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Identification of Key Determinants on Quality-of-Life Related Transportation: A Spatial Statistical Modeling Approach Based on Transport Accessibility and Subjective Well-Being

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Abstract

This study examines spatial disparities in access issues to provide insights for targeted policy interventions, aiming to improve urban transportation and its influence on quality of life. Using spatial modeling, we conducted an analysis to assess accessibility and its correlation with quality of life, as measured by life satisfaction in Bangkok. We collected two types of data which include physical data from geographic information systems and 600 questionnaire responses. All data were gridded into 500m x 500m cells and subjected to analysis using Geographically Weighted Regression (GWR). The study's outcomes unveil substantial variations in spatial accessibility and preferences across diverse geographical regions. In general, regions with high accessibility consistently demonstrated higher average life satisfaction levels in the context of travel. However, it is crucial to acknowledge that, despite high accessibility, the average life satisfaction associated with travel was relatively low. This phenomenon highlights the idea that mere proximity to transportation modes or residential locations near transportation hubs does not necessarily guarantee an improved quality of travel life. The provision of travel patterns and the alignment of transportation services with user needs emerge as critical factors influencing this intricate relationship, particularly concerning facilitating access to desired activities.

Keywords: Accessibility; Life satisfaction; Megacity; Quality of life; Sustainable transportation.
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1. Introduction

With the development and growth of cities over the past decade, transport systems have played a vital role in driving urban expansion and development.[1-3] The transportation system functions as both a fixed and dynamic infrastructure, forming a network that connects various activities and facilitates the movement of people and goods from origin to destination. These activities occur within the city, driving day and night functions. This positive urban mobility benefits individuals, neighborhoods, cities, and entire nations. The transportation issue is frequently discussed in the context of improving the quality of life for urban residents.[4-6] Spatial and network elements are crucial components of urban infrastructure, and their integration and collaborative planning are essential. The primary focus should be on enhancing accessibility and connectivity across all urban elements.[7] Numerous studies focusing on spatial configuration emphasize the necessity for a comprehensive approach that integrates spatial and network considerations.[8] This approach centers on urban planning and design in conjunction with transportation systems, creating opportunities for enhanced access. It encompasses not only providing access to transportation systems, but also allocating infrastructure and systems to facilitate access to various transportation services, including traffic routes leading to destinations. Addressing these issues constitutes a key aspect of transportation design and planning, with particular emphasis on achieving equitable access. Insufficiently planned cities and transportation

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systems may foster spatial inequalities, as the transport system serves not only as a conduit for people and goods, but also as a catalyst for economic activities within urban areas.[7] Illustrative instances abound, such as the escalation in land values in regions where mass transit is developed or the emergence of upscale housing developments along the peripheries of such rail systems.[9,10] These activities precipitate spatial disparities in the nature of activities and economic value within the urban landscape.

In recent years, the issues of "inequality" and "equity" have gained increasing prominence in societal discourse, with spatial inequality persisting as a global concern.[11] This phenomenon has far-reaching implications for economic and social opportunities, contributing to an overall rise in inequality stemming from economic instability driven by policy distribution and resource development disparities. Disparities in access to material and social resources can exacerbate living standards, personal prospects, and foster exclusion.[12-14] Notably, these challenges are closely intertwined with the quality of life experienced by urban populations. Improvements in transportation systems have the potential to enhance the overall quality of life and promote sustainable development.[4] Achieving this requires transportation systems that are safe, environmentally responsible, affordable, and accessible.[15-17] As a result, transportation systems hold the promise of significantly influencing individuals' social and economic well-being by enhancing their capacity to access crucial opportunities essential for human development, including employment, healthcare, and education,[18,19] ultimately contributing to an improved quality of life for all.

In the context of Thailand, the government has accorded heightened priority to transportation development, as evidenced by the 20-year strategic transportation plan (2018-2037). This strategic framework emphasizes the creation of equal and equitable access to transportation systems through the design and provision of services catering to all demographic groups, including the elderly, individuals with disabilities, and children. The objective is to ensure that all segments of the population can effortlessly access transportation services, characterized by accessibility, affordability in terms of reasonable fares, and efficiency. This development trajectory aligns with the principles of sustainable urban development and the enhancement of people's quality of life, as advocated by the United Nations (2021).[15] Nevertheless, it is imperative to acknowledge that the city's development and the existing transportation system exert a profound influence on both the character of activities within a region and the economic value it embodies. This influence emanates from the allocation of transportation facilities and infrastructure within a given area, significantly impacting access to social activities, economic opportunities, and the acquisition of essential basic services through transportation access. A multitude of studies corroborate these observations. For instance, spatial accessibility analysis was performed concerning medical facilities,[20] while the spatial impact of transportation accessibility was explored on regional performance.[21] Furthermore, a study was conducted a study to examine the relationship between job accessibility and employment prospects.[22] Their findings highlight the positive impact of improved public transport on individual employment opportunities.

Access to transportation systems encompasses numerous dimensions, including physical proximity, travel time, and the availability of diverse modes of transportation. It is imperative to investigate these various facets to discern development priorities and formulate effective solutions. Notably, mere proximity or allocation to an accessible point does not guarantee actual access; for instance, residing next to a metro line does not automatically ensure the ability to utilize the service, despite its proximity. Therefore, to achieve a comprehensive understanding and integration of all three dimensions, *e.g.*, individuals, spatial considerations, and network infrastructures which is essential to incorporate a people-centric perspective. In this study, we endeavor to bridge the gap between factors by integrating attitudinal factors into the analysis of transportation network utilization. This approach amalgamates physical accessibility and users' satisfaction, as reflected through individuals' attitudes toward access to transportation within their vicinity. This method helps mitigate the constraints imposed by solely relying on physical factors and minimizes bias in the analysis from the respondents' viewpoints. Our aim is to investigate the accessibility among different modes within urban transportation systems that impact the quality of life concerning travel, ultimately striving to enhance the overall quality of life for urban residents. Consequently, understanding spatial disparities in various dimensions of access becomes paramount to recommend policies or tailored solutions that address the unique needs of city users, thereby fostering the enhancement of quality of life within transportation systems. The details of the literature review and related research are outlined as follows:

1.1 Quality of life related transportation

Quality of life is a well-established concept embraced by both city planners and urban residents. City planners frequently employ this term as a foundational framework for policy

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proposals aimed at fostering the allocation of opportunities within cities and catalyzing positive developmental initiatives to mitigate challenges arising from urban transformations. Simultaneously, urban residents actively seek avenues to enhance their quality of life. Perspectives on quality-of-life studies are multidimensional and have evolved significantly over the years. Examining the quality of life in the context of travel represents a specific dimension within this broader field of study. It constitutes a domain-specific exploration of quality of life, distinct from other areas such as housing and interpersonal relationships.[23] The study of quality of life in the context of transportation revolves around the evaluation of travel satisfaction and the overall travel experience. However, it's noteworthy that there is no universally standardized definition for quality of life in travel. While most definitions adhere to fundamental principles of quality of life assessment, variations exist in the specific indicators employed, with a predominant focus on factors related to transportation issues. These factors typically encompass accessibility, safety, affordability or cost, and mobility, among others.[23-25] The assessment of quality of life in transportation incorporates a range of indicators and analