access to credit lines for long-term rental projects.

Urban regeneration constitutes another key component. The program prioritizes the rehabilitation of vacant or underused buildings, particularly in degraded urban areas, as a means of revitalizing neighborhoods and increasing housing availability without consuming new land. This approach aligns with sustainability goals and supports the preservation of architectural heritage.

Internationally, similar supply-side strategies have been adopted with notable success. In Vienna, Austria, the city's long-standing commitment to municipal housing—where over 60% of residents. live in subsidized units—has helped stabilize prices and maintain affordability across generations.[19] Similarly, Helsinki, Finland, has implemented land-use policies reserving plots for affordable housing, ensuring that new developments include a mix of income levels and tenure types.[20] These examples

demonstrate that sustained public investment, combined with strategic land management, can effectively counteract market-driven housing pressures.

Prioritizing Vulnerable Groups

The second strategic goal of the *Construir Portugal* program underscores the imperative to support those most acutely affected by the housing crisis. These include low-income families, young adults entering the housing market, university students, elderly residents with specific accessibility needs, and migrant populations often excluded from stable housing pathways. The program recognizes that without targeted interventions, these groups risk being permanently marginalized from secure, affordable, and dignified housing.

To address this, the strategy introduces a comprehensive suite of social and fiscal measures. Central among them is the expansion of the public housing stock, with a focus on long-term rental options that offer stability and affordability. This is complemented by the development of transitional housing solutions for individuals and families in precarious situations, such as those experiencing homelessness or domestic displacement.

Notably, it introduces fiscal incentives for young buyers—such as exemptions from property transfer tax (IMT) and stamp duty for individuals under 35—and reforms to the *Porta 65* rental support scheme to better reflect current economic realities.[21] In parallel, the Porta 65 rental subsidy scheme has been restructured to better reflect current economic conditions and housing market dynamics. The revised program expands eligibility criteria, simplifies application procedures, and adjusts subsidy levels to account for regional disparities in rent prices. These reforms aim to make rental support more accessible and responsive to the realities faced by young tenants.

The program also emphasizes the importance of partnerships with the social and cooperative housing sectors. By leveraging the expertise and community ties of these organizations, the government seeks to deliver housing solutions that are not only affordable but also socially integrated and tailored to local needs.

This focus on vulnerable groups aligns with broader European policy frameworks, particularly the European Pillar of Social Rights, which enshrines the right to access affordable, quality, and energy-efficient housing. Several European cities offer instructive examples of how such principles can be operationalized. In Leuven, Belgium, the renovation of a 120-unit social housing complex—funded through EU cohesion policy—resulted in improved energy performance and reduced utility costs, directly benefiting low-income tenants.[22] In Leuven, Belgium, the renovation of a 120-apartment social housing complex with EU funding improved energy efficiency and affordability for low-income families.[23] In Aalborg East, Denmark, a regeneration project led by Himmerland Boligforening transformed a stigmatized area into a vibrant, inclusive neighborhood through resident participation and integrated social services.[24] This was achieved through a participatory planning process, integration of social services, and a focus on mixed-use development.

These international cases demonstrate that targeted support for vulnerable populations can yield substantial social returns, including improved health outcomes, educational attainment, and community cohesion. The *Construir Portugal* program builds on these lessons, aiming to embed equity and inclusion at the heart of national housing policy. By doing so, it not only addresses immediate needs but also lays the groundwork for a more just and resilient housing system.

Streamlining Bureaucratic Processes

The third strategic goal of the *Construir Portugal* program addresses one of the most persistent barriers to housing development in the country: bureaucratic inefficiency. Lengthy approval timelines, fragmented administrative procedures, and inconsistent municipal practices have historically delayed

construction projects, increased development costs, and discouraged private investment. Recognizing that regulatory bottlenecks can undermine even the most ambitious housing strategies, the program introduces a series of structural reforms aimed at modernizing and simplifying the planning and permitting ecosystem.

At the core of this effort is the adoption of Building Information Modelling (BIM), a digital tool that enables real-time collaboration among architects, engineers, contractors, and public authorities. BIM enhances transparency, reduces design errors, and allows for more accurate cost forecasting and project scheduling. Its integration into public procurement and licensing processes is expected to streamline communication and reduce administrative friction across all stages of development.[25]

Complementing this is the expansion of the Simplex program, a government-wide initiative to cut red tape and improve public service delivery. In the housing sector, Simplex reforms include the standardization of documentation requirements, the reduction of procedural redundancies, and the introduction of "one-stop-shop" platforms for developers and citizens. These changes aim to make the licensing process more predictable, efficient, and user-friendly.[26]

Another key measure is the digitalization of municipal planning systems, which seeks to harmonize procedures across Portugal's diverse local authorities. By moving from paper-based to fully digital workflows, municipalities can process applications more quickly, track project progress in real time, and ensure greater accountability. This also facilitates data integration at the national level, enabling better monitoring of housing supply pipelines and land-use trends.

While these reforms are expected to accelerate project delivery and reduce transaction costs, their broader impact on housing affordability and social inclusion will depend on how they are implemented and governed. Without safeguards to ensure that efficiency gains translate into lower costs for end-users, there is a risk that streamlined processes could disproportionately benefit higher-margin developments or speculative investments.

International experience offers valuable lessons. In Madrid, Spain, the *Plan Vive* initiative has demonstrated how regulatory innovation can be aligned with social objectives. By leveraging public land, simplifying licensing procedures, and partnering with private developers under strict affordability conditions, the program has delivered rental housing at prices up to 40% below market rates. This model illustrates the potential of combining administrative agility with strong public oversight to achieve both speed and equity in housing delivery.[27]

In summary, the *Construir Portugal* program's focus on streamlining bureaucratic processes reflects a critical recognition that regulatory reform is not merely a technical exercise, but a strategic lever for unlocking housing supply. When paired with clear social goals and robust implementation frameworks, these reforms can play a transformative role in building a more responsive, inclusive, and efficient housing system.

CONCLUSION

The *Construir Portugal* program was launched as a bold and necessary response to Portugal's housing crisis, proposing a multidimensional strategy that integrates supply expansion, social protection, and administrative reform. Although its initial rollout was hindered by political instability, the program remains a cornerstone of national housing policy, and its continuation under the new administration offers a critical opportunity to recalibrate and strengthen its impact. Lisbon, as the focal case study, reveals the depth of the crisis and the urgency of action, where soaring demand, limited supply, and speculative investment converge to create a landscape of exclusion and displacement. The city's experience exposes the limitations of generic policy tools and underscores the need for locally adapted solutions that respond to the lived realities of residents.

While the program has begun to stimulate economic activity through increased construction and housing transactions, its social outcomes remain uneven. Without targeted affordability measures, the benefits of growth risk being captured by investors rather than those most in need. Effective and lasting solutions must go beyond technical fixes and embrace a rights-based approach to housing that prioritizes equity, resilience, and community stability. This requires managing demand through regulation, expanding supply through inclusive investment, enhancing affordability through fiscal support, and protecting tenants through robust legal frameworks.

Across Europe, several success stories demonstrate that inclusive and sustainable housing policy is achievable. In Great Britain and Poland, Habitat for Humanity's *Empty Spaces to Homes* initiative has successfully repurposed vacant buildings into affordable, energy-efficient housing, contributing to both social equity and climate goals.[28] In Belgium, the city of Leuven renovated a 120-apartment social housing complex with €3 million in EU funding, improving both affordability and sustainability for low-income families.[29] In Portugal, Porto City Council invested €8 million to upgrade public housing with thermal insulation and solar collectors, reducing energy consumption by 47% and improving living conditions for residents.[30] These examples show that when governments align investment with social outcomes and empower local actors, transformative change is possible.

To promote *Construir Portugal* as a national mission, the government must lead with coordinated action across ministries while empowering municipalities to tailor local solutions. Public engagement is key, housing, should be framed as a right through national campaigns and transparent progress tracking. Policies must be inclusive, co-designed with communities, and supported by incentives for youth and vulnerable groups. Investment strategies should align public and private efforts, with a focus on affordability, sustainability, and tenant protection. Legal reforms must simplify land use and strengthen rental security. Learning from successful European models and leveraging EU funds will help scale impact. Ultimately, the mission must foster a cultural shift toward housing solidarity, where safe, dignified living is recognized as a shared national goal.

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URBAN IMAGINATION AND CITY FORM

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INTRODUCTION

In recent years, urban studies have increasingly highlighted the idea of *urban imagination* as part of the ongoing exploration of placemaking, spatial transformation, and the redesign of cities, which seek to establish new perspectives and collective models of thinking about the future of urban life and its implications. Yet one fundamental question emerges: does our urban imagination rely on predefined socio-spatial schemes when striving to envision new places? Do such schemes act as preconditions for the very spatial practices we aim to rethink and redesign in an era of growing uncertainty?

This paper proposes a reading of the urban form as a projection of imagination. By outlining parallels between urban form and cognitive patterns, I aimed to reveal underlying spatial conceptions and explore how they are manifested in the tangible urban structure and its fabric.

IMAGINATION HAS A FORM

Imagination is the means by which we conceive of possibilities, design scenarios, and connect to our desires, beliefs, and experiences. Founded on our demand for order, it enables us to organize and translate the world into form.[1]

When we envision innovative solutions, we draw from imagination—yet one grounded in memory, experience, and knowledge. It is both simultaneously attentive and exploratory, navigating fictional and visual realms while striving toward realization.[2]

As Pier Vittorio Aureli notes in *The City as a Project*, it is an illusion to believe that contemporary urban form emerges spontaneously. While the ability to conceive of cities as coherent projects declined with the rise of neoliberalism in the 1980s, planning itself did not disappear. Instead, it was reconfigured as a tool to illustrate the supposed inferiority of the state to the market. Aureli argues that the "informal" city, often regarded as ungovernable, is in fact the product of deliberate political will, a reality many architects choose to overlook.[3] This observation opens the way for a broader inquiry into the relationship between political motivation and urban form. My aim here is to initiate such a study by examining the relationship between city structure and human imagination, pointing toward a culture of spatial complexity.

Euclidean Geometry and The Centripetal Imagination

How has the symbolic power of center and periphery evolved alongside urban form? Can the breakdown of boundaries be traced through shifts in scientific and geometric imagination? For centuries, this binary of core and shell, a navel and periphery, inside and outside, inclusion and exclusion, has been deeply rooted in human cognition. Cities, as archaic constructs, have long embodied these oppositions.

Sulcus Primigenius and Umbilicus Urbis

The founding of Etruscan and Roman cities was a ritualized act. A sacred boundary—the *pomerium*—was marked by plowing the *sulcus primigenius*, symbolizing domestication. According to Mircea Eliade, this act mirrored the myth of creation, transforming undifferentiated land into ordered space.
Before this, a pit—the *Umbilicus Urbis*—was dug, marking the symbolic navel and center of the city. In Roman settlements, this point anchored the grid and established order. In ancient ontology, cities acquired reality by aligning themselves with a "celestial archetype", becoming real through imitation the structure of the universe.[4] The plowing the furrow echoes the same conception of Euclid's third postulate, which defines the circle as the locus of points equidistant from a center.[5]

Geometry, Body, and the City

With its center and boundaries established, the city was "born". Two intersecting axes divided it into quarters, each further subdivided. Livy, in *Ab Urbe Condita*, likened crossing the pomerium to deforming a body.[6] Vitruvius similarly saw the city's structure as an extension of the human body, with the navel serving as its central marker of origin.[7] Human anatomy thus provided a mythic blueprint for urban design, where the navel symbolized birth and origin.

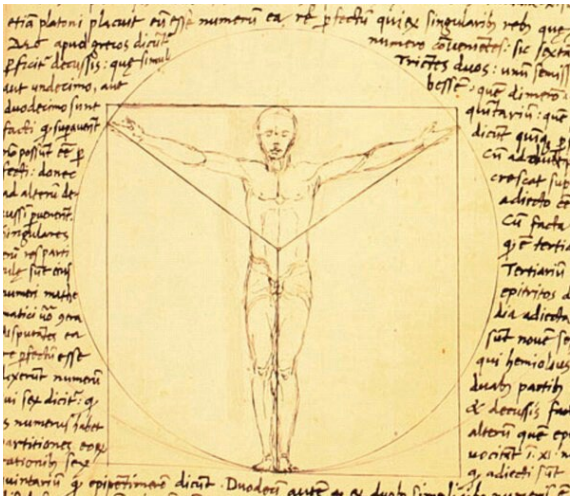

Figure 1. Giacomo Andrea, L'uomo vitruviano, c, 1490

Concentric Order and a Coherent Whole

The eleventh-century work of Al-Hasan Ibn al-Haytham, later translated into Latin, and the fifteenth-century revival of Vitruvius, deeply influenced architects such as Alberti and Filarete. Both envisioned the city as a rational, geometric whole—expressing social and political harmony.
As outlined in Alberti's *On Construction* (1452) and Filarete's *Sforzinda*, the ideal city was imagined as a perfect, concentric system: orderly, modular, and symbolically unified.[8]

