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for Night Time
Economy Planning:
A Case Study in Nha
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Multi-Level Interactive Platform for Night Time Economy Planning: A Case Study in Nha Trang, Vietnam

Nam-Hai Hoang Le*, Tu-Anh Trinh, Khoi Pham

Institute of Smart City and Management, University of Economics Ho Chi Minh City, Vietnam

*Corresponding author: haihln@ueh.edu.vn

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Abstract

Urban planning demands careful handling of data and teamwork among various experts. Traditional urban planning training often struggles with limited group work, hard-to-reach stakeholders, short-term goals, and tight resources. This paper introduces a new digital tool called Night Time Economy Platform (NTEP), built with open systems, and tested in Nha Trang, Vietnam, to tackle these problems. The study, carried out during a 2023 summer camp and a 2025 seminar course, uses real-time Urban Digital Twins (UDTs) to encourage community involvement in decision-making, reaching an 85% approval rate. Feedback from 54 people liked NTEP's easy-to-use interface (56%) and design features (48%) but pointed out slow performance (28%) and data shortages (56%). NTEP's focus on people, MapGL visuals, and open connections set it apart from old tools, boosting public input in planning education and studies. Results show NTEP makes planning smoother and more inclusive, offering ideas for wider NTE governance.

Keywords: night-time economy; participatory design; scenario planning; urban digital twins; civic engagement.

Introduction

The Night-Time Economy (NTE), covering evening and nighttime activities, plays a key role in keeping cities lively by supporting tourism, jobs, and cultural exchange (Ashton et al., 2018; Clark, 2025; Georges River Council, 2021; Hadfield, 2015). In Nha Trang, Vietnam, a city focused on tourism, the NTE thrives with beachfront dining and evening markets, lifting economic growth and community spirit (Tuong, 2022). Still, challenges such as safety worries, scattered data, and low stakeholder input slow down sustainable planning, tying into worldwide sustainability aims (UN Habitat, 2016).

In Vietnam, traditional urban planning remains top-down (Fig. 1), shaped by a city or province-led master plan with limited integration of local input. Despite being reformed by the 2017 Law on Planning and further updated through the 2024 Law on Urban and Rural Planning (effectively July 2025), public contribution is minimal. The current consultation, governed by Decree 43/2014/ND-CP mandates the public hearing but it suffers from inconsistent data formats across departments (e.g., planning and tourism), and inadequate digital tools for real-time feedback—resulting in stalled projects and inequitable outcomes (Pham et al., 2023). These constraints are problematic



in fast-changing sectors like the NTE, where static tools like AutoCad fail to reflect the dynamic and informal nature of nighttime activities (Ashton et al., 2018).

Traditional urban planning approaches in Vietnam - particularly for the NTE - are overly top-down, lack real time data integration, and fail to reflect the diverse landscape of nighttime activity. These limitations result in inefficient, inequitable and non-adaptive urban outcomes. (Pham et al., 2023)

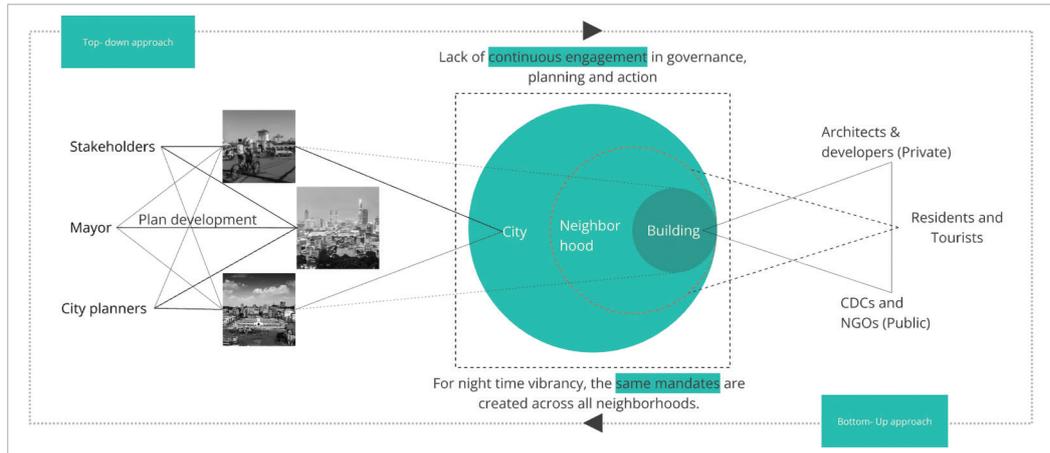


Fig. 1

The 2 approaches: Top-down and Bottom-up in urban planning - The challenge and the impact scales

Urban planning for NTE takes place within a complex institutional context and thus can be considered a wicked problem as it is not only technical in nature, but also political (Machiels et al., 2023). Multiple forces, ranging from private investment to policy decisions make outcomes unpredictable leading to high degrees of uncertainty. This complexity poses a challenge when planning for a more inclusive future, as traditional predictive data and modelling techniques struggle to account for uncertainty.

Studies point out the need for safe, open NTE areas to balance money-making and social good (BOP Consulting, 2020; Smeds et al., 2020). Urban Digital Twins (UDTs), mixing location data with people's input, help with flexible planning and community involvement, growing from early mapping systems (Batty, 2008; Batty et al., 2024; Goodchild, 1992). Programs like CityEngine and ArcGIS Urban give data-based options but are tough for non-experts to use (Al-Kodmany, 2002). Ideas like Goodspeed's bottom-up way (Fig. 1) push for including more voices, though they're rare in developing areas (Zigmund & Stephen Zigmund, 2022). Fancy setups like Virtual Singapore use open links for clear planning but fit better in data-heavy Western spots. Nha Trang's struggles with few data and weak governance show the need for custom fixes.

In this paper, we employ participatory digital platforms as a planning support tool that explicitly embraces uncertainties by enabling open, multi-level inputs from diverse stakeholders alongside real-time data access. This methodological approach aligns with contemporary urban research to allow engaging diverse urban actors in modeling alternatives (Rye et al., 2024). Such platforms are particularly valuable for NTE's dynamic landscape, where multilevel stakeholder engagement—spanning residents, businesses, and authorities—integrates local knowledge to balance competing priorities such as safety, cultural vitality and economic vibrancy. Real-time data streams enable adaptive monitoring of nighttime flows, addressing data silos and enhancing responsiveness in tourism-driven contexts (Reia, 2025).

This study presents the Night Time Economy Platform (NTEP), a human-centered, digital platform tackling mentioned issues with an integration approach between top-down planning frameworks with bottom-up stakeholder engagement. NTEP, a live UDT, and open connections allows non-experts to participate in, making planning transparency in Nha Trang. The research objectives are: (1) identifying local NTE needs through fieldwork, (2) developing and evaluating NTEP's capacity

for participatory design that bridges top-down requirements with bottom-up stakeholder inputs, and (3) assessing its governance impact, including improvements in consultation efficiency and inclusivity. Conducted during a summer camp in 2023 and a seminar in 2025 at the University of Economics Ho Chi Minh City, this research puts forward an adaptable NTE planning approach, taking cues from smart city ideas. The process moved forward step by step: fieldwork pinpointed local needs, shaped NTEP's creation, and backed up scenario building and stakeholder reviews. The following sections detail its deployment in the Nha Trang case study.

Literature review

Background to NTE

The NTE, which includes evening and nighttime activities such as hospitality, entertainment, and cultural events, has become a vital driver of urban vitality, economic growth, and social cohesion in contemporary cities. Originating in the late 20th century amid deindustrialization and cultural shifts, NTE development underscores its transformative role in bolstering tourism (Lovatt & O'Connor, 1995).

Yet, NTE's dynamic landscape—characterized by fluctuating spatio-temporal patterns in consumption, mobility, and social interactions—introduces complexities, including noise pollution, safety vulnerabilities, and spatial inequalities (Sampéris et al., 2025). In tourism-dependent locales like Nha Trang, Vietnam, beachfront markets and dining generate economic uplift but marginalize peripheral low-income areas, amplifying divides (Georges River Council, 2021; Smeds et al., 2020). Recent scholarship links the NTE with Sustainable Development Goals (SDGs), particularly SDG 11, which promotes inclusive, safe and resilient cities, but many initiatives still prioritize commercial benefits over equitable access (Clark, 2025; UN Habitat, 2016). Studies show NTE can contribute up to 10% of urban GDP in major cities, but without inclusive governance mechanisms, the benefits are often unevenly distributed (Sampéris et al., 2025).

Despite those research on NTE's benefits and challenges, there remains a lack of context-specific studies addressing how to effectively balance economic development and social equity in data-limited, developing contexts like Nha Trang, Vietnam

Data Challenges in NTE Planning

NTE planning is severely constrained by a lack of data, exacerbated by inconsistent formats, silos, and the absence of real-time insights, which hinder evidence-based strategies in its fluid, temporal ecosystem (Reia, 2025). Traditional urban data sources, such as censuses or periodic surveys, inadequately capture NTE's dynamic nighttime landscapes making key activities "invisible" and impeding adaptive interventions like event zoning (Purnasasmita, 2025).

In developing countries, these issues intensify due to inconsistent data formats across departments, governance limitations, and resource scarcity, as seen in Vietnam's fragmented tourism-planning silos under Decree 43/2014/ND-CP, which mandates hearings but lacks standardized integration (Ogunkan & Ogunkan, 2025; Tuong, 2022; UN Habitat, 2022). This "predict and provide" approach overlooks latent demands such as informal nighttime economies or equity burdens on shift workers—leading to stalled projects and inequitable outcomes (Clifton & Moura, 2017). Those reviews also stress the need for aggregated real-time frameworks, such as observatories, to mitigate these gaps. Despite these calls, few practical, scalable solutions have been developed for the data challenges unique to NTE planning in resource-constrained cities.

Urban Digital Twins and Participatory Platforms

Urban Digital Twins (UDTs) offer a promising linkage to participatory platforms, harnessing real-time simulation and data integration to navigate NTE's dynamic landscape while empowering diverse stakeholders amid data shortages (Batty et al., 2024; Eicker et al., 2020). Building

on Geographic Information Systems (GIS) foundations, UDTs replicate urban environments, enabling scenario testing that democratizes spatial foresight for non-experts (Goodchild, 1992; Al-Kodmany, 2002). Literature positions UDTs as participatory enablers, where open Application Programming Interfaces (APIs) and 3D visuals facilitate co-design, bridging data inconsistencies through crowdsourced contributions (Adade & Vries, 2025; Bettencourt, 2024; Lei et al., 2023). This synergy addresses developing-country challenges by mixing top-down policies with bottom-up inputs: baseline models incorporate mandates, refined iteratively via stakeholder feedback (Rye et al., 2024). For NTE, UDTs simulate dynamic flows and consumption patterns (Cugurullo & Xu, 2024).

While the technical literature on UDTs is expanding quickly, there is still an empirical blind spot in how these tools are deployed in cities with weak data ecosystems and low digital literacy. Most platforms are designed for data-rich, high-capacity governance environments (Adade & Vries, 2025). In cities like Nha Trang, questions remain around how to develop systems and ensure inclusive use by non-expert stakeholders.

This gap between technological promise and local implementation reality underscores the need for context-sensitive, modular UDT platforms that embed capacity-building into their deployment—not just as a byproduct, but as a core design principle. Current literature seldom addresses how these technologies can be sustained in settings where urban planning institutions are under-resourced and often operate under centralized, top-down mandates.

This study investigates urban planning for Nha Trang's Night-Time Economy (NTE) using a mixed-methods approach, integrating field observations, NTEP development, a case study, and stakeholder analysis. During a 2023 summer camp and a 2025 Seminar: Technology and the Smart City course, the research employs digital tools to address planning challenges, aligning with 24-hour city principles (Clark, 2025). It leverages participatory design and real-time Urban Digital Twins (UDTs) to promote sustainable NTE governance (Batty et al., 2024; Eicker et al., 2020). The methodology progressed sequentially across 4 stages: (1) contextual fieldwork and stakeholder analysis (2) NTEP development, (3) scenario design and (4) impact evaluation. These methods reflect the research objectives of identifying local NTE needs, enabling co-creation through digital tools, and evaluating their influence on planning governance.

Stage 1: Fieldwork - Stakeholder Analysis

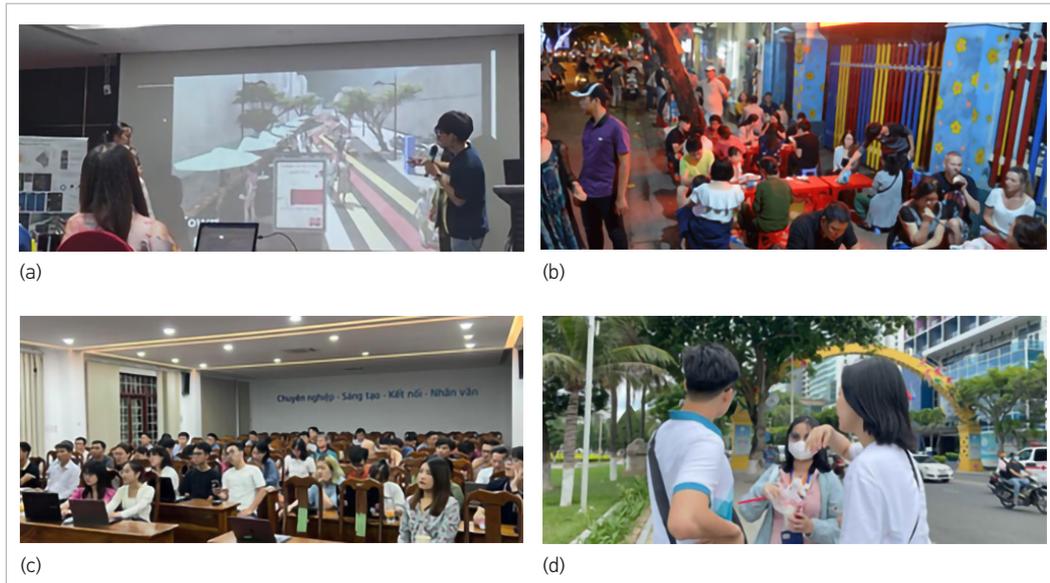
In a seven-day fieldwork in Nha Trang during the 2023 summer camp, 25 students and 4 professors collaborated with local stakeholders to document current NTE conditions. The focus was on four domains: land use, building use, activity, and economic performance. Data were collected through direct observations, GPS-based geospatial mapping (structured as timed transects across 4 zones—e.g., Tran Phu Street and beachfront—to capture temporal variations in activity patterns), and semi-structured interviews with 30 stakeholders, including residents, business owners, tourists, and local officials. Interviews probed safety concerns, economic constraints, and governance issues, providing qualitative insights. Fieldwork activities are shown in Fig. 2. Geo-tagged data were encoded into custom GeoJSON layers organized under three taxonomies (Tables 1–3): Land Use Type, Building Use Type, and Activity Points. This localization ensured that subsequent platform development reflected real, place-based dynamics rather than generic urban models.

Workshops following data analysis to pinpoint governance gaps, such as inconsistent data formats across departments, limited updated data availability, and poor stakeholder coordination. These findings spurred the creation of NTEP to improve data integration and collaboration among diverse groups.

Methods

Fig. 2

Student data collection and stakeholder engagement activities included: (a) team discussion, (b) fieldwork, (c) authority engagement, and (d) interview.



Stage 2: Platform Development and Stakeholder Engagement (NTEP Implementation)

In response to the challenges identified in Stage 1, the NTEP was developed as a modular, open-source planning support tool. The platform, which is for urban modeling, simulation and decision-making, serves as a mediator among diverse stakeholders: city authorities, foreign investors, landlords, local organizations, academia, and residents with a goal to support collaborative planning using localized datasets. Its architecture follows a modular design, with data flow from storage to interaction.

Frontend.

ReactJS and a UI library create an intuitive interface. Turf.js handles coordinate logic, while Mapbox GL JS and Mapbox GL Draw enable interactive maps, geospatial visualization, and design tools, supporting non-experts.

Storage and Authentication:

Google Firebase Storage manages GeoJSON data (e.g., base maps, scenarios) in project/geojson, interview charts, media, and scenario coordinates. Administrators upload initial GeoJSON files (land use, building use, activity points, interview points). Google Firebase Authentication secures user registration and login (Giraud & Artopoulos, 2023).

Rendering.

Map loading triggers a Firebase API call for data, which Mapbox renders with colored layers based on property values. Filtering selects table values, filtering coordinates for Mapbox updates. For example, filtering commercial land use highlights relevant zones, enhancing scenario design. NTEP also supports real-time collaboration.

The platform supports 2 core functionalities:

- Data Sharing: Secure uploads of geospatial and qualitative data (Land Use, Building Use, Activity Point, Interview Point) with role-based access (Clark, 2025). Data categories, defined through authority consultations and urban planning standards, are outlined in Tables 1-3.
- Visualization: 3D renderings of NTE zones, integrating data layers for land use, building use, activity patterns, and interview insights (Fig. 3), facilitating exploration of urban dynamics (BOP Consulting, 2020).

Type	Description	Code
Housing	Urban residential land	ODT
Office	Office land	TSC
Public Infrastructure	Streets, square or any infrastructure land	DGT
Commercial	Commercial	SKC
Administrative	Administrative	DSN
Water, Greenery and Public square	Lakes, parks, and public square	DKV

Table 1

Land Use type for the Nha Trang project

Type	Description
Housing	Urban residential
Office	Office, Co-working space
School and Institute	School, Institute, Library
Hotel	Hotel, Airbnb, Motels
Administrative	Administrative
Mix-used	Mixed functions

Table 2

Building Use type for the Nha Trang project (The user can input the number of stories)

The Activity Point as shown in the table 3 below which can be formal or informal, and having the opening hours divided into 3 types: 6am-6pm, 6pm-10pm and 10pm-6am

Type	Description
Entertainment	Entertainment venues
Art and Craft	Art, craft activities
F&B	Food and beverage
Clothes and Fashion	Retail fashing
Wellness	Spa, health services
Mix-used	Multiple functions
Miscellaneous	Other activities

Table 3

Activity Point for the Nha Trang project

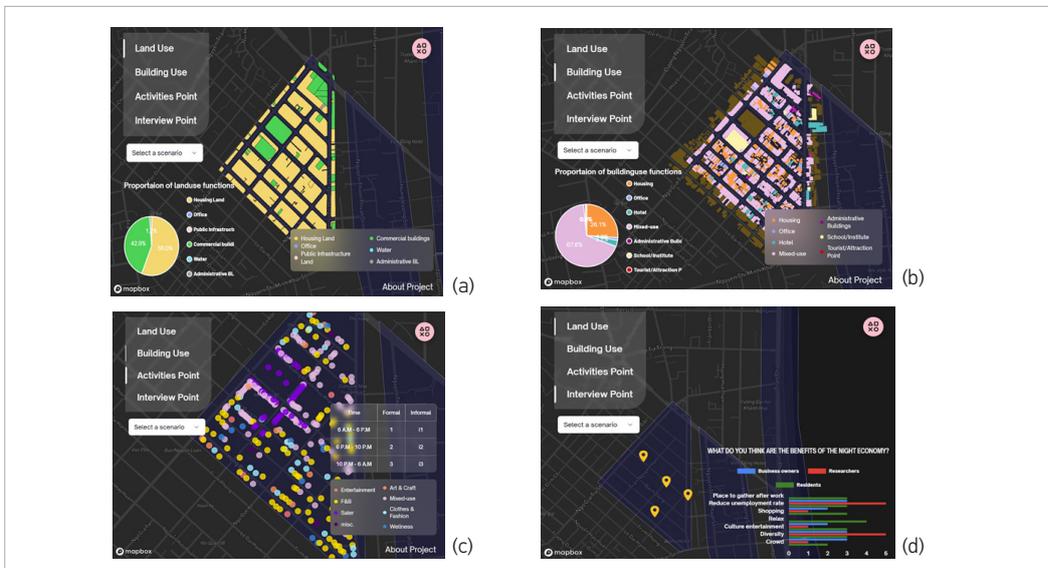


Fig. 3

Different layers: "Land Use" (a), "Building Use" (b), "Activity Point" (c), "Interview Point" (d) were collected and visualized in the NTEP

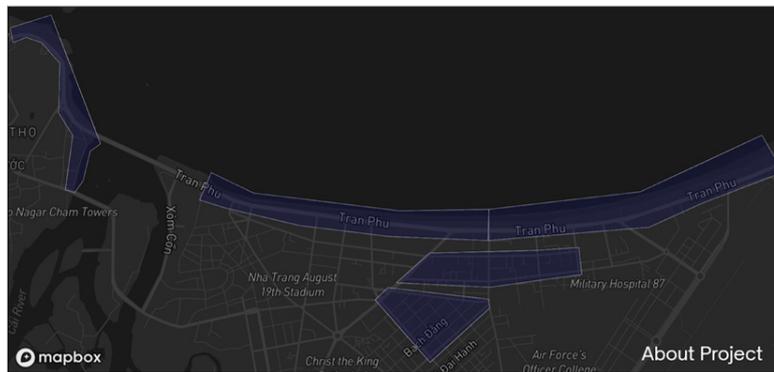
Stage 3: Scenario Design

NTEP works as an open tool for students, designers, and planners to create, discuss, and revise scenarios, with collaborative dashboards for stakeholder feedback (Batty, 2008). 34 Students and faculty grouped into 4 teams developed scenarios during the 2025 seminar, using platform tools to visualize proposed interventions and share them with stakeholders for iterative refinement. These were iteratively refined based on interview feedback, demonstrating how qualitative methods enhanced digital usability.

The Scenarios for particular sites (Fig. 4), such as Tran Phu Street (a commercial hub) and beachfront areas (tourist hotspots). Scenarios included proposals for extended operating hours, improved lighting, and pedestrian-friendly pathways, informed by field observation data.

Fig. 4

5 site visiting in
Nha Trang

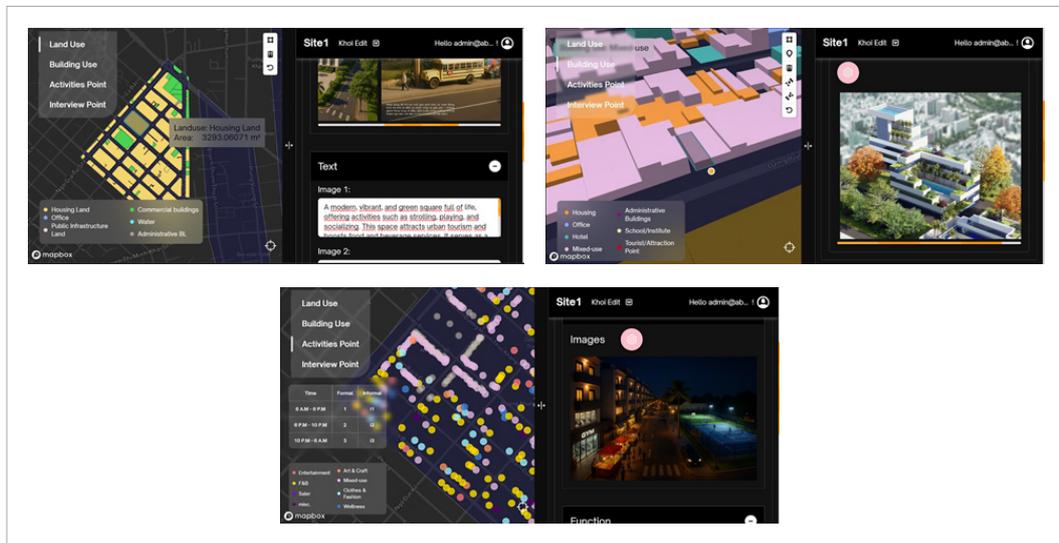


Each team presented their designs to 10 stakeholders, residents, business owners, tourists, and city officials via platform dashboards during a two-day workshop. Stakeholders provided feedback through surveys and moderated discussions,

leading to scenario revisions (e.g., adjusting lighting plans to address tourist safety concerns). Final scenarios, including Fig. 5 showing Group 1 informal economy design with open spaces around administrative buildings, achieved an 85% approval rate, demonstrating NTEP's participatory strength. The iterative process demonstrated the platform's capacity to facilitate data-driven, participatory planning (Eicker et al., 2020).

Fig. 5

Design by Group 1 illustrating the concept of informal economy activities. The Land Use, Building Use, Activity Point were designed to prove the concept. Besides, the other stakeholders including non-expert can view images for particular designs scenarios on NTEP



Stage 4: Impact Evaluation

NTEP's effectiveness and impact were evaluated through qualitative and quantitative methods, focus on: (1) Usability (interface, accessibility), (2) Inclusivity (diversity of stakeholder engagement) and (3) Planning governance impacts (efficiency, transparency). 10 authorities, 34 students, and

20 stakeholders (n=64) were surveyed. Thematic analysis identified themes like data accessibility and inclusivity, highlighting NTEP's role in fostering collaborative governance (Zigmund & Stephen Zigmund, 2022). Questionnaires (post-scenario, digital via Google Forms) complemented interviews, quantifying satisfaction (e.g., 48% engagement uplift) and guiding UDT refinements, thus evaluating the methods' contribution to bridging analog insights with digital outputs. (Lei et al., 2023; Deng et al., 2025).

This study evaluates the NTEP effectiveness in facilitating participatory urban planning for Nha Trang through a mixed-methods approach. The results highlight feedback from students and stakeholders on platform usability, general perceptions of UDT, insights from local authorities and stakeholders, including the platform's impact. These findings underscore the platform's role in addressing urban planning challenges while identifying areas for improvement (Batty et al., 2024).

Platform Feedback

Feedback from 34 students and 20 stakeholders (n=54) during 2025 seminar workshops evaluated the NTE Platforms usability and functionality (Table 4). Advantages included an intuitive map interface, with 56% (n=30) praising its simplicity and accessibility without specialized software. Data reliability was noted by 12% (n=6), providing access to land use ratios and building functions, while 32% (n=17) valued support for assessing conditions and designing scenarios (Yvonne Yexuan Gu, 2021). The platform's role as a collaborative bridge was endorsed by 24% (n=13), connecting authorities, businesses, and residents. Time efficiency (16%, n=9), scenario comparison (48%, n=26), and flexible simulation (32%, n=17) were highlighted, alongside visibility of nighttime business activities (24%, n=13) and locations (8%, n=4).

Challenges included slow performance with large datasets (28%, n=15), occasionally causing data loss. Insufficient user guidance and documentation were reported by 40% (n=22), and limited language support affected 12% (n=6), indicating accessibility gaps (Giraud & Artopoulos, 2023).

