



IMPACT OF A LINEAR CITY SPATIAL CONFIGURATION ON OLD TOWN AREA: THE CASE OF THA WANG OLD TOWN, NAKHON SI THAMMARAT, SOUTHERN THAILAND

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Abstract

Nakhon Si Thammarat, a city in southern Thailand, has changed over time following a linear pattern expanding along a north-south axis, characterized by the expansion of urban areas spreading out from its old center, and how these changes have affected Tha Wang Old Town area, once a vibrant trade center, it now struggles to maintain its functionality and spatial centrality have faced challenges amidst the Nakhon Si Thammarat city's growth. As Nakhon Si Thammarat city expanded, the Tha Wang Old Town area's importance changed. This research aims to find the changing pattern of Nakhon Si Thammarat city's Street layout and public space. the Impact on accessibility, connectivity, and liveability which affects the role of Tha Wang old town as a spatial center in the present day. By using analytical methodologies, Space Syntax, and Geographic Information Systems (GIS), to analyse the street layout and public space systems, as a spatial configuration change, based on periods of time. The results found that the urban area expanded to the east along the continuous road development has changed the potential of the spatial centrality of Tha Wang Old Town area over time. In conclusion, the study is not only about history but also about planning for the future. By understanding how a city's spatial patterns change over time to make better decisions about how to preserve their heritage while adapting to modern needs through spatial centrality cognition. The findings offer valuable insights for urban planners and policymakers, showing how to create cities that are both dynamic and maintain the vibrancy of urban life in the Old Town area with a set of knowledge about urban morphology.

Keywords: Spatial configuration, Urban expansion, Old Town, Space Syntax

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INTRODUCTION

The expansion of modern Nakhon Si Thammarat city has followed a longitudinal pattern along a north-south axis, closely paralleling the historic route of the Tha Wang Old Town area. Tha Wang Old Town, once a bustling urban center, is renowned for its numerous valuable vernacular architectural buildings that reflect the city's rich cultural heritage. However, the expansion of the urban area has significantly impacted these historical structures. Many of these buildings have suffered from abandonment or inappropriate repurposing due to the rapid urban development and modernization processes that have taken place.

This study seeks to analyze the urban configuration of Tha Wang Old Town to complement other aspects of its development. It introduces the application of space syntax techniques as a means to understand and assess the spatial potential of this historic area. Building upon earlier research conducted by Tinnakhon (2021) in the vicinity of Wat Phra Mahathat Woramahawihan, this study extends the investigation to include the adjacent Tha Wang Old Town area. The aim is to explore its spatial characteristics in greater detail and evaluate its integration within the contemporary urban environment.

The need for a comprehensive study of urban public spaces, including roads and sidewalks, becomes evident in this context. Previous studies on various historic towns, such as the George Town heritage site in Malaysia, have emphasized the importance of spatial analysis for understanding accessibility levels in these areas (Safizadeh, 2022). Tools like Space Syntax are utilized to analyze the spatial network configuration, building density, and land use mix. This analysis highlights the critical importance of integrating old and new structures to improve accessibility and ensure mobility equality within modern urban planning frameworks.

The study aims to leverage the results of urban spatial configuration analysis across different historical periods to gain insights into the evolution and transformation of the Tha Wang Old Town area. By highlighting the area's potential, the study seeks to evaluate the appropriateness and sustainability of urban development strategies. The objective is to provide valuable information that will guide urban planning decisions, ensuring that the development of Tha Wang Old Town is both respectful of its historical context and aligned with contemporary urban development principles. This approach aims to enhance the long-term viability and livability of Tha Wang Old Town, addressing both historical preservation and modern community needs.

LITERATURE REVIEW

Urban Spatial Configuration

Recent literature on urban configuration encompasses various theories and methodologies aimed at understanding and modelling the spatial organization of

cities. Space Syntax theory emphasizes the relationship between urban structures and functions, highlighting the importance of accessibility measures in determining land values (Lykostratis, 2018). Additionally, the development of urban areas is influenced by the interaction between three-dimensional elements and free spaces, impacting the quality of public spaces and urban planning strategies. Furthermore, research delves into the emergence of universal patterns in cities over time, exploring processes like preferential attachment and reaction-diffusion that govern street structure growth and differentiation, ultimately shaping land use and building development (Al-Sayed, 2014). Advancements in deep learning have also sparked interest in automating urban planning processes, aiming to generate land-use configurations efficiently based on surrounding spatial contexts (Wang, 2020). These diverse studies collectively contribute to a comprehensive understanding of urban configuration dynamics and their implications for urban development and design.

Urban Old Town Conservation

Urban old town conservation can benefit significantly from space syntax analysis, as seen in studies focusing on historic cities like George Town in Malaysia (Fan, 2024) and Trafalgar and Old Market Square (Mahmoud, 2023). By utilizing space syntax theory, researchers can model and analyze the unique pedestrian landscapes of old towns, identifying issues like poor connectivity, safety concerns, and inadequate access to key attractions. This approach allows for a comprehensive spatial understanding, leading to the development of strategies to enhance pedestrian networks, optimize urban spaces, and preserve historical identities. Through the integration of space syntax with geographic information systems and regression analysis, a scientific basis is established for creating regional characteristics in urban spaces, guiding conservation efforts and urban planning in old town areas.

Space Syntax in urban planning

Space syntax theory is essential for analyzing spatial configurations and morphological changes in historic towns, as shown by research on cities like George Town (Fan, 2024). Using space syntax methods such as UCL DepthmapX simulations and axial maps, researchers assess pedestrian landscapes, network connectivity, and spatial intelligibility. This analysis uncovers key insights into structural issues, pedestrian flow patterns, and evacuation vulnerabilities, providing guidance for urban planning to improve accessibility, safety, and design in culturally significant historic areas.

RESEARCH METHODOLOGY

This study employs a qualitative method approach, by use the geographic data of Nakhon Si Thammarat Old Town includes map review, and GIS data analysis. Spatial integration is measured using the space syntax technique with DepthmapX software.

The space syntax technique is an urban configuration tool derived from three main theories:

1. Theory of Natural Movement: The configuration of the urban grid influences the movement of people within the spatial environment. (Hillier, Penn et.al., 1993)
2. Theory of Movement Economy: Increased free movement within a denser urban grid provides opportunities for continuous activities, especially commercial activities, which in turn intensify the natural movement within the area. (Hillier, 1996)
3. Theory of Spatial Centrality: As the processes from the Theory of Movement Economy take effect, the area experiences increased density of natural movement, creating a multiplier effect that drives the area to become spatial centrality, thus forming the urban center. (Hillier, 1999)

Which synthesizes these theories, to examine the connectivity and potential of Tha Wang Old Town area in present day by compared the axial map in 3 phases of times, the values derived from the calculations of both global and local integration are compared to illustrate the variations and changes observed. to determine whether it functions as a central area.

Space Syntax is a method used to analyze the spatial configurations and their effects on movement and social interactions within buildings or urban environments. It relies on mathematical and graphical tools to understand how spatial layouts influence behavior and how different spaces relate to one another. This study scoped at four value form Space Syntax calculate such as:

1. Global Integration: Reflects overall centrality in the network.
2. Local Integration: Reflects connectivity within a specific area.
3. Synergy Coefficient: Evaluates the alignment between spatial layout and functional use.
4. Intelligibility Coefficient: Reflects ease of understanding and navigation.

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ANALYSIS AND DISCUSSION

Settlement and Development of Nakhon si Thammarat city



Figure 1: Nakhon Si Thammarat Province is situated in the South of Thailand.