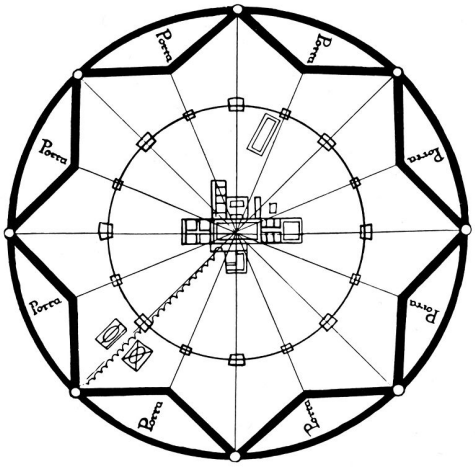

Figure 2. Antonio di Pietro Averlino (Filarete), Plan of Sforzinda, 1457

Cartesian Imagination and the Coordinate Surface

The shift that started by René Descartes' development of analytic geometry and coordinates, and later culminating in Newton's formulation of calculus, made a decisive impact on the philosophy of science and on conceptions of space. Newton's assertion that the universe is governed by uniform, precise, and harmonious mathematical principles profoundly shaped modern thought, framing the universe as infinite, and motion as a process in which bodies change their places, perceiving the distinction between absolute and relative spaces.[9]

Dennis Sepper argues that Descartes' imagination was closely tied to his mathematical and physical work, operating through symbolic imagery that was both abstract and concrete, serving as a direct representation of real-world problems. Geometry, in this framework, becomes a medium that bridges spatial motion, geometric representation, and algebraic symbolism—what later came to be known as analytic geometry.[10]

Sepper suggests it was not a coincidence that Descartes was able to model the structure of the physical universe by means of "imaginary spaces". In this framework, geometry becomes a medium that enables a fundamental isomorphism between spatial motion, geometric representation (through lines and forms), and algebraic symbolism—what would later be known as analytic geometry. It represents a systematic and disciplined form of imagination, grounded in the concept of two-dimensional projection. For Descartes, geometry exemplifies rigorous, structured imagination.

At the core of the Cartesian conception of space lies then aspiration to ground certainty within a measurable, ordered environment—structured by length and width, and delineated by rational, spatial coordinates. Descartes thus formulated a model of imagination that became the foundation not only for mathematics and science, but also for the emerging spatial order of modernity.

Urban researcher Abraham Akkerman proposes that the evolving urban environment of the Renaissance may have significantly influenced Descartes and his contemporaries in shaping the principles that became central to modern philosophy and science. The defined geometric street grids and formal urban compositions of Renaissance cities—designed as metaphors for cosmic perfection and rational order—may have inspired Descartes' emphasis on "clear and distinct ideas." Akkerman suggests that Descartes' encounter with coordinate geometry was instrumental in his philosophical breakthroughs. In this light, the rationalist foundations of modern thought were not only mirrored in, but also shaped by, the orthogonal layouts and conceptual clarity of Renaissance urban planning. Descartes, as a founding

figure of modernity, projected these emerging urban ideals into his philosophical vision, ignited by a passion for precision, logic, and spatial coherence.[11]

Figure 3. 'Alexander laying out the city of Alexandria' by Andre Castaigne, 1899

Complex Order and the Shape of Systems to Come

In the late nineteenth century, Henri Poincaré laid the foundations for nonlinear dynamics, introducing what would evolve into topology. His work revealed that geometric problems often depend not only on structure but also on relational patterns between the elements, which I suggest to see as one of the main issues of urban design. This insight catalyzed a nonlinear imagination—one capable of describing complex systems, modeling evolution, and recognizing that transitions from order to chaos follow hidden patterns of organization.[12]

The End of Certainty

The city has never remained a coherent whole. Understanding its evolving form raises a core question drawn from the philosophy of science: how do we conceptualize dynamic systems?

Ilya Prigogine challenged the Newtonian paradigm by envisioning a "new rationality"—a science that moves beyond determinism and absolute certainty. He distinguished between closed (conservative) and open (dissipative) systems. Dissipative systems, which operate far from equilibrium, cannot be fully explained by mechanistic models. Their defining feature is interaction with the environment. At critical thresholds—bifurcation points—systems either collapse or reorganize into higher-order structures.

Prigogine thus revealed disequilibrium as a generative force, the source of new order. His framework provides a powerful model for interpreting complexity across scientific and social domains, offering what was later called *The Shape of Systems to Come*. [13]

Dissipative Imagination and the Shell-less City

Between the fossilized facade of the traditional city and the fluid boundaries of the contemporary urban conditions lies a multitude of threshold states—ranging from dense to diffuse. Each reflects distinct spatial perceptions and territorial practices: what is excluded; what is displaced at its margins; and how center and periphery are redefined. These are not only expressions of urban imagination but also of *non-urban imagination*— that which remains untamed and unintegrated.

In *Speed and Politics* (1977), Paul Virilio argued that the abolition of city walls under the pressures of speed collapsed the spatial experience and undermined the geometric coherence once central to urban form.[14]

Strikingly, the same year Virilio published his book, Prigogine received the Nobel Prize for his work on dissipative structures. Both thinkers addressed the dissolution of boundaries—Virilio from a cultural-technological angle, Prigogine from a scientific one—suggesting the need for a more fluid imagination to understand the emerging, boundaryless city.

Nonlinear Imagination and Data-Driven Urbanism

In recent decades, Big Data methodologies have revolutionized urban research. Urban morphology, in particular, has benefited from network-based analyses of size, scale, and shape. Such approaches reveal how urban networks operate across multiple hierarchical levels and within polycentric structures. Central to this inquiry is the ability to analyze and optimize the flows generated by these systems, where scale and patterns of exponential growth further underscore the nonlinear dynamics at play.

The field of network science has enriched urban studies by conceptualizing cities as spatial-social networks. By abstracting structural patterns, this approach allows for predictive modeling of urban development and growth. Unlike static paradigms, network-based models encode explicit relationships between spatial elements—capturing connectivity, circulation, and interaction. This marks a fundamental shift toward dynamic, data-driven interpretations of urban complexity.

Hodological Imagination and Perceptual Monitoring

What role does imagination play in shaping our lived experience and interpreting urban spaces? And how do spatial structures shape our perception?

Edmund Husserl's phenomenology positioned everyday experience as the primary mode of our engagement with the world. Abstract, geometric understandings of space, he argued, are secondary derivations from embodied experience, as every geometric projection is an idealization or abstraction of that experience of space.[15] Crucially, the phenomenological notion of spatiality resists the Cartesian abstraction of space as a measurable, objective domain merely perceived by a detached thinking subject. Instead, it offers a critique of the universalizing tendencies of modern spatial thought, emphasizes spatiality as dynamic, lived, and evolving experience of the built environment.[16]

On Artificial Spatial Perception

To explore phenomenological imagination further, I turn to artificial spatial intelligence. At MIT, researchers developed *Kimera*, a robotic model of perception that constructs dense 3D semantic maps and tracks movement through space. In order to act meaningfully in space: identifying objects, navigating to a specific place in a larger space—robots are designed to perceive environments much like humans do. [17]

The method relies on hierarchical spatial mapping, where objects are nested within broader spatial units via shared nodes, forming a chain of thresholds and corridors. Movement becomes a journey through these thresholds—echoing Kurt Lewin's notion of *hodological space* (1934), where perception is structured by bodily movement through paths (hodos) and decision points.[18]

The 3D Dynamic Scene Graph (DSG), employing simultaneous localization and mapping (SLAM), illustrates how perception arises from active engagement with environments. Professor Luca Carlone, who leads the project, emphasizes that spatial mental models are essential for decision-making. While humans generate them intuitively, robots struggle to translate raw visual input into spatial understanding—underscoring the complexity of human cognition.[19]

By mimicking threshold-based logic, spatial AI highlights a renewed need for clear navigational nodes and boundaries—standing in sharp contrast to the dissolving structures of contemporary urban ideas.

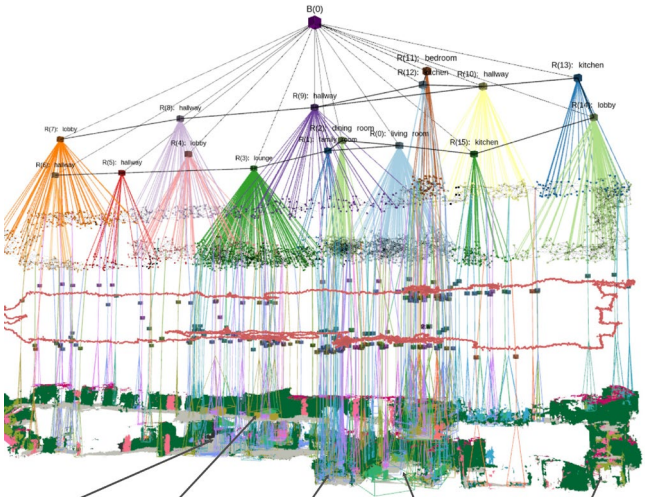

Figure 4. Foundations of spatial perception for robotics: Hierarchical representations and real-time systems, 2024

CONCLUSION

This paper has explored the evolving relationship between human imagination, as reflected in geometric thought, and the forms of the city. From the ritualized foundations of ancient settlements and the symbolic geometry of the urban sphere, through the rationalist grids of Cartesian modernity, to the nonlinear complexity of contemporary networked urbanism, each paradigm has revealed how imagination shapes spatial form. Cities are projections of collective thought—materializations of cultural, scientific, and philosophical worldviews.

The progression from Euclidean and concentric models, through Cartesian planes, to Poincaré's nonlinear geometries and Prigogine's dissipative systems demonstrates a deep entanglement between epistemology and urban morphology. Each transformation in scientific rationality has found resonance in the way we conceptualize, design, and inhabit cities. The shift from fixed boundaries to fluid thresholds, from centralized to polycentric networks, and from static coherence to dynamic self-organization suggests that imagination remains not only a design tool but also a diagnostic lens through which urban transformations can be interpreted.

Data-driven methodologies and artificial spatial intelligence extend this trajectory. They do not simply provide technical tools for analysis but reveal new ways of perceiving urban life, concern with embodied experience while simultaneously abstracting space into networks, flows, and probabilistic patterns.

In an era of uncertainty and accelerating change, understanding the qualifications of the structures in dynamic systems is a major task of contemporary urban studies. If, as Prigogine argues, disequilibrium is generative, then the future city must be understood not as a fixed object but as an adaptive, evolving system.

By addressing the parallels between urban form and cognitive patterns, I sought to reveal structures upon which cities are founded, regardless of how amorphous they may appear. These insights may offer urban designers' valuable conceptual tools for reimagining the shape and structure of cities to come.

NOTES

[1] In his book *The Savage Mind*, Claude Lévi-Strauss acclaims that: "*The thought we call primitive is founded on this demand for order. This is equally true of all thought; but it is through the properties common to all thought that we can most easily begin to understand forms of thought which seem very strange to us."* (Chicago: University of Chicago Press, 1966), 17.
[2] Mariabruna Fabrizi and Fosco Lucarelli, *Inner Space: Constructing the Imagination* (Lisbon Architecture Triennale: The Poetics of Reason, 2019), 8-9.
[3] Pier Vittorio Aureli, "Means to an End, The Rise and Fall of the Architectural Project of the City," in *The city as a Project*, ed. Pier Vittorio Aureli (Berlin: Ruby Press, 2020), 10-11.
[4] Mircea Eliade, *The Myth of the Eternal Return: Cosmos and History*, trans. Willard R. Trask (New York: Harper and Brothers Publishers, 1954), 6-21.
[5] See Euclids' postulates in Oliver Bryne's translation to Book I. Basic plane geometry of *The Elements* of Euclid (1847): "*Let it be granted that a circle may be deſcribed with any centre at any diſtance from that centre.*", https://www.c82.net/euclid/book1/.
[6] According to Livy (Titus Livius), the pomerium was the edge of the town, made as a sacred boundary. See in: Richard Sennet, *Flesh and Stone: The Body and the City in Western Civilization* (New York London: W.W. Norton and Company, 1994), 107-109.
[7] Subsequent endnote: Sennet, 106-107.
[8] Leon Battista Alberti, "Book One: Lineaments," in *On the Art of Building* (1443-1452), *Chapter 9*, 23. Alberti *De re aedificatoria* (*On the Art of Building*) largely depended on Vitruvius's *De architectura.*.
[9] Alexandre Koyré, *From the Closed World to the Infinite Universe* (Baltimore, MD: Johns Hopkins University Press, 1968) 160-169.
[10] Dennis L. Sepper, "Part I, Historical Treatments of Imagination 2: Descartes," in: *The Routledge Handbook of Philosophy of Imagination*, ed. Amy Kind (London New York: Routledge, 2016), 32-33.
[11] Abraham Akkerman, "Urban Planning in the Founding of Cartesian Thought," Philosophy and Geography, vol. 4 (2001): 141-167.
[12] Gabriel Schreiber, Simply Complex, A Literary-Geometric_non_Linear Journey from Borges to Lacan (in Hebrew), (Tel Aviv: Resling, 2011), 99.
[13] Ilya Prigogine, The End of Certainty: Time, Chaos, and the New Laws of Nature (New York: The Free Press, 1996), 60-71.
[14] Paul Virilio, *Speed and Politics: an essay on dromology*, trans. Mark Polizzotti (Los Angeles, CA.: Semiotexte, 2006).
[15] "*Every geometry, indeed every conceivable idealization of spatiality, is based upon the experience of space which belongs originally to the life of the senses and of the body. All geometrical conceptualization is only a secondary formation, derived from this original spatial experience*." Edmund Husserl, *Ideas Pertaining to a Pure Phenomenology and to a Phenomenological Philosophy, First Book.* Trans. F. Kersten, (The Hague: Martinus Nijhoff, 1982), 44.
[16] See in Henriette Steiner and Maximilian Sternberg's introduction to *Phenomenologies of the City. Studies in the History and Philosophy of Architecture*, (London and NY: Routledge, 2015).
[17] Jennifer Chu, "Expanding robot perception, Associate Professor Luca Carlone is working to give robots a more human-like awareness of their environment," MIT News, January 28, 2025. Accessed March 17, 2025, https://news.mit.edu/2025/expanding-robot-perception-luca-carlone-0128.
[18] Steffen Nijhuis, "The shape of a walk," Landscape Architecture TU Delft, December 18, 2015. Accessed March 18, 2025, https://landscapearchitecturetudelft.nl/the-shape-of-a-walk/.
[19] SLAM (simultaneous localization and mapping) is a method of mapping and being localized in the map at the same time. This method, in use for robots and vehicles, enables to map out unknown surroundings. A dynamic scene graph is a layered graph where nodes represent spatial concepts at different levels of abstraction, and edges represent spatiotemporal relations among nodes. See at Antoni Rosinol et al. "Kimera: From SLAM to spatial perception with 3D dynamic scene graphs," The International Journal of Robotics Research, vol. 40, issue 12-14 (2022): 1511-1512. doi:10.1177/02783649211056674.

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UNCOVERING THE HIDDEN ECONOMIC BENEFITS OF INVESTMENT IN THE PUBLIC REALM: A BUSINESS CASE OF URBAN AMENITIES

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EXECUTIVE SUMMARY

This research offers insight into the business case for urban amenities through a literature review of 63 global case studies spanning 9 countries and 43 cities. The report addresses a knowledge gap in evaluating urban amenities' economic value to cities and municipal administrations, expanding understanding of the catalytic opportunities inherent in public realm investment.

The research reveals a combined Total Economic Value (TEV) of $16.44 billion (2024 CAD), with substantial contributions from recreational, educational, and infrastructural projects. Recreational projects emerged as major contributors, delivering an average collective benefit of $357 million per project, largely driven by indirect advantages including social and environmental benefits. Educational projects, encompassing museums, libraries, and science centers, averaged $291 million in economic value per project through direct cashflows, while infrastructural projects like bike lanes and road dieting indirectly generated $73 million on average by fostering walkable streets, reducing collisions and fatalities, and decongesting commutes.

By aligning TEV against capital costs and annual operation expenditures, we establish Benefit-Cost Ratios (BCR), that offer a clearer perspective on value over time. Recreational and educational urban amenities demonstrate exceptional value with five-year BCRs of $4.8 and $3.9 returned per dollar invested respectively. Such investments in the public realm suggest that municipalities can expect not only to recover their initial outlay but also to achieve significant additional returns.

Conversely, slow-maturation projects such as urban street tree planting yield a 5-year BCR of $0.7 per $1 invested, taking closer to 7 years to break even on average. However, considering intensifying climate change impacts, ecological projects likely have vastly undercalculated values under today's evaluation metrics.

INTRODUCTION

Cities worldwide are undergoing a monumental shift: revising outdated business models toward attracting capital, labor, and growth through provision of desirable spaces within their urban fabric.[1] This shift moves away from conventional understanding of cities as growth machines—"growth" defined as "[…]increasingly intensive land development, higher population density, and increased levels of financial activity."[2] This nakedly capitalist mindset can leave urban centers bereft of spaces not surrendered to direct economic productivity. However, thoughtful public spaces and urban

amenities are becoming more valuable and catalytic as "Citizens in the post-industrial city increasingly make quality of life demands, treating their own urban location as if tourists, emphasizing aesthetic concerns."[3]

Contrary to *smokestack chasing* (offering larger direct financial incentives than competing cities to attract capital and labor), this research explores *home advantage*—a business model where localities better serve taxpayers with local urban amenities while leveraging higher quality of life to incentivize rehoming of new capital and labor.[4] This duality of urban amenities, serving both public and private needs, underscores the importance of thoughtful considerations in development. When used strategically, cities can harness the power of satisfying business and public endeavors simultaneously, both contributing to local economic advancement.

This research explores how urban amenities interact with cities and people, investigating how these advantages pertain to urban development strategies and residents' overall quality of life. Financial benefits are evident in everyday lives of citizens, delivering exponentially large savings in healthcare, stormwater interception, urban heat island effect mediation, educational opportunities, and lower crime rates.[5] Ultimately, this research seeks to further understanding and development of urban amenities for the public realm and a city's bottom line, offering insight into unrealized potentials of underutilized spatial assets. The hidden value of urban amenities as social, environmental, and economic assets is uncovered—laying groundwork for a paradigm shift in prevailing urban development strategies.

METHODOLOGY

A comprehensive, cross-sectoral literature search was conducted including the collection, analysis, and synthesis of 63 case studies across 6 typologies (educational, infrastructural, recreational, ecological, commercial, and industrial). To account for ranging intervals across pre-existing resources—such as research articles, case study analyses, third party economic impact reports, municipal financial records, and private financial records—values were adjusted to 2024 Canadian Dollars. Standardized methods evaluated benefits guided by industry-leading reports such as Oxford Economics and the Organization for Economic Cooperation and Development, measuring value through four factors: Initial Cost, Annual Cost, Direct Annual Value, and Indirect Annual Value.[6]

Definitions

Together, direct and indirect outputs make up Total Economic Value (TEV). Direct value can be defined as "benefits that accrue to an individual or organization and can be reliably estimated."[7] Such as day use, ticket sales, or tax revenue, and other financial income.