Category	Feedback	Frequency	Proportion (%)
Advantages			
Data Management	Reliable data access (e.g., land use, building functions)	6	12
Design Support	Supports condition assessment and scenario design	17	32
	Flexible simulation and design capabilities	17	32
	Time-efficient process	9	16
Stakeholder Engagement	Bridges stakeholders (authorities, businesses, community)	13	24
Usability	Enables comparison of multiple scenarios	26	48
	Simulates nighttime business activities	13	24
	Provides nighttime activity locations	4	8
	Intuitive, easy-to-use map interface	30	56
Challenges			
Usability	Slow performance with large datasets	15	28
	Insufficient user guidance/ documentation	22	40
	Limited language support	6	12

UDT Perception

General UDT feedback from the same respondents (n=54) underscored their potential and limitations (Table 5). Advantages included enhanced community engagement (48%, n=26),

Results

Table 4

NTEP Advantages and Challenges from students and stakeholders (n=54).

effective decision-making support (40%, n=22), and transparency in design processes (36%, n=19). Accessibility for diverse users (28%, n=15) and multi-perspective design (8%, n=4) were noted, with 24% (n=13) appreciating data-driven decision-making. Only 4% (n=2) found UDTs easily accessible to new users, suggesting complexity.

Challenges included insufficient, outdated local data (56%, n=30), reducing UDT reliability. An unintuitive interface with complex operations was reported by 40% (n=22), and handling multiple data layers was difficult for 20% (n=11). Lack of content moderation (8%, n=4) risked misinformation, and high maintenance resources concerned 8% (n=4) (Lei et al., 2023).

Table 5

General UDT feedback from students and stakeholders (n=54).

Category	Feedback	Frequency	Proportion (%)
Advantages			
Stakeholder Engagement	Enhances community engagement	26	48
	Increases transparency and democratization	19	36
Design Support	Supports effective decision-making	22	40
	Supports multi-perspective design	4	8
	Improves data-driven decision-making	13	24
Usability	Easily accessible to new users	2	4
	Caters to divers users	15	28
Challenges			
Data Management	Insufficient, outdated local data	30	56
Challenges			
Usability	Unintuitive interface, complex operations	22	40
	Difficult to handle multiple data layers	11	20
	No content moderation	4	8
Maintenance Costs	High maintenance resources	4	8

Local authority insights and Platform Impact

Qualitative data from 10 follow-up interviews with local authorities, 34 students, and 20 stakeholders evaluated NTEP usability, collaboration, and scenario effectiveness, revealing governance challenges and impacts. Authorities reported that AutoCADs static 2D drawings hindered dynamic NTE planning, requiring manual updates and delays. Lack of synchronization between departments (e.g., planning, transport) and officers limited digital training further impeded governance. Students and stakeholders praised the platform's collaborative features, with themes of enhanced inclusivity and real-time data access recurring.

NTEP's impact included streamlined data sharing, planning efficiency, and enhanced civic engagement. MapGLs interactive visualizations made complex urban data accessible to non-experts, increasing participation. Compared to traditional static maps, the NTEP reduced planning time by enabling real-time scenario adjustments. For instance, different groups produced 4 layout proposals for Nha Trang's NTE zones, optimizing for daylight, noise, and accessibility. Enhanced civic engagement: During the implementation of the platform, NTE enabled stakeholders to contribute to planning processes transparently. Citizens (People) prioritized safe, accessible spaces for learning and leisure, while businesses (Private) focused on maximizing foot traffic and revenue. Government (Public) emphasized security and order, and designers (Professional) focused on spatial connectivity and sustainability (Batty, 2008; Batty et al., 2024; Izquierdo, 2020). Collaborative

workshops enabled iterative scenario refinements, enhancing decision-making and stakeholder consensus (Eicker et al., 2020).

The novelty of the framework is in the merging of peer-to-peer systems and urban participation to overcome the restrictions of the conventional urban planning introduced by (Batty, 2008; Batty et al., 2024; Rye et al., 2024) such as static processes and ineffective stakeholder coordination. Instead of top-down with reactionary input, as is the case with traditional approaches, the proposed methodology democratizes planning via real-time and shared data usage. This also corresponds to a worldwide trend for digitalisation in urban planning such as in the Swedish digitalisation plan (Lei et al., 2023; Varela et al., 2022).

Field observations in 2023 provided critical data on land use, building use, activity patterns. Thirty stakeholder interviews revealed safety deficiencies and economic currents that informed the development of NTEP. For example, data on activity patterns informed real-time visualization functions which allowed planners to simulate crowd movements and to optimise the use of the event areas. These findings related to locally-based issues, such as the need to improve safety of night-time activities, that static tools such as AutoCAD were not able to capture. By rooting NTEP in the empirical concepts, the platform guaranteed that it reflected Nha Trang's particular urban situation.

