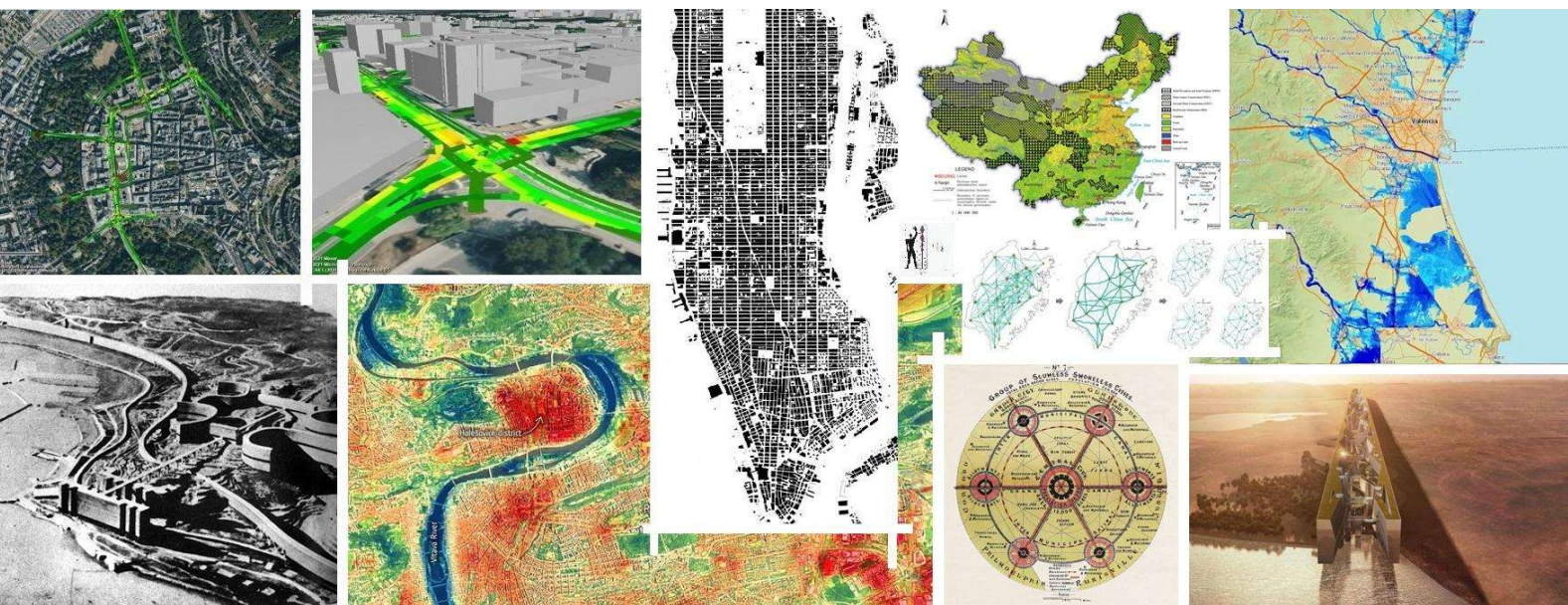




Sustainable Urban Planning & Territorial Management: future challenges in the new era of climate change and artificial intelligence

Proceedings of the SUPTM 2026 conference

**S. García-Ayllón
& J.L. Miralles**
Editors

THIRD INTERNATIONAL CONFERENCE ON FUTURE CHALLENGES IN
SUSTAINABLE URBAN PLANNING & TERRITORIAL MANAGEMENT

SUPTM 2026

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The Technical University of Cartagena is an institution with an unwavering commitment to sustainability, the environment, urban studies and proper land-use planning. Hosting the third international conference on the challenges of the 21st-century in urban planning and land management, SUPTM 2026, is a privilege for us as a scientific and academic institution.

As one of the four technical universities in Spain, our students and researchers are deeply engaged in these disciplines through various academic programmes and research initiatives. City design, urban mobility, environmental and territorial planning, and natural disaster management, such as flood control and preservation of coastal space, are areas where our institution excels nationally and internationally. Every year, we graduate numerous professionals who bring their expertise to diverse fields.

