

HYBRID URBAN SPACE: INNOVATION OF PUBLIC SPACES INTEGRATING TECHNOLOGY, CULTURE, AND SUSTAINABILITY (Case Study: Denpasar City)

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ABSTRACT

Rapid urbanization and tourism-driven economic growth in Denpasar City have created significant challenges for the continuity of traditional cultural spaces, environmental resilience, and technological transformation of public spaces. As the capital city of Bali, Denpasar's public spaces are not only urban facilities but also cultural and spiritual arenas shaped by Balinese identity. This research examines the concept of Hybrid Urban Space as an innovative urban design strategy that integrates technology, cultural values, and sustainability into public space development. Using a descriptive qualitative approach, this study analyzes three major public spaces — Puputan Badung Public Square, Lumintang City Park, and Niti Mandala Renon Civic Park — through field observations, stakeholder interviews, and document analysis. The findings reveal that Denpasar has begun to adopt digital infrastructure such as smart lighting, Wi-Fi services, and surveillance systems; however, the integration remains partial and tends to prioritize functionality over cultural and ecological meaning. The proposed design model highlights four key strategies: adaptive smart technology, cultural-based spatial reinterpretation, sustainable tropical design, and socially adaptive public space programming. The study concludes that hybrid public spaces have strong potential to support inclusivity, maintain cultural authenticity, and enhance environmental resilience while advancing smart city development. This approach contributes to the achievement of Sustainable Development Goal (SDG) 11: Sustainable Cities and Communities, especially in the context of culturally distinctive Southeast Asian cities such as Denpasar.

Keywords: *hybrid urban space; smart city; Balinese culture; public space; sustainable urban design; Denpasar.*

1. INTRODUCTION

Denpasar City, as the capital of Bali Province, plays a strategic role as the center of government, economy, and culture in the southern region of Bali. Over the past two decades, the dynamics of urbanization in Denpasar have progressed rapidly due to the growth of the tourism and service sectors. Based on data from the Central Bureau of Statistics (BPS, 2023), the population of Denpasar City has reached more than 725,000 inhabitants, with the highest density found in West and North Denpasar Districts. Meanwhile, the Sarbagita metropolitan area (Denpasar–Badung–Gianyar–Tabanan) has developed into a unified urban region with a population of over 2 million. This growth poses significant pressure on infrastructure, spatial planning, and the availability of inclusive public spaces. Increased economic activity and population mobility have caused public spaces to

experience not only physical pressure but also shifts in social meaning and function (Sari et al., 2022).

Along with these changes, the function of public spaces in Denpasar has shifted from traditional communal spaces closely tied to cultural and religious activities into multifunctional areas that are sometimes dominated by economic and tourism interests. City Park Lumintang, Puputan Badung Field, and Niti Mandala Renon Field, for example, now serve as recreational areas, event venues, and social spaces, yet they simultaneously face issues of cultural value degradation and limited ecological capacity (Yuliana & Prasetya, 2021). Field studies by Ardika (2020) also indicate that changes in land use and commercialization pressures have led to a “distortion of identity” in Denpasar’s public spaces, where traditional areas formerly used for rituals are increasingly utilized for consumptive activities. This condition requires new approaches to designing public spaces that balance the needs of modernity with the preservation of local cultural values.

In addition to socio-cultural pressures, Denpasar is also dealing with serious ecological challenges. Changes in land use and the loss of green open space have increased the city’s vulnerability to disasters such as flooding, particularly in East and South Denpasar (BNPB, 2024). The rise in extreme rainfall due to climate change highlights the weakness of the urban environmental resilience system. Yet, public spaces play an important ecological role in cities—functioning as water infiltration zones, urban lungs, and microclimate stabilizers (Widiastuti et al., 2023). Therefore, strategies for developing public spaces in Denpasar must be sustainability-oriented, encompassing ecological, social, and cultural aspects.

Amid these dynamics, the development of digital technology and smart city concepts presents new opportunities to improve the efficiency and quality of urban space management. Smart city implementation in Indonesia, including Denpasar, has begun to be applied through the use of public information systems, environmental sensors, and data-based energy management (Syalianda & Kusumastuti, 2021). However, several studies highlight that smart city initiatives in Indonesia remain technocentric and have not sufficiently considered socio-cultural dimensions and citizen inclusivity (Haikal et al., 2025). This has created a gap between digital infrastructure and local context. Technology is applied without regard to social characteristics, cultural rituals, or local value systems that shape spatial identity. As a result, “smart” public spaces often lose their social meaning and cultural aesthetic.

To address these challenges, the concept of Hybrid Urban Space has emerged—an innovative approach combining three essential domains: technology, culture, and sustainability. According to Tan (2022), hybrid urban space is a form of public space that is not only physical but also contains interconnected digital, social, and ecological layers. In the context of a cultural city like Denpasar, this concept can be interpreted as an integration of smart technologies (such as environmental sensors, energy-efficient lighting, or participatory digital platforms) with local cultural expressions (such as traditional Balinese spatial arrangements, ritual symbols, and communal activities) as well as the implementation of green design principles (energy efficiency, environmentally friendly materials, and green open spaces). Hence, the hybrid urban space becomes not only functional but also a representation of the city’s identity, innovation, and sustainability.

Previous studies show that the hybrid space approach can enhance community engagement and strengthen social cohesion amid urban transformation. Choi, Bruyns, and Reeve (2023) found that the concept of the negotiated public realm—public spaces negotiated between economic, social, and technological interests—can create a more inclusive and adaptive urban form. Similar principles could be applied in Denpasar, where balancing Bali’s sacred cultural values with the

demands of modern urban life can be achieved through the design of public spaces that harmoniously accommodate both. This approach is also aligned with the Sustainable Development Goals (SDGs), particularly SDG 11: Sustainable Cities and Communities, which emphasizes the importance of inclusive, safe, resilient, and sustainable urban development (United Nations, 2022).

Considering these conditions, this research aims to examine how the Hybrid Urban Space concept can be applied to public spaces in Denpasar City as a strategy to preserve Bali's cultural identity while adopting technological innovation and sustainability principles. The main focus of the study is to understand how public spaces can serve dual functions: as social spaces that facilitate interaction and cultural activities, and as adaptive spaces leveraging technology to strengthen the city's ecological resilience. Through a multidisciplinary approach that integrates architectural, technological, cultural, and environmental perspectives, this research is expected to provide a conceptual model for future public spaces that are contextual, inclusive, and beneficial for the people of Denpasar and other tropical cities facing similar challenges.

2. RESEARCH METHODOLOGY

This research employs a descriptive qualitative approach with a multidisciplinary paradigm, integrating perspectives from architecture, urban planning, technology, culture, and the environment. A qualitative approach was chosen because the focus of this study is to understand the meanings, values, and socio-cultural interactions that shape hybrid public spaces in Denpasar. As stated by Creswell (2014), qualitative research allows researchers to explore phenomena in depth within their natural context, taking into account the subjective meanings produced by participants and their social environments. This approach is relevant because the concept of Hybrid Urban Space is not only related to the physical aspects of space but also to how communities interact with and adapt to technology and social change.

The study, titled "Hybrid Urban Space: Innovative Public Spaces Integrating Technology, Culture, and Sustainability (Case Study: Denpasar City)", was conducted in Denpasar with three case study locations: Puputan Badung Field, Lumintang City Park, and Niti Mandala Renon Field. These locations were selected based on their function, scale, and the level of interaction between technology, culture, and sustainability. The types of data used include both primary and secondary data. Primary data were obtained through field observations, in-depth interviews, and visual documentation. Observations were carried out to understand spatial characteristics, social functions, and the integration of technological and cultural elements at each site. Meanwhile, secondary data were collected from literature studies, urban planning reports (Denpasar RTRW and RDTR), smart city policy documents, and scholarly publications regarding public spaces, Balinese culture, and sustainability (e.g., Choi et al., 2023; Tan, 2022).

Data collection techniques consisted of three complementary methods:

- (i) Field observations, in-depth interviews, and study of documentation and literature. Direct observations were conducted to identify the existing conditions of public spaces in Denpasar, including community activities, circulation patterns, and physical elements representing cultural, technological, and environmental integration. A place-based observation approach was adopted to understand spatial experience phenomenologically based on the temporal and operational context (Seamon, 2018).
- (ii) In-depth interviews, conducted semi-structurally with three key groups of informants: Denpasar City Government officials—particularly from the Public Works and Spatial Planning Agency (PUPR) and Communication and Information Agency (Kominfo)—responsible for smart city policies and public space management; architecture and urban planning practitioners involved in

the design of public areas; and cultural figures or local communities engaged in social and ritual activities in public spaces. These interviews aimed to explore stakeholder perspectives on the integration of technology and cultural values in shaping adaptive public spaces.

- (iii) Documentation and literature study, conducted to supplement primary data by reviewing photographs, city morphology maps, activity videos, and municipal policy archives. The reviewed academic literature includes theories on hybrid urban space, smart city planning, and cultural sustainability as the conceptual foundation of this study (Tan, 2022; Haikal et al., 2025; Choi et al., 2023).

Data analysis employed thematic analysis, consisting of three stages:

- (a) Data reduction — selecting relevant data related to technology, culture, and sustainability;
- (b) Data presentation — in the form of city morphology maps, relational diagrams, and visual interpretations of hybrid urban space;
- (c) Verification and synthesis — producing a Hybrid Urban Space concept based on Denpasar's local identity.

3. LITERATUR REVIEW

The theoretical review in this study aims to provide a conceptual foundation for the formation of hybrid public spaces that integrate technological, cultural, and sustainability aspects. The relevant theoretical frameworks can be grouped into four main categories:

(a) Contemporary Public Space Theory

In the development of architecture and urban design, the concept of public space is no longer understood merely as a physical space, but as an arena of social, economic, and cultural interaction. According to Ntakana (2025), modern public spaces must function as inclusive social environments that accommodate diverse activities and social groups. This indicates a paradigm shift from public space as a static container toward a dynamic urban interface that responds to social change.

Choi, Bruyns, and Reeve (2023) introduce the concept of the Negotiated Public Realm, which explains how contemporary public spaces emerge through negotiation among various interests: government, communities, and the private sector. Such negotiation produces hybrid forms of public space—simultaneously commercial and public, traditional and modern, physical and digital. In the context of Denpasar, this theory is relevant to explain the shifting functions of public spaces influenced by local culture, tourism, and digitalization demands.

(b) Hybrid Space Theory and Urban Digitalization

The concept of Hybrid Urban Space is rooted in hybrid space theory developed by Adriana de Souza e Silva (2006) and further expanded by Heinrich (2025). Hybrid space is defined as a convergence of physical and digital dimensions where social interaction is no longer limited by traditional spatial boundaries. In hybrid public spaces, digital technologies—such as environmental sensors, public Wi-Fi, smart lighting, and participatory applications—create an added layer that enriches user experience.

Heinrich (2025) also argues that hybrid spaces reflect a symbiotic relationship between humans and technology, producing new urban experiences. In this research, hybrid space theory is used to analyze how digital infrastructure installed in Denpasar's public spaces (such as at Lumintang City Park or Niti Mandala Renon) influences social interaction patterns.

Additionally, Di Marino (2023), in *Hybrid Cities and New Working Spaces*, emphasizes that urban hybridization is not solely a physical phenomenon, but also cultural—transforming how people perceive and attach meaning to space. Thus, in Denpasar, hybrid urban spaces may be understood as the intersection between

traditional Balinese spatial systems (based on Tri Mandala and Natah) and modern digital city systems introduced through smart city initiatives.

(c) Cultural and Environmental Sustainability Theory

Sustainability in urban architecture is not only about energy efficiency and environmental management but also the preservation of cultural values. Soini and Birkeland (2014) introduce the concept of Cultural Sustainability, which asserts that sustainable development must protect cultural heritage as part of a city's identity. This theory is crucial in Denpasar, where public space character is inseparable from Tri Hita Karana—the harmony between humans, nature, and God.

Ehab et al. (2025) developed a framework for resilient green space design, emphasizing ecological and social connectivity in sustainable public spaces. This principle is relevant to Denpasar's current issues: seasonal flooding and loss of green spaces due to rapid urbanization. Ecological landscape elements—such as natural drainage systems, tropical vegetation, and the use of local materials—become key strategies in designing sustainable hybrid spaces.

(d) Resilient Urban Design Theory

Resilient Urban Design provides perspectives on how public spaces adapt to social, economic, and ecological changes. Wagner (2025) argues that modern cities must create public spaces that are flexible, climate-resilient, and responsive to digital society dynamics. In Denpasar, resilience is reflected in the multifunctionality of public spaces—accommodating both traditional ceremonies and recreational or digital-based activities.

Rode and Bhargava (2024), in *Hybrid Cities: Conceptual Framework and Methodology*, explain that future hybrid cities are characterized by the integration of three primary layers:

1. Technological layer — digital systems and smart infrastructure
2. Social layer — community, culture, and public activities
3. Ecological layer — sustainability and environmental resilience

This multilayered integration forms the core analytical foundation of this research.

(e) Conceptual Synthesis

Based on the theoretical review, Hybrid Urban Space can be understood as the synthesis of three interconnected dimensions:

1. Technological dimension — implementation of digital systems and smart infrastructure to enhance spatial efficiency.
2. Cultural dimension — rooted in local values, spatial symbolism, and Balinese social practices.
3. Sustainability dimension — promoting ecological efficiency and urban climate resilience.

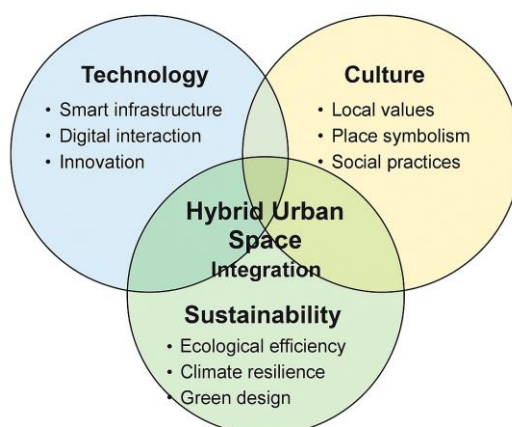


Figure 1. Hybrid Urban Space Conceptual Model.

These three dimensions intersect to form the conceptual framework of this study, referred to as the Integrative Hybrid Urban Space Model (Figure 1). This model illustrates the dynamic relationship between technological innovation, cultural preservation, and ecological sustainability in the design of public spaces in Denpasar.

4. RESULTS AND DISCUSSION

4.1 Analysis of Existing Conditions of Public Spaces in Denpasar City

Denpasar City has unique public space characteristics rooted in Balinese cultural values that are spiritual, communal, and ecological in orientation. However, rapid urbanization and tourism expansion have driven significant changes in the morphology of the city's public spaces. Based on field observations conducted between 2024 and 2025, three major types of public spaces were identified as case study locations: Puputan Badung Field, Lumintang City Park, and Niti Mandala Renon Field. Each of these spaces represents different forms and dynamics of public space but collectively reflect the identity of modern urban Denpasar.

(A) Puputan Badung Field: A Historic Public Space

Puputan Badung Field is the civic heart of Denpasar, rich in historical significance and spirituality. It serves as a venue for traditional ceremonies, historical commemoration, and daily social interaction among residents. Observations indicate that although its traditional functions remain, there has been a shift in how the space is utilized—from ritual practices toward recreational activities. Additionally, technological infrastructure such as smart lighting, CCTV surveillance, and public Wi-Fi has been implemented since 2019 through the Denpasar Smart City initiative. While these upgrades enhance social function and safety, they also pose challenges in balancing modernization with the preservation of traditional values (Choi et al., 2023).



Figure 2. Puputan Badung Field

Architecturally, the spatial layout of Puputan Badung Field still maintains a symmetrical composition with symbolic orientation toward Pura Jagatnatha, reflecting the Balinese Tri Mandala spatial principle. However, modern interventions such as digital parking facilities and tourist kiosks occasionally disrupt visual continuity and spatial sacredness. Thus, this space illustrates hybrid conditions where cultural sacredness coexists with contemporary urban demands.

(B) Lumintang City Park: A Recreational and Digital Public Space

Lumintang City Park represents the emerging modern face of Denpasar's public spaces—more interactive, digital, and youth-oriented. Field observations show the park is particularly active during the evening, enhanced by sensor-based smart lighting systems. Public Wi-Fi access, digital sound systems, and LED public information displays demonstrate the integration of smart infrastructure in the city's outdoor environments.



Figure 3. Lumintang City Park

However, the study found that the presence of such technologies has not fully enhanced intergenerational interaction. Activities tend to be fragmented: younger groups dominate digital zones, while elderly visitors prefer quieter, more traditional green areas. This condition suggests that digital public spaces require more inclusive design strategies to bridge different social groups (Languillon-Aussel, 2021). From a sustainability standpoint, Lumintang Park performs relatively well in tropical vegetation management and water infiltration capacity, but its socio-cultural aspects still need strengthening to ensure that technology does not overshadow local spatial identity.

(C) Niti Mandala Renon Field: A Monumental and Multi-functional Space

Niti Mandala Renon Field exemplifies a relatively balanced integration of cultural, recreational, and tourism functions. The area is surrounded by government buildings, a museum, and the Bajra Sandhi Monument—the landmark commemorating Bali's historical struggles. Activities are highly diverse, ranging from sports and cultural festivals to digital-based annual events such as the Denpasar Smart Festival.



Figure 4. Niti Mandala Renon Field

Spatially, the field has an open structure with a radial layout that reinforces its monumental function and the city's visual identity. Sustainability integration is shown through green corridors, open drainage systems, and the use of solar-powered energy-efficient lighting. However, as Rode and Bhargava (2024) highlight, public spaces of this nature often face challenges in maintaining a balance between public accessibility and government administrative control. Excessive regulation may restrict social spontaneity and community-driven innovation.

4.2 Evaluation of Hybrid Elements Implementation (Technology, Culture, Sustainability)

Based on the synthesized findings from the three case studies, the implementation of the Hybrid Urban Space concept in Denpasar can be categorized into three primary layers of interaction:

(A) Technological Layer

Denpasar has succeeded in integrating digital components into public spaces through smart lighting, public Wi-Fi, and data-based security systems. However, this integration remains partial and does not yet create a participatory digital spatial experience. As stated by Wagner (2025), digital public spaces should encourage inclusive civic interaction—for example, through citizen reporting applications or location-based community information systems.

(B) Cultural Layer

Balinese cultural values continue to serve as the foundation for spatial structure and public space aesthetics. Spatial orientation toward mountains and the sea, the use of local materials such as batu padas and teak wood, and symbolic architectural elements show continuity between modern space and local spirituality. The challenge lies in avoiding superficial symbolic decoration that lacks meaning. As noted by Soini and Birkeland (2014), cultural sustainability requires not only preserving visual form but also maintaining the social meanings embedded within it.

(C) Sustainability Layer

The three observed public spaces demonstrate ecological sustainability efforts such as increased green space, natural drainage, and energy-efficient lighting. However, these strategies are not yet fully integrated. In the context of resilient urban design (Ehab et al., 2025), public spaces must be designed not only for aesthetic comfort but also to enhance resilience against climate-related hazards and long-term social change.