The use of an online, open NTEP overcomes barriers to accessibility and inclusivity, making urban planning education more engaging and practical. For instance, the intuitive MapGL-based interface, praised by 56%, enabled non-experts to engage in planning, a significant departure from specialized software. Scenario design tools, valued by 48%, facilitated comparison of multiple proposals, streamlining planning processes. By allowing stakeholders to co-create scenarios. The framework fosters a sense of ownership and aligns with sustainable development goals, particularly SDG 11 (UN Habitat, 2016). However, 28% reported performance issues with large datasets, and 40% noted insufficient documentation, underscoring the need for technical improvements (Giraud & Artopoulos, 2023; Zhang et al., 2024). These findings suggest NTEP enhances efficiency but requires optimization to handle complex urban data, aligning with prior studies on digital platform scalability (10).

General UDTs feedback yielded transformative potential including 48% reporting improved community engagement and 36% increased transparency (Izquierdo, 2020). Contrarily to conventional 2D fixed layouts, UDTs were ranging the NTE in real-time, offering data-driven decisions (Purnasasmita, 2025). However, 56% reported inadequate local data, while 40% believed that the interfaces were complicated, suggesting that barriers to implementation exist in areas of limited data (Dawkins & Kitchin, 2025). These are examples of the robust data ecology that would be needed to make UDT effective, especially in the context of developing urban areas in which real-time monitoring is difficult to manage.

The innovation of our study is the use of NTEPs in Nha Trang, a city undergoing urbanization, whereas previous work has been based primarily on Western populations (Lei et al., 2023; Varela et al., 2022; Zhang et al., 2024). Its human-centered design empowered non-experts, while real-time UDTs provided dynamic insights unattainable with traditional tools. By integrating open APIs with local governance systems, NTEP enhanced transparency and synchronization, addressing data fragmentation (Dawkins & Kitchin, 2025; Izquierdo, 2020). The platform's success in producing approved scenarios (85%) through iterative, stakeholder-driven workshops underscores its potential to redefine urban planning in resource-constrained contexts.

This study demonstrates NTEPs transformative impact on the core research problem of fragmented, top-down NTE planning in Vietnam's reforming system by enabling participatory UDTs that

Discussion

Conclusions

resolve consultation shortcomings - soloed data and insufficient work. That has been reducing planning time, achieving an 85% scenario approval rate, public participation through transparent stakeholder cooperation (Cugurullo & Xu, 2024).

Its contributions are original: the first use of a MapGL-based, UDT-based platform in a developing urban NTE, merging human-centered design and real time data visualization. Unlike former static tools such as AutoCAD, NTEP allowed non-experts to take part, generating 4 scenario layouts, which could be optimised for a range of priorities from safety through to sustainability (Dane et al., 2020). Adoption of an open API allowed the government to control data fragmentation and integration problems (A. Anttiroiko, 2016).

Findings reveal enhanced inclusivity (48% reported community engagement gains) and efficiency (40% time reduction), generalizable beyond NTE to other sectors like eco-tourism, as UDTs facilitate multi-perspective design in data-scarce contexts. Theoretical contributions include hybrid top-down/bottom-up models, empirically validated through 64 stakeholder interviews and surveys.

Next steps include improvements to NTEPs data update mechanism to rectify insufficiencies in the local data, the provision of multilingual support to increase accessibility and the scaling of the platform to other developing cities. These efforts could further democratize urban planning, ensuring inclusive, sustainable NTE governance globally (Eicker et al., 2020; Izquierdo, 2020).

Acknowledgment

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Use of Artificial Intelligence Tools

During the preparation of this article, the authors used Gemini to support language editing and improve text clarity. The authors reviewed and revised the content independently and assume full responsibility for the accuracy and integrity of the work.

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About the authors

NAM-HAI HOANG LE

Lecturer

Institute of Smart City and Management, University of Economics Ho Chi Minh City, Vietnam (UEH)

Main research area

Urban Design, Architecture, Data, AI.

Address

232/6 Vo Thi Sau St., District 3, Ho Chi Minh City, Vietnam
E-mail: haihln@ueh.edu.vn

TU-ANH TRINH

Director

Institute of Smart City and Management, University of Economics Ho Chi Minh City, Vietnam (UEH)

Main research area

Mobility, Living Lab, Smart City, Sustainability

Address

232/6 Vo Thi Sau St., District 3, Ho Chi Minh City, Vietnam
E-mail: trinhluan@ueh.edu.vn

KHOI PHAM

Technician

Institute of Smart City and Management, University of Economics Ho Chi Minh City, Vietnam (UEH)

Main research area

Computer Science, Software Development

Address

232/6 Vo Thi Sau St., District 3, Ho Chi Minh City, Vietnam
E-mail: khoipm@ueh.edu.vn