Source: authors edited from google earth

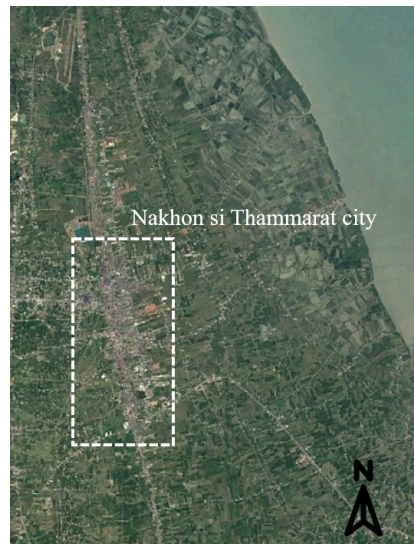


Figure 2: Nakhon si Thammarat city near the coast

Source: authors edited from google earth

The development of urban areas takes various forms, influenced by different factors of each area that promote diverse patterns of settlement. Particularly in this study, the focus is on the urban area of the old town of Nakhon Si Thammarat. The original settlement was located along a beach known as 'Hat Sai Kaew beach,' a sandbar stretching north to south of east coast of Nakhon si Thammarat. This city is one of the significant ancient historical sites of the Malay Peninsula. Based on the discovery of ancient artifacts and Brahmanical religious sites that influenced this area in the 9th-10th Buddhist centuries (about 350 - 450 A.D), and the significant Buddhist site is Wat Phra Mahathat Woramahawihan. (Noonsuk, 2001) With the settlement on this area, urbanization occurred over time, leading to the expansion of Nakhon Si Thammarat and the construction of new roads at various times.

- Phase 1: before 1965 Ratchadamnoen Road – The ancient road from settlement era.
- Phase 2: 1965 Phattanakan Khukwang Road was constructed.
- Phase 3: 1999 Therdprakkiat Road was constructed.

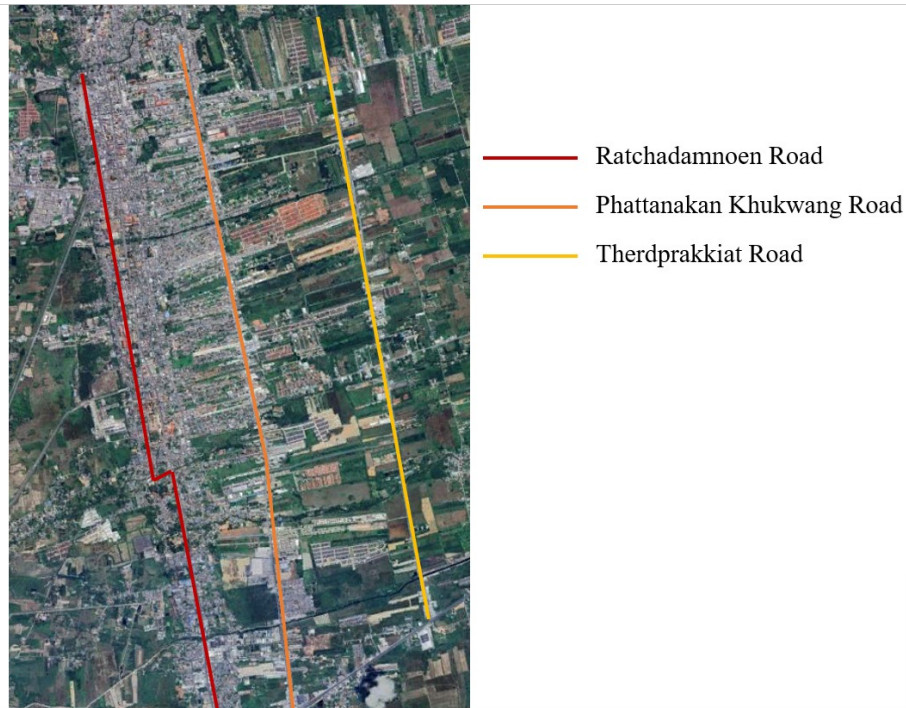


Figure 3: 3 Roads in 3 Phases in this study
Source: authors

This urban expansion occurred urban transformation and changes of the spatial patterns of Nakhon Si Thammarat urban area. Since the three roads have continuously developed along the north-south axis, extending eastward in parallel, the increase in roads has led to the expansion of settlements. This expansion has affected the connectivity of transportation with the original central area. Urban development in Nakhon Si Thammarat city has been a subject of interest, focusing on conservation efforts and public space utilization (Thinnakorn, 2021; Thinnakorn & Chapklap, 2022).