4.3 Conceptual Design Model: “Hybrid Urban Space Denpasar”

Based on field results and theoretical synthesis, this study formulates the conceptual model Hybrid Urban Space Denpasar integrating three core components: smart technology, Balinese cultural values, and ecological sustainability. The proposed design principles are:

(A) Integration of Adaptive Technology

Public spaces should be equipped with contextual—not dominant—digital infrastructure, such as smart sensors for energy efficiency and security, augmented-reality-based cultural information, interactive systems educating visitors about local values.

(B) Reinterpretation of Balinese Culture

Spatial patterns follow the Tri Mandala principle (utama–madya–nista) but are adapted for modern activities such as digital festivals and interactive art

performances. Architectural elements such as a digital bale banjar can serve as a community hub merging information technology with Balinese communal culture.

(C) Principles of Tropical Sustainability

Design strategies include local materials, natural ventilation, layered drainage systems, integration of endemic vegetation. The green loop concept (connected green corridors) becomes an essential element to strengthen ecological connectivity among Denpasar's public spaces.

(D) Socially Adaptive Space

Public spaces must be flexible to accommodate time-based functional differences—from morning traditional rituals, afternoon commercial activities, to evening digital cultural performances. This supports the idea of temporal hybrid space—a space that transforms based on contextual activities (Heinrich, 2025).

4.4 Implications for Urban Design and City Policy.

The Hybrid Urban Space model has implications in two main domains:

(A) Design Policy Domain

This domain refers to architectural and spatial planning guidelines ensuring that all interventions align with technology, culture, and sustainability principles. This is essential considering Denpasar's conditions: tourism pressure shifting public spaces toward commercial uses, increasing technological demands, and declining cultural values. Without design-based policy control: local identity may gradually disappear, technology risks becoming mere gimmick, sustainability becomes a slogan without implementation. Examples of applicable design policies include:

- 1) Smart Public Space Design Guidelines — smart lighting, sensors, and Wi-Fi that encourage social interaction.
- 2) Cultural Identity Conservation Policy — maintaining sacred spatial orientation, bale banjar principles, etc.
- 3) Urban Green Infrastructure Strategy — green loops and local vegetation networks connecting public spaces.

(B) Urban Governance Domain

This domain focuses on how the government manages and regulates public spaces to ensure an effective, inclusive, and continuous integration of technology, culture, and sustainability. Key policy directions include:

- 1) Government–Traditional Community Collaboration — bridging modernity and customary traditions.
- 2) Digital Inclusion Policy — ensuring technology empowers citizens rather than discriminates.
- 3) Balance between Economic, Cultural, and Ecological Values — preventing over-commercialization and spatial inequality.

5. CONCLUSION

Based on the analysis above, it can be concluded that the transformation of public spaces in Denpasar reflects a complex dynamic between technological modernization, the preservation of Balinese cultural values, and the need for environmental sustainability. The three case studies demonstrate that urban public spaces are undergoing hybridization at varying degrees, influenced by tourism development, urbanization, and the Denpasar Smart City program. The Hybrid Urban Space concept emerges as a strategic approach capable of bridging the contemporary needs of urban society with local identity. This integration is articulated through three interrelated dimensions: (i) smart technology that enhances security, efficiency, and civic connectivity; (ii) Balinese cultural values as essential spatial identity that must be preserved both in meaning and function; and

(iii) tropical sustainability that promotes ecological quality and urban resilience. However, an important finding of this study is that such integration remains uneven. Technology tends to be applied in a technocratic manner; cultural representation occasionally appears as symbolic decoration without meaning; and sustainability has not yet been fully planned across the larger urban context. Therefore, the implementation of Hybrid Urban Space in Denpasar remains at a partial stage and has not yet developed into a comprehensive system within urban public space policy.

This research thus emphasizes that the success of hybrid public space innovation in Denpasar relies on two key aspects: Design Policy — ensuring every spatial intervention follows an integrative principle of technology–culture–ecology, and Urban Governance — fostering participatory and inclusive collaboration among government institutions, traditional communities, and the general public.

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