Conversely, indirect value is a more ephemeral, intangible asset. This value is harder to estimate, oftentimes reaching beyond the confines of the urban amenity and creating benefits that "spill over" to the rest of the economy.[8] For parks, this can include health benefits, reductions in air pollution, and stormwater collection.[9] For libraries, this can mean education received or research conducted that further benefits the economy.[10]

When deciding on a relevant monetary metric, Benefit-Cost Ratio (BCR) was chosen over Return on Investment (ROI) for the purpose of this study. BCR accounts for multiple factors such as capital costs; annual costs; annual direct revenue; and indirect revenue. This range of data supersedes ROI's use of only annual costs and returns, giving us a more accurate picture of money over time.[11]

RESEARCH FINDINGS

Education

Educational amenities (museums, libraries, science centers) averaged $291M in annual TEV with a 5-year BCR of 3.9:1. Oxford Economics found Canadian GLAMs generate $8.6B annually. Annual attendance to GLAMs in Canada was 150 million, with libraries assisting 204,000 citizens monthly with job-seeking advice and offering training to nearly 17,000 people monthly.[12] The economic significance lies within education received by students and children who achieve higher incomes over working lifetimes, valued at $3.4B.[13] This study found that seven district library's from Vancouver to South Korea had an average TEV of $381M annually with operational costs of $94M annually and five-year BCR of 4:1. Educational amenities excel at dual functionality—serving both public enrichment and municipal economic goals.

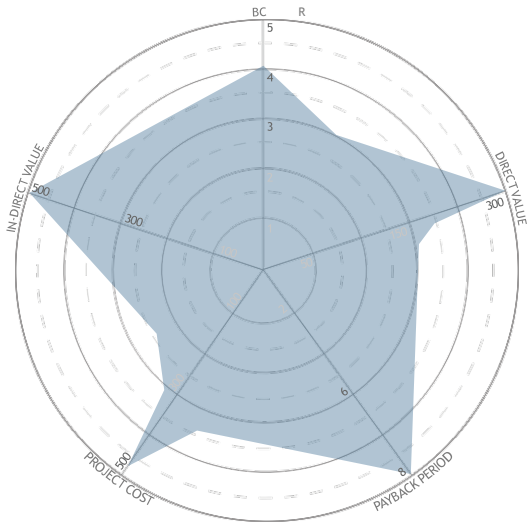

Figure 1. Overlay of all educational case studies and their values

Infrastructural

Infrastructure projects had average annual TEV of $73M with five-year BCR of $3.8 per $1 invested. A New York City Department of Transportation study recorded 58% decrease in injuries to pedestrians and 49% increase in retail sales after implementing sustainable roadway infrastructure.[14] Barcelona's Superblocks study found infrastructural changes led to decreases in air pollution and heat island effect with increases in physical activity, projecting these changes can prevent 667 premature deaths per year, resulting in potential economic benefit of $2.5B if all planned Superblocks are implemented.[15] These interventions not only serve municipal purposes but also meet citizens' needs, increasing capacity to offer indirect financial gains while achieving livelihood improvements and making commuting accessible.

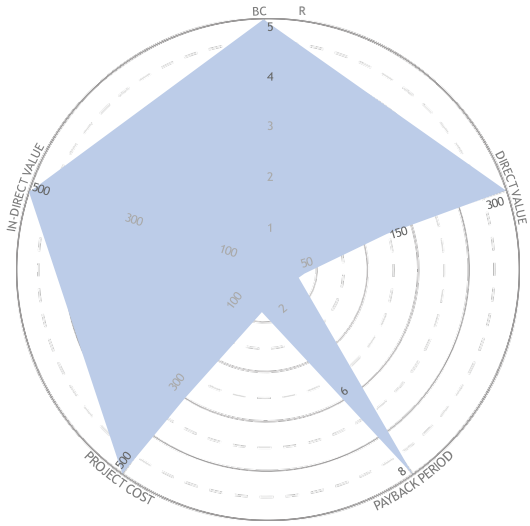

Figure 2. Overlay of all infrastructural case studies and their values

Recreational

Recent studies describe access to parks as an absolute necessity for human well-being, as they are social, ecological, and recreational engines serving wide populations while providing large arrays of health benefits to society.[16] The presence of parks in our lives may have more of an impact than we think, exceeding conventional social and wellbeing benchmarks and extending into the realm of economic value.[17]

On average, recreational amenities have annual indirect economic value of $423M and direct value of $68M. Indirect benefits from resiliency features and health benefits take precedence in this typology regarding economic viability, as many outdoor spaces are accessible at no charge. Parks present themselves as opportunities for people to congregate, interact, and recreate, while doubling as large permeable landscapes offering shading, biodiversity and water collection.[18] Resiliency features—stormwater interception, floodplain restoration, wetland creation—play a large role in the economic success of amenities with particular significance in recreational typologies.

Buffalo Bayou Park, completed in 2015, is a project where opportunity for development was used twofold, capturing both the human and infrastructural benefits.[19] By restoring floodplains, providing extensive trails, and implementing erosion-proof materials, the completely submergible park is capable of withstanding 100-year flood impacts.[20]

The park provides the 44,000 households within a 10 minute walk the opportunity for activity and incentivizing a healthy lifestyle.[21] This aspect alone is estimated to deliver $194M in health benefits to residents.[22] For the city, millions of dollars have been saved from flood capacity (withstanding hurricane Harvey in 2017); while the lure of the space has sparked billions of dollars' worth of development in surrounding areas.[23] This perspective on recreational amenities allows for quality-of- life enhancements to be synonymous with cost savings for a city.

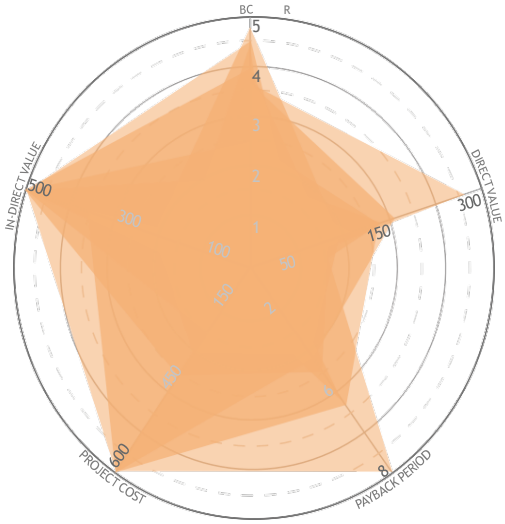

Figure 3. Overlay of all recreational case studies and their values

Ecological

Ecological projects often stem from cost savings of reducing load on city systems. A study evaluating stormwater management in Calgary, Toronto, and Vancouver found trees absorb 3.12 cubic meters of rain annually, and given $155 to plant a tree in Calgary, they "produce annual savings of $159.12 and a payback period of a little under a year."[24] A Portland study inspecting street tree impact documented cumulative $1.2B (2008 dollars) increase in property value, meaning street trees also increase tax revenues by $15.3M annually (approximately $180 in taxes per street tree).[25] The public receives more green aesthetic areas around homes and benefits from increased property value upon selling, while the city collects increased property tax revenues to reinvest in the public realm. Given increasing challenges associated with climate change, current metrics behind monetary value equivalences are likely underreporting even more significant gains.