Research in these critical areas is essential for the future of the planet and must be prioritised by society, supported by public administrations, and disseminated to industries through knowledge transfer. I reaffirm our institution's unwavering commitment to participating in international knowledge sharing events, which empower our researchers and facilitate collaboration with peers.

I am confident that this conference marks the beginning of a series of meetings that will drive progress towards our planet's sustainable development goals.

Mathieu Kessler

Rector of the Technical University of Cartagena



It is a pride for the city of Cartagena to host this third international conference on challenges in urban planning and land management SUPTM 2026. The city of Cartagena, as the cradle of a three-thousand-year-old civilization, is a historical reference in terms of architecture and urban planning. However, we are not resigned to living from our past, but rather we are committed to a future in which innovation and research are the spearhead to help move our society forward.

In this sense, our city is a reference in sustainable urban mobility, environmental planning and innovative architecture, incorporating researchers and professionals of the highest prestige into our projects. These projects have placed our city in a vanguard position in many of the topics that will be discussed during these days in this congress. In this sense, I am convinced that the results of this meeting will be very useful and will help our cities and territories to advance along the path of sustainable development.

I am confident that the success of this first call is only the beginning of new meetings in the future that will consolidate our city as a benchmark in terms of research on urban planning and land-use planning. And I am sure that in the near future, the more than 200 researchers from the five continents who will meet electronically these days, will be able to come and see our wonderful city in person at the next edition of the congress, which we will be happy to invite you to.

Noelia Arroyo
Mayor of Cartagena



PREFACE

For many years now, the scientific community has warned of the need to evolve the social and economic activities of our societies around the world towards a situation of ecological balance with the ecosystems that produce the environmental services that these activities consume. And this, in addition, maintaining a fair distribution of wealth so that the evolution towards that ecological balance does not generate greater differences in economic development between the different countries of the planet. This is the great challenge that humanity faces in the coming decades.



Furthermore, every social or economic activity generates its own land demand for associated uses in the city and territory, sometimes competing with ecosystem uses that generate essential environmental services or altering them and modifying the urban and territorial morphology and landscape.



According to the United Nations, the urban population will concentrate up to 70% in urban areas in the coming years, and this means, as many authors highlight, that the economic and social transformation towards a sustainable society, and the achievement the United Nations SDG, it will only be managed if sustainable cities are achieved in ecological balance with the territory that provides essential environmental services.

In this context, the 3rd International Conference on Future Challenges in Sustainable Urban Planning & Territorial Management (SUPTM 2026), whose proceedings are published in this book, wants to be a scientific contribution to the great challenge of sustainability that humanity faces in the coming decades. A space for thought, the exchange of experiences and action.

In the process towards an economic activity based on ecological balance, urban and territorial planning is an essential and irreplaceable instrument since, unlike other areas of the economy in which errors in the production of goods and services can be corrected, in the field of the location of uses and activities in the city and the territory, mistakes in said decisions either cannot be corrected or their correction is very economically expensive and requires a lot of time. Therefore, it is, in any case, better to prevent through urban and territorial planning to guarantee the maintenance of the production of environmental services. The poor planning of activities, such as developing industrial or a tourist areas in zones where essential

environmental services are produced, implies a territorial transformation that is practically unaffordable or even impossible to reverse, and consequently a production loss of environmental services. A sustainable urban and territorial planning is only possible if there is simultaneously an administrative organization able to enforcing it, especially in its environmental dimensions, and particularly the protection of areas with some environmental values, locating urban developments in areas compatible with the maintenance of said ecological assets.

The researchers who deal with urban and territorial sustainability in any of its many facets is very aware of this, as is evident in the high participation that has occurred in this conference as well as in the great variety of topics discussed. It is therefore evident, on a global scale, of the great concern that exists in humanity about these issues and, at the same time, it shows the need to share knowledge, experiences, analysis, proposals... In our scientific field, knowledge is often generated locally as a way to generate universal rules. Local analysis and experiences allow us to learn about similar situations in societies that apparently are very different, and to generate global knowledge.

Urban and territorial sustainability will be global, or it will not be. The major environmental problems that exist on our only planet require, in many cases, comprehensive global solutions. In this framework, research in our field plays a fundamental role. As an example, aspects such as the emission of greenhouse gases, which in a significant part occur in the transportation sector, require a transition towards widespread sustainable mobility. And of course, these transformation processes should not produce an increase in wealth differences between the different countries of the world.

A huge job to do, a huge task ahead, a great challenge that humanity has never faced. Our collective, with the contributions of our research, plays an essential role.

At the same time, many scholars and scientists who share their research in this conference are academics who also fulfill the function of transmitting the acquired knowledge to new generations. Again, in this area we also face a great challenge. It is the challenge of global learning thorough systems such as Collaborative Online International Learning, so that new generations learn to live and share with students from any other university in the world, and to address global challenges collaboratively, thus generating a New Ecological Paradigm global.

We hope that humanity will be able to generate and apply the knowledge that constitutes this New Ecological Paradigme to achieve a balanced world in its economic development that must necessarily be based on a local and global ecological balance.

Salvador García-Ayllón & José Luis Miralles
Chairs of the SUPTM 2026 conference

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Gabriela Munguía-Urbe & Pedro Gutiérrez-Yurrita. *The Impact of the COVID on People Who Visited Urban Gardens in México City. Reframed the Landscape Concept Through Attachment to Place.*

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Opening Lecture

Urban green infrastructure and its implications for equity and well-being

Urban green infrastructure (UGI) has become a central concern of contemporary urban planning and policy, as cities confront the intertwined challenges of environmental degradation, public health risks, and socio spatial inequality. Rather than treating green spaces as isolated amenities, UGI conceptualizes them as an integral part of the urban systems that support ecological functioning, human well being, and equitable development. This talk synthesizes conceptual and empirical insights on UGI with explicit relevance for urban planning and public policy, focusing on high density contexts. Drawing on recent theoretical frameworks and empirical evidence from Mainland China and Hong Kong, it examines how UGI influences health outcomes, how planning decisions affects equal access to UGI, and how peri urban green spaces can contribute to environmental justice. The talk argues that a policy oriented infrastructural approach to UGI is essential for advancing sustainable and inclusive urban development.



Urban green infrastructure (UGI) reflects a modern planning approach focused on multifunctionality and integration, transitioning from solely recreational spaces to interconnected networks of natural and built systems. International definitions emphasize intentional design, integration with existing infrastructure, and the delivery of multiple public benefits, positioning UGI as a priority in urban governance and investment. Evidence shows that UGI improves physical and mental health by supporting activity, reducing environmental hazards, and enhancing well-being through stress relief and social interaction. However, these benefits depend on careful planning around location, access, design quality, and ongoing maintenance. Currently, research gaps remain: studies often favor parks and street trees, leaving other forms of UGI underexplored, especially regarding indirect health benefits. Additionally, UGI can lead to unequal social impacts, such as gentrification and displacement, challenging planners to balance environmental, health, and equity objectives.

Research on inequalities in access to urban green infrastructure (UGI) shows that green space accessibility often increases housing prices, reinforcing income-based residential sorting. This raises questions about who truly benefits from public investment in green spaces. The research by Shan, Fan, and He (2024) examines the implications of prevalent "club" green spaces in urban China—greenery within gated communities and accessible by residents only, which primarily serve wealthier populations. The widespread club green

space challenges the assumption that expanding green space always means increasing public access. Empirical evidence from Nanjing, China illustrates how public and private green spaces interact within urban systems shaped by planning and market forces. Using multi scalar accessibility analysis and hedonic modelling, research shows that public parks and club green spaces exhibit a supplementary and mutually reinforcing relationship. Club green space can enhance residents' daily contact with greenery, particularly in newly developed areas, while public park provision may incentivize private developers to invest further in green amenities to capture housing premiums. However, the distributional effects vary by urban context and travel mode. In inner city areas, club green space may exacerbate inequalities in walking accessibility, whereas its influence is stronger in suburban sub cities under comprehensive travel modes. These findings highlight the need for planning policies that explicitly regulate and coordinate public and private green space provision.

Another research by Shan and He (2025) examines the role of peri-urban parks in enhancing urban green spaces accessibility from an environmental justice perspective. Country parks, situated on city edges, conserve ecology and provide recreation. Unlike urban parks, they feature larger, semi-natural settings that serve varied needs and offset limited city green space. Their effectiveness depends on accessibility and transport links, making them a crucial element in spatial and infrastructure planning. The case of Hong Kong demonstrates how peri urban parks can reshape urban green space accessibility and environmental justice outcomes. Although the influence of country parks generally declines with increasing travel time, empirical analysis shows that they can mitigate or even reverse disparities between central and peripheral areas across different accessibility thresholds. Importantly, neighborhoods with more disadvantaged populations are often more reliant on peri urban parks to improve overall access to green space, and this reliance has intensified during recent urbanization processes. To inform urban policy making, these findings underscore the importance of coordinating green space planning with transport investment and housing policy to ensure acceptable travel times and equitable access.

Looking forward, an integrated UGI–health nexus provides a policy relevant framework for future urban planning. Such a framework conceptualizes UGI as a system composed of diverse elements, including public parks, club green spaces, green roofs, and peri urban parks, operating across multiple spatial and temporal scales. Health and well being outcomes are similarly multidimensional, ranging from short term psychological effects to long term life course impacts. For policymakers, this suggests the need for longitudinal

evaluation, cross sectoral coordination, and adaptive governance mechanisms capable of responding to changing social and environmental conditions.¹

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¹ **References:**

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Shan, L., & He, S.* (2025). The role of peri-urban parks in enhancing urban green spaces accessibility in high-density contexts: An environmental justice perspective. *Landscape and Urban Planning*, 254, 105244.

Closure Lecture

What does it mean to be “too hot”? A New Paradigm for Extreme Heat Management

It is a pleasure for me to close this conference on challenges for the 21st century in sustainable urban planning and territorial management. [...] Heat is a central concern for cities everywhere. Fundamentally, the term ‘heat’ describes a thermal state determined by multiple climate-related variables including air temperature, radiation, humidity, and air movement that have consequences for the human body and biophysical systems (Oke 1982, Parsons 2002, Kuras et al 2017). Those thermal states are consequential to cities as a set of impacts on people and places. For instance, extreme heat—a thermal state that has negative consequences for human bodies—is one of the deadliest climate change impacts globally and predicted to increase with future urban population growth and an extreme heat event (EHE) frequency and severity (WHO, C40, Madge 2011, Mora 2017, Buchanan 2021, Tuholske et al 2021). Impervious surfaces such as asphalt and other attributes of the built environment contribute to states such as local warming and the regional urban heat island (UHI) in most urbanized regions (Oke 1982, Grimmet al 2008, Imhoff et al 2010, Stewart and Oke 2012, Lazzarini et al 2013, Hardin et al 2018).



The combined effects of global and urban-scale warming are disproportionately felt by marginalized groups due to higher heat exposure and lesser capacity to cope with hot conditions (Harlan et al 2006, Eisenman et al 2016, Hoffman et al 2020, Dialesandro et al 2021). Excess heat can amplify other environmental problems, worsening air and water quality, increasing wildfire risk, and greenhouse gas emissions through higher energy demand for cooling (Santamouris 2020). Heat has consequences for every aspect of urban life: it compromises critical urban infrastructure (Chapman et al 2013), lowers educational outcomes (Park et al 2020), increases pre-term births (Barrecca et al 2018, Barecca and Schaller 2020), and reduces labor productivity (Park 2021). Given that urban heat is a multi-faceted problem, cities will need to pursue a suite of different approaches to effectively govern a hotter future.

Few governing institutions at any jurisdictional scale have historically formally, directly, or comprehensively managed heat (Nordgren et al 2016, De Shazo et al 2021, Gabbe et al 2021, Keith et al 2021, Meerow and Keith 2021). Some of the first efforts to mainstream heat response and management by government and international non-government actors⁸ laid the foundation for a current acceleration in action. The distributed network of response to

heat suggests that nascent urban heat governance systems are emerging. Environmental governance refers to the 'set of regulatory processes, mechanisms and organizations through which political actors influence environmental actions and outcomes' (Lemos and Agrawal 2006). Problem framing is a critical function in environmental governance, because it constrains what solution sets are deemed critical and which institutions take ownership of governance (Adger et al 2011, Whittemore and Ben Dor 2018), with downstream implications for what aspects of a problem are addressed or not. Heat governance framing directs attention to particular consequences of elevated temperature for people and places, with implications for what constitutes a desirable state and if and how to address it.

Municipal plans provide insight into prevailing problem framings through inclusion of particular policies, programs, and initiatives and alignment with a specific high-level 'vision' (e.g. sustainability, resilience, see Berke and Godschalk 2009). Those broad visions are an amalgamation of policy agendas set in consultation with environmental networks and local innovations (Broto and Bulkeley 2013, Nordgren et al 2016). Plans—or networks of plans—do not encompass the full variety of actors, tools, and narratives present in a governance system, but do signal which environmental agendas are included and prioritized in formal in city governance (e.g. Berke et al 2000, Tennoy 2010, Berke et al 2019).¹

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¹ words extracted from the presentation given by Professor Kelly Turner at the closing ceremony of the SUPTM conference held on January 22, 2026



The Impact of Urban Acupuncture on the Social Logic of Space

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Abstract:

This study investigates the influence of urban acupuncture on the social logic of space, focusing on the recent intervention along Via Roma in Cagliari, Italy. Urban acupuncture, in the context of urban planning refers to a strategic approach where small-scale, precise urban interventions are implemented to stimulate positive, cascading changes across a larger urban area, akin to the precise points used in acupuncture to treat a system. Despite its significance as a major vehicular artery, the impact of this recent urban development, aimed at enhancing pedestrian walkability and social interactions within this critical street, has not been systematically examined. This analysis offers critical understanding of how diverse urban design typologies contribute to the social logic of space. To achieve this, the study employs the space syntax methodology to explore different scenarios. The initial phase involves analysing the syntactical properties of Via Roma prior to the intervention. The second phase re-evaluates the detailed urban design interventions through comprehensive space syntax analysis, utilising both axial line map analyses. All spatial analyses are conducted using AutoCAD 2026 and Depthmap10 software. The findings manifest a profound shift in the spatial paradigm of the area, revealing that the urban acupuncture project has effectively regulated the street's social logic by significantly increasing integration and connectivity, thereby transforming Via Roma into the most prominent social node within the wider urban system. This research is expected to offer critical elucidation of the effectiveness of such design interventions in addressing the social needs of pedestrians within contemporary urban environments.

Keywords: Urban Acupuncture; Urban regeneration; Social logic of space; Space Syntax; Walkability; Sociability

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1. Introduction

Urban acupuncture represents a contemporary paradigm in territorial management, advocating for strategic, small-scale interventions to precipitate systemic improvements across the broader urban fabric [1]. Unlike traditional, cumbersome regeneration schemes, this approach focuses on precise "pressure points" to rejuvenate the social logic of space: a concept rooted in Space Syntax theory which assumes that spatial configuration fundamentally dictates patterns of movement and social encounter [2]. By enhancing the syntactical properties of a specific site, urban acupuncture aims to alleviate social stagnation and increase a plethora of spontaneous interactions [3]. The efficacy of such interventions rests on the assumption that even a localised modification can reconfigure the hierarchy of accessibility, thereby transforming the sociability of the entire urban system through enhanced spatial connectivity and visual permeability [4].

Despite its historical prestige, Via Roma in Cagliari previously suffered from a significant shortage in pedestrian-oriented design, serving primarily as a congested conduit for a deluge of vehicular traffic. This dominance of the automobile created a hostile envi-

ronment that effectively overwhelmed social vitality and delivered the waterfront area fragmented from the city's historical core. The lack of liveability in this major street represented a critical challenge for local authorities, as the high levels of noise and pollution served to discourage sedentary activities and communal engagement. Consequently, the objective of this study is to systematically evaluate the recent pedestrianisation of Via Roma through a Space Syntax lens. By comparing the pre-existing vehicular-dominated state with the new configuration, this research seeks to prognosticate the project's success in revitalising the street's social logic and restoring its role as a vibrant public realm.