Axial maps of Nakhon si Thammarat including Tha Wang old town shown the public space network within the boundaries of the roads defined in the study area.

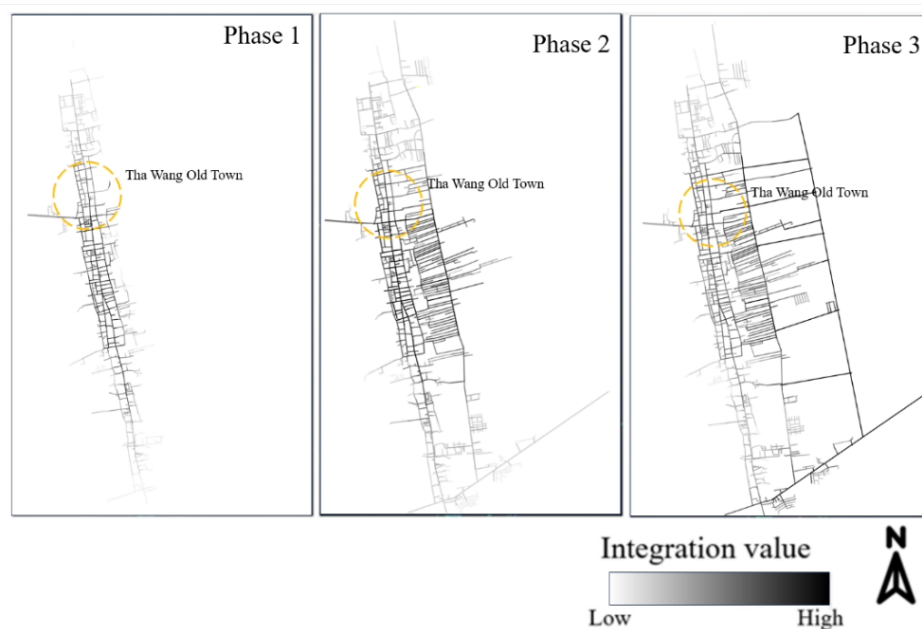


Figure 4: Nakhon Si Thammarat axial map - Global integration

Source: authors

In Figure 3, the Global Integration values, which serve as indicators of the potential for containing natural movement throughout the entire public space network based on the axial lines in each phase, exhibit changes over time. The axial lines are essentially the longest lines of sight and movement paths within the urban space, and they play a crucial role in determining the flow and accessibility of these spaces.

In the initial phase, the old town's axial lines already exhibit certain integration values, suggesting a foundational structure that facilitates movement and connectivity. The integration values here reflect the traditional layout and historical pathways that have likely been in area for a long time.

In phase 2, the axial lines Tha Wang Old Town area show the highest integration values within this area. This phase highlights a peak in the accessibility and movement potential of the old town. The high integration values suggest that during this phase, the old town was a central hub for movement within the public space network. Tha Wang Old Town's streets and pathways were highly accessible, indicating that it likely served as a major point of convergence for people moving through the area.

In phase 3, Therdprakiat Road emerges as the area with the highest Global Integration values. This road becomes the new focal point for natural movement, surpassing the old town in terms of accessibility and centrality. The shift to Therdprakiat Road indicates that this area has become more integrated into the public space network, possibly due to new urban developments, changes in infrastructure, or modifications in traffic flow that enhance its accessibility.