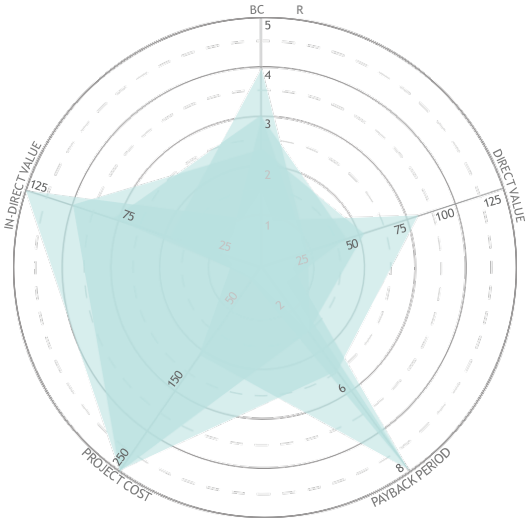

Figure 4. Overlay of all ecological case studies and t heir values

Commercial and Industrial

The film industry and large event centres show similar average TEV: $170M and $120M annually respectively. The Brisbane Convention Centre holds 1,187 bookings for events up to 2029 with economic value of $900M.[26] Oxford Economics evaluated "The Last of Us" production in central Alberta, finding $181M spent directly supporting 1000 local businesses while creating 840 full-time job equivalents, with $71M directly contributing to Alberta's GDP.[27]

Figure 5. Overlay of all commercial (left) and industrial (right) case studies and their values

CALGARY VIABILITY ANALYSIS

To ensure Calgary relevance, case studies were filtered by three criteria. Climate was highlighted as incredibly important since most amenities are outdoors and usage is dictated by weather. We identified Calgary within the Humid Continental climate region, with twenty studies matching this criteria.[28] Calgary's population was last recorded as 1,422,800 in 2023, falling within the "Comparable" range [600,000–2,000,000], with twenty-four studies in this category.[29] Upon reviewing The City of Calgary's 2023-2026 Service Plans Budget, projects in the "Large" cost range [<$110M] were closest to the city's scope, with twenty-three studies found within this range.[30]

Climate

Morden Urban Forest Plan

In 2016, Morden, Manitoba set out to assess the health, value, and economic benefits of local tree populations. Their assessment included an i-Tree Street analysis, a tool commonly utilized to provide estimates of monetary annual benefits provided by trees.[31] The analysis quantified stormwater mitigation, energy consumption savings, aesthetics, public values, air quality improvement, and carbon sequestration.[32]

Morden's inventory of 5,330 trees was valued at $7,456,264 and produced an economic benefit of just over $600,000 a year. The largest contributor was aesthetic and social considerations valued at $472,000, recorded through willingness to pay assessment. The second largest benefit was the annual interception of 22,471 cubic meters of stormwater, contributing to $64,000 in savings. Energy, CO2, and air quality savings were valued at $60,000, $10,000, and $5,800 respectively.[33] Accounting for annual maintenance expense of $150,000 produced a benefit-cost ratio of 4:1.

Monon Boulevard

This infrastructural revamp transformed Monon Blvd. into a lively spot for cultural involvement, social cohesion and recreation. Located in Carmel, Indiana, this landscape was built with innovative resiliency features including permeable pavement, a 380,000-gallon underground water tank, and the planting of 325 trees. These inclusions provide environmental and cost-saving benefits—reducing the street temperature by 3º and providing 72% reductions in stormwater runoff rates.[34] Pedestrian safety was also prioritized through dedicated paths and narrower low-speed vehicular lanes.[35]

The street has seen an exponential increase in park use up 118% from 340,000 yearly users to 742,000 even given the cold winter temperatures. Five interviewed businesses within 2 blocks reported increased gross customer visitation, with one business estimating a 20% increase in sales. The boulevard revitalization has catalyzed an estimated $167m in private investments within the area.[36] Despite lower foot traffic during colder months, proper people-centric infrastructure continues to benefit users and businesses alike.

POPULATION

Cultural Trail

Before opening in 2013, Indianapolis' local Cultural Development Commission advocated that six neighbourhoods should be established as cultural districts to serve the inner city's 880,000 population. However, nothing linked the districts. Once opened, the trail became a vehicle for economic success across a 12-kilometre stretch of businesses.[37]

A University of Indiana study in 2015 quantified how the trail benefits the city, users, and businesses. Trail counters discovered the passage averaged 214,000 visitors annually, outcounting all other Indianapolis pathways combined with the exception of Monon Blvd.[38] Forty-eight percent of firms reported higher earnings. These increases were attributed to higher foot traffic and the trail making businesses more accessible, with patrons using the trail as their primary mode of transportation. Thirty percent of 558 respondents indicated they would spend an average of $53; at this level of spending the advantages achieved by any segment of the trail ranges from $963,000-$3,200,000 (2015 USD).[39]

Kylde-Warren Highway Cap

Dallas' downtown has been severed in two for most of its existence: a cultural district and a dense mixed-use area separated by an eight-lane sunken freeway. In 2012, Dallas set out to build a greenspace stretching three full city blocks acting as a bridge, park, and tunnel design all in one.[40] A Landscape Architecture Foundation case study report found that these pedestrian-centric amenities improved the quality of life for 90% of survey respondents, with 69% of respondents now living healthier lifestyles.[41]

The park has recovered over half of its original cost of $200M through an annual increase in tax revenue of $12M, while exceeding its full cost when taking into account the $312M worth of economic development generated by the project.[42] Preexisting buildings in the area also saw large increases in property value. One building saw a 65% increase from its prerecorded 2008 value of $32M to a projected market value of $91M (2013 USD).[43]

COST RANGE

Cumberland and Riverfront Park

In 2010, Nashville was calling for an activated riverfront providing better recreation opportunities, accessibility, and performance spaces. Cumberland and Riverfront Park was officially opened in 2012. This impressively quick turnaround cost the city $83M—creating an economic and social powerhouse and environmentally sound space. Use of underutilized brownfield property, restoration of floodplain

able to meet 500-year flood events, stormwater collection and filtration, and doubling the area's biodiversity were among goals achieved.[44]
A 300,000-gallon tank below the park collects on average 2,649 cubic meters of water every year, 100% of which is used to irrigate the park. Given its downtown adjacent location, views of the Nashville skyline, and large collection of attractions, the park has met the call for an activated riverfront. All of this activity has generated a reported $1B locally within a two-block area—making the space a major contributor to the surrounding economy from what was once a vacant lot.[45]

Fishtail Park

From a heavily polluted dumping ground to an urban oasis of floating islands and ecological benefits, Fishtail Park in Nanchang, China, is an award-winning landscape architecture project costing tens of millions less than one would expect.[46] Built for a low cost of $34M, the park offers an extremely replicable model, boasting a modest budget of around $58/square meter.[47] This cost was achieved through reuse of local materials found in and around the once-abused landscape. When remediation began, ash was mixed with mud from a nearby dumping site, to produce islets and a lake geared towards delivering a recreational environment for locals. Now, 26,000 flood-resistant trees populate the islands, actively filtering the canal's water. This natural filtration was found to improve the water quality by 34-50%.[48]
A conducted survey found 58% of respondents expressed positive public opinion towards the management of the city and land, while 66% agreed the park is in harmony with the land, and 56% reported they visit for mental health benefits.[49] These case studies highlight the significant economic and ecological impacts that can be achieved within a reasonable cost range, offering valuable lessons for Calgary's urban development.

CONCLUSION

Today, cities face challenging economic decisions regarding land use, zoning, vacancies, and underutilization. However, neglecting these considerations—in a world where amenities are more critical than ever—presents a significant problem. This exclusion is not only a common oversight but a financial mistake for cities. Conversely, business models taking consideration of amenities' dual abilities to serve both public and civic needs have proven advantageous. As this research presents, the better the duality of the project, the quicker it pays for itself, and the larger its profits over time.
The typologies categorized in this study, and the similarities drawn to Calgary, outline a very concise message: despite the population density, climate, or cost range, providing for the community is not a money sink—it is a strategic opportunity to advance city needs, with the added bonus of increasing taxpayer satisfaction and the potential for a greater than 'break-even' BCR. These multifactorial advantages suggest that intentional design of urban spaces should be a focus for municipalities, ensuring they are productive in more than one way.
Among the summary of these case studies a pattern develops: the emerging value of amenities as social, environmental, and economic assets is becoming more attractive to the public eye, furthering economic viability for municipalities. Urban amenities shape our lives, and the more attention and detail we can bring to them, the better they can increase safety on our roads, reduce flooding in our urban landscapes, and weave a tighter cultural, social, and communal connection between the places we reside in so frequently.

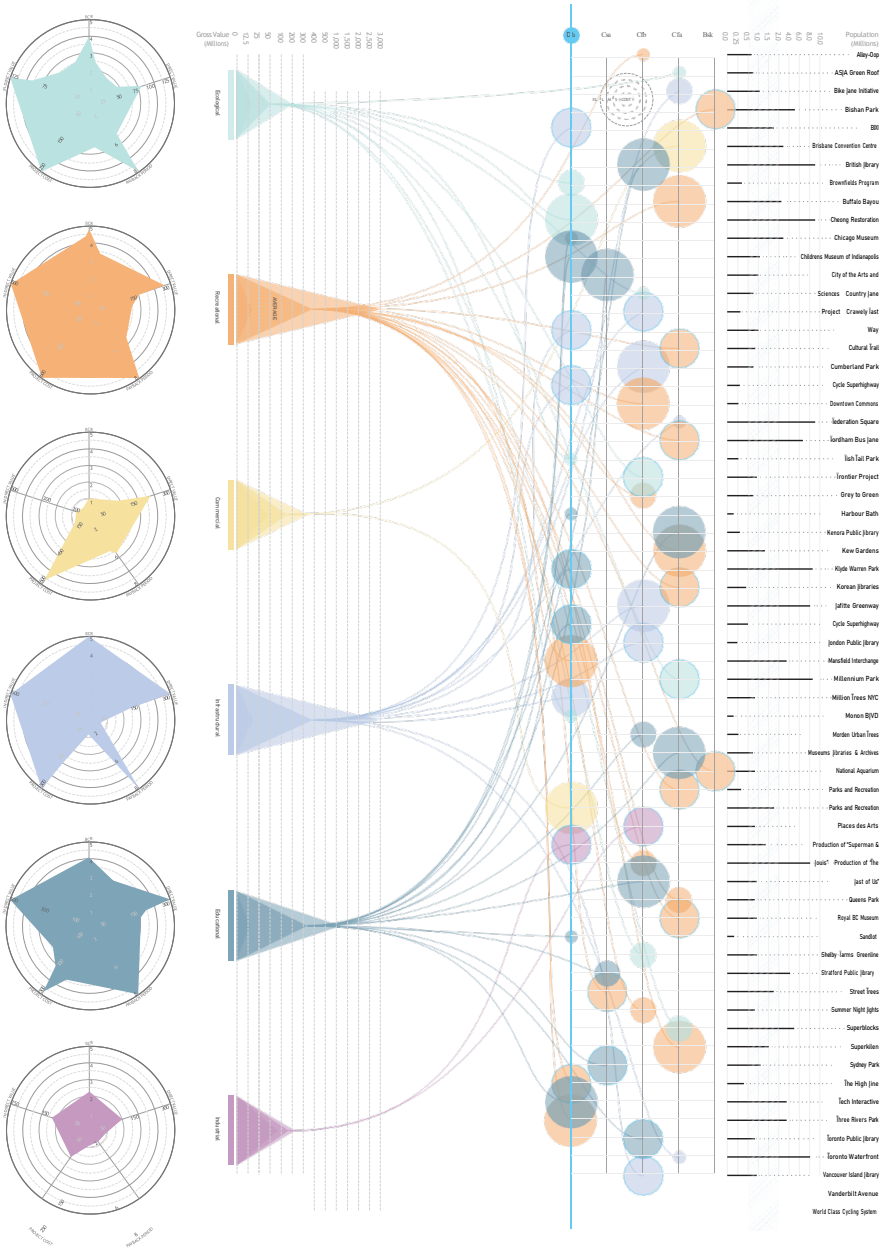

Figure 6. Urban Amenity Data Cascade Depicting Each Case Study and Their Descriptive values

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