2. Material and Methods

The methodology employed in this study is underpinned by the Space Syntax framework, a theoretical apparatus developed by Bill Hillier to elucidate the reciprocal relationship between spatial configuration and social behaviour [5]. The study area focuses on Via Roma, a prominent waterfront street located in Cagliari, the capital city of the Italian island of Sardinia. To accurately model the morphological evolution of this critical site, a meticulous data collection process was undertaken, synthesising official datasets from the Geoport Sector of the Cagliari Municipality with satellite imagery from Google Earth. This secondary data was augmented by the researcher's own immersive direct observations and empirical mapping using AutoCAD 2026, ensuring that the nuances of actual pedestrian movement were not overlooked.

The core of the analysis involved the construction of Axial Line Maps, which were processed using the Depthmap10 software to calculate properties of connectivity and integration. By adopting this rigorous analytical approach, the research sought to move beyond a mere superficial description of the street, instead providing a profound discernment of how the recent urban acupuncture interventions have reconfigured the underlying spatial hierarchy. This systematic inquiry allows for a comparative evaluation of the pre-existing vehicular-dominated state and the current pedestrian-oriented configuration, effectively bridging the gap between theoretical spatial modelling and the lived reality of the urban environment.

3. Results

The comparative axial analysis reveals a striking transformation in the syntactical properties of the study area following the implementation of the urban acupuncture project. In the initial configuration (Figure 1a), Via Roma revealed an ostensible integration value of 3.78 and a connectivity value of 1,683. While the street was already a significant component of the urban fabric, it was constrained by its role as a vehicular channel. However, the subsequent analysis of the new pedestrian-oriented design (Figure 1b) demonstrates a profound shift; the integration value surged to 4.96, while connectivity reached a plethora of 5,767. This quantitative growth indicates that the precise spatial modifications have not only enhanced the local street quality but have effectively regulated the global hierarchy of the city's network. Most notably, the data confirms that Via Roma has now surpassed other prominent public nodes, such as Piazza Giuseppe Garibaldi, to become the most accessible and connected space within the entire urban system.

The implications of this increased integration extend far beyond the immediate site, acting as a mediator for the sociability of the wider neighbourhood. By converting Via Roma into a highly connected pedestrian street, the urban acupuncture intervention has effectively bridged previously fragmented sectors of Cagliari's waterfront. The drastic increase in connectivity suggests a significant reduction in spatial depth, which is a critical determinant for enhancing walkability. As the street now occupies a pre-eminent position in the axial map, it serves to draw movement from the surrounding urban tissue, thereby increasing a vibrant environment for social encounter and communal life. These findings suggest that the transition from a traffic-clogged street to a pedestrian-centric hub has

successfully resolved the previous lacuna in social vitality. The spatial logic has shifted from a state of segregation to one of high integrity, ensuring that the street now functions as a primary engine for socio-spatial equity and public engagement.

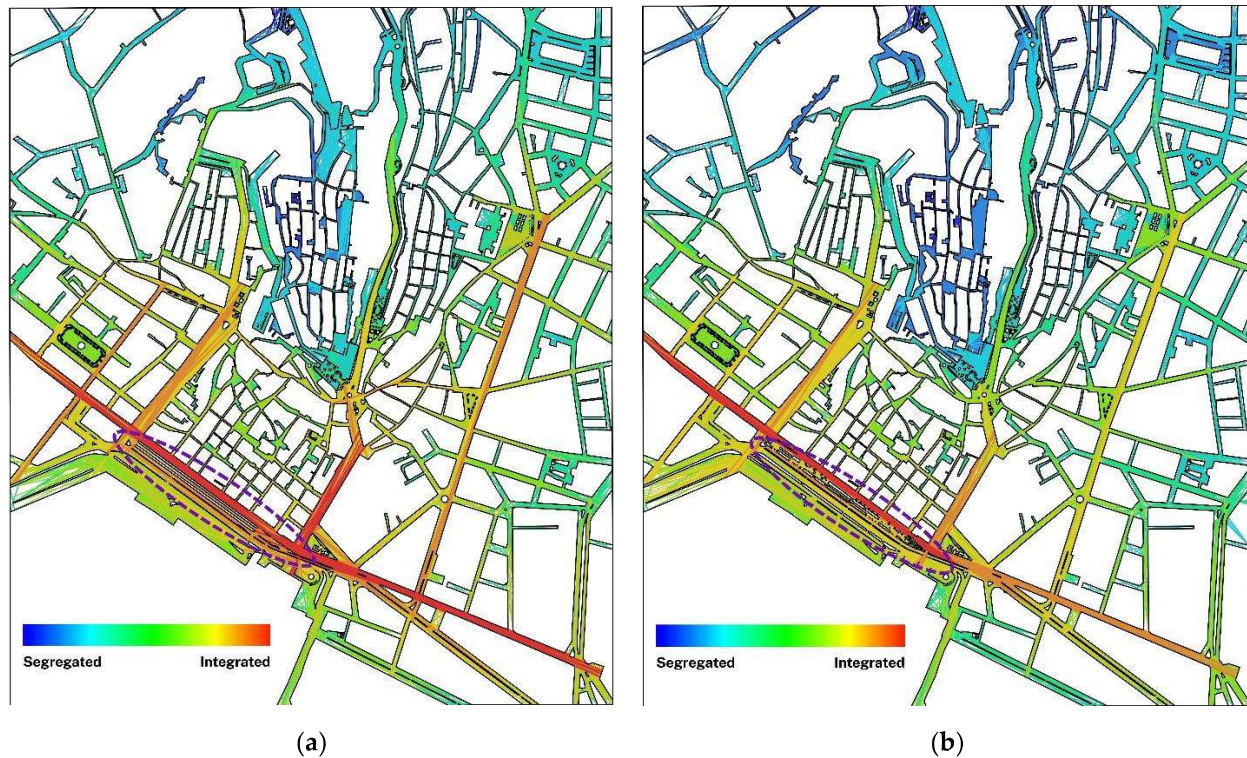


Figure 2. (a): Axial integration map of the area prior to the urban acupuncture intervention, highlighting the pre-existing spatial logic of Via Roma; (b): Axial integration map following the pedestrianisation of Via Roma, showing its emergence as the most integrated node in the urban system.

4. Discussion and Conclusion

The primary objective of this research was to evaluate the transformative potential of urban acupuncture on the social logic of Via Roma, a task achieved by quantifying the shift from a vehicular-oriented environment to a pedestrian-centric hub. Unlike previous studies that often focus on large-scale, exhaustive master plans, or urban architecture initiatives [6–11], this work highlights the efficacy of strategic, localised interventions in regenerating the entire urban system's spatial configuration. The contribution of this research lies in its empirical demonstration that "acupuncture" points can resolve long-standing spatial fragmentation without the need for total reconstruction. However, the current findings represent a nascent stage of investigation; future studies should expand this syntactical approach by incorporating further pedestrianised developments along the waterfront and the adjacent Matteotti Square to determine if these positive effects continue. By underscoring the originality of utilising space syntax to validate such interventions in historic cores, this study provides an experimental framework for evidence-based design that challenges the traditional dominance of vehicular infrastructure in historical port cities.

In conclusion, this study confirms that the pedestrianisation of Via Roma has successfully inverted its previous state of social segregation, establishing it as a pre-eminent node for social logic of space within Cagliari. The latent meaning behind this research suggests that the "social logic of space" is not a static attribute but a malleable quality that can be reclaimed through thoughtful and stringent design. By surpassing established public nodes in connectivity, this project proves that urban acupuncture is an efficacious tool for fostering socio-spatial equity and sustainability. The advantages of this approach ex-

tend into the realms of urban governance and territorial management, offering a cost-effective paradigm for creating liveable cities that prioritise human encounter over transit efficiency. Ultimately, this work articulates a manifest shift in urban planning philosophy: by treating specific spatial "ailments" with precision, we can rejuvenate the vitality of the contemporary urban fabric, ensuring that public spaces serve as the democratic heart of sustainable territorial development.

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Conflicts of Interest: The authors declare no conflict of interest.

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