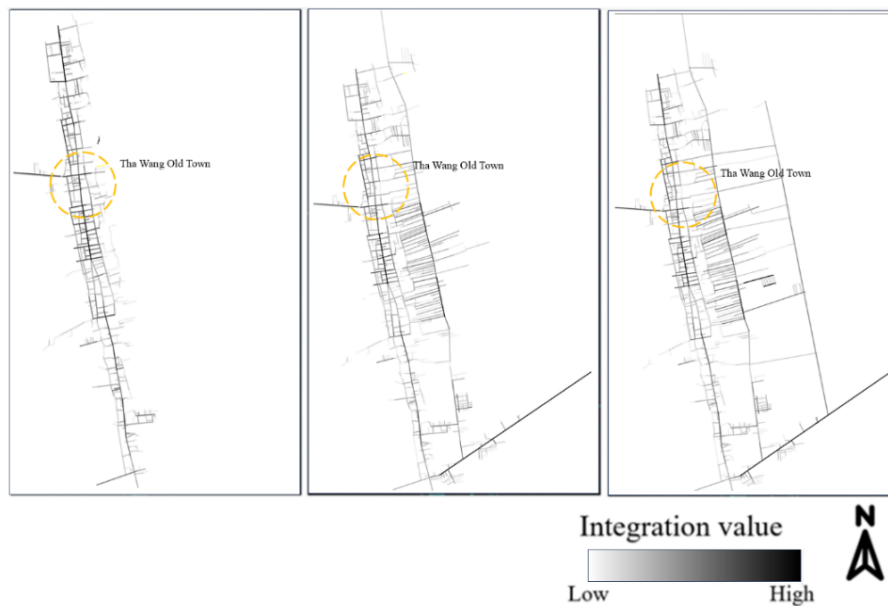


Figure 5: Nakhon Si Thammarat axial map - Local integration
Source: authors

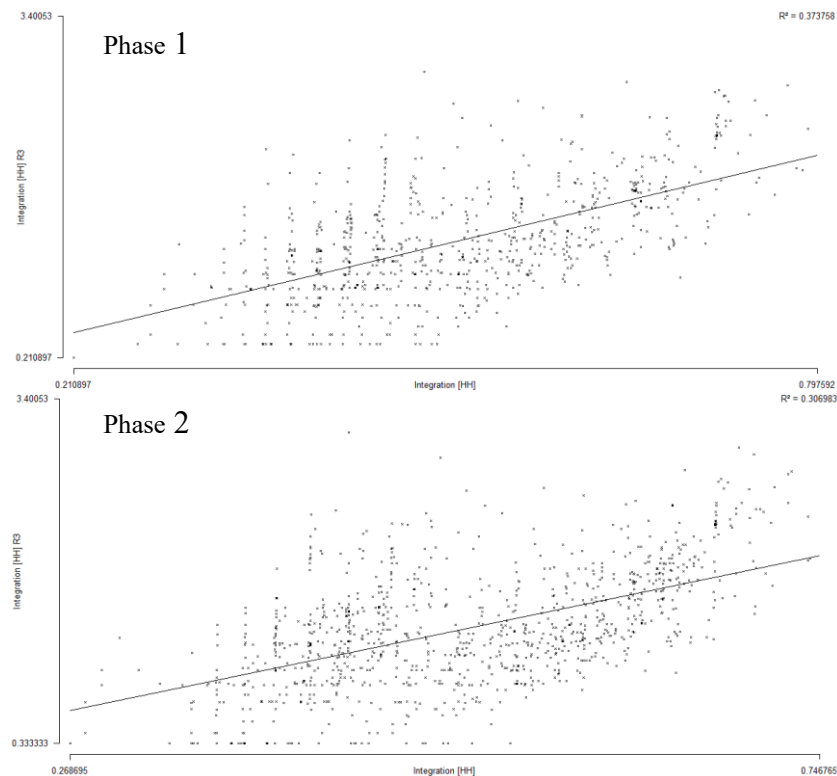
Local integration values provide insights into the density of natural movement potential within specific sub-areas of a city. These values help us

understand how different sections of the urban space facilitate or restrict movement on a more localized scale. The analysis spans three phases, revealing important patterns and consistencies in the public space network.

Figure 4 indicates that the highest integration values in Phase 1 are concentrated around Ratchadamnoen Road. Specifically, the area around Wat Phra Mahathat Woramahawihan stands out with particularly high integration values. This suggests that these locations have been central to the movement patterns from the beginning, reflecting their significance in the urban layout.

In the second phase, the local integration values continue to show similar patterns to those observed in Phase 1. The points with the highest values remain around Ratchadamnoen Road and Wat Phra Mahathat Woramahawihan. This consistency indicates that these areas have consistently been key nodes for natural movement within the urban space.

By Phase 3, the local integration values continue to reflect a similar distribution. The areas around Ratchadamnoen Road and Wat Phra Mahathat Woramahawihan still exhibit the highest integration values. This indicates that, even as other parts of the city may have undergone changes, these specific locations have maintained their central role in the movement network.



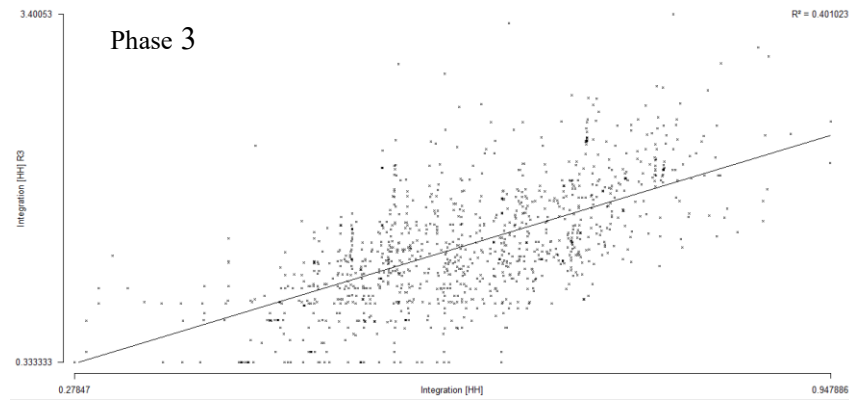
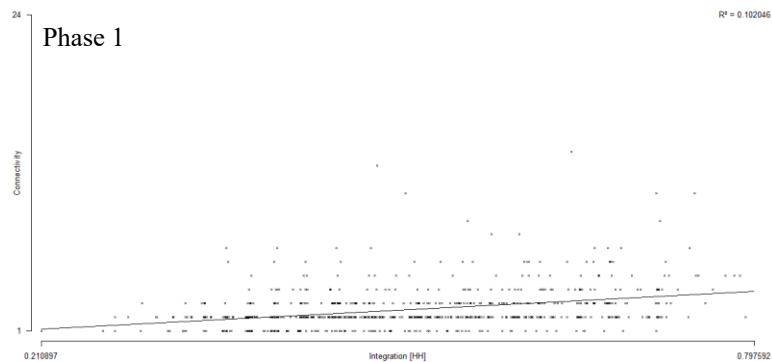


Figure 6 Synergy coefficient
Source: authors

The synergy coefficient values of the area, which demonstrate the potential for movement through the entire area network, do not yield very high R^2 values across all three phases. However, there is also not much significant change observed. As Figure 5 shown in Phase 1 = 0.37, Phase 2 = 0.30 and Phase 3 = 0.40, This indicates the potential for accommodating movement through the axial map network in all three phases. Despite the expansion of road alignments over time, it does not significantly increase the synergy coefficient values.



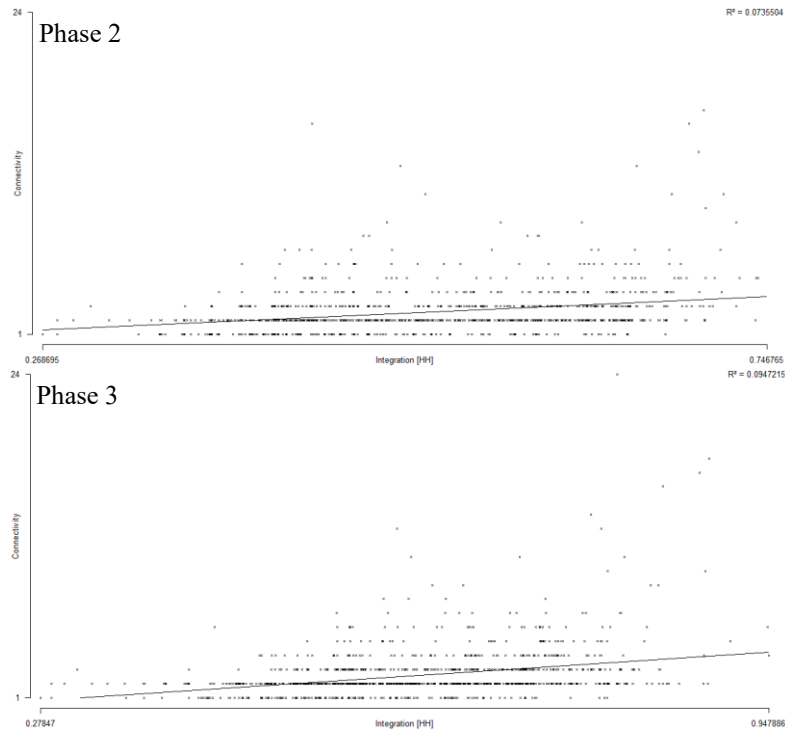


Figure 7: Intelligibility coefficient
Source: authors

The Intelligibility coefficient values, which represent the ability to understand the entire network while within the boundaries of each phase, have relatively low R^2 values across all phases. Furthermore, there is minimal change observed between phases. As Figure 6 shown in Phase 1 = 0.10, Phase 2 = 0.07 and Phase 3 = 0.09, This suggests that the public space network of Nakhon Si Thammarat city may be somewhat difficult for people to comprehend, making it easy to get lost.

Table 1: Summary of coefficient value

Phase	Synergy coefficient	Intelligibility coefficient
1	0.374	0.102
2	0.306	0.073
3	0.401	0.094

Source: Author's Calculation

The study revealed that the values calculated by the DepthmapX software using space syntax techniques showed that the Intelligibility coefficient (in table 1), which was initially highest in the first phase, decreased and then

increased sequentially. This suggests that the increase in roads does not necessarily indicate an improved understanding of movement within the area. As for the synergy coefficient, it decreased in phase 2 and slightly increased in phase 3, indicating a slight increase in the potential for movement through the Nakhon Si Thammarat area. The elongation of the city along the axis did not significantly affect the volume of traffic in the system, consistent with the local integration of all three phases, which did not differ significantly. Additionally, the global integration of the entire area in the first phase on Ratchadamnoen road significantly declined in phase 3, indicating the ability to become a new route accommodating traffic from the Therdprakkiat Road system. However, it is not yet clear whether this has influenced Tha Wang old town, including the global integration of the Tha Wang old town area, which has not changed significantly.

CONCLUSION

In conclusion, the spatial configuration of a linear city pattern of Nakhon Si Thammarat did not impact the Tha Wang old town area, the calculated values do not definitively demonstrate that the linear urban expansion of Nakhon Si Thammarat has significantly impacted the reduced utilization of the Tha Wang old town area. This finding denies the current observed realities. Additionally, referencing the previous study by Tinnakhon (2022), which similarly concluded that the urban expansion depicted by the axial map revealed high integration along the newly expanded roads, indicates the formation of a new urban center in Nakhon Si Thammarat. But analysis by Tinnakhon in the old town area surrounding Wat Phra Mahathat Woramahawihan highlights the failure to maintain global integration in this area due to utilised for public offices, religious places and schools. This hinders the grid intensification process which contradicts the findings of this study as well. Therefore, it suggests that study provides a basis for further research into additional contributing factors, offering a more comprehensive understanding of the underlying dynamics and their impact on urban development and spatial configuration, may be due to other socio-economic factors such as rental prices or area management. This could be further explored in future studies.

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DISCLOSURE STATEMENT

The authors declare no conflict of interest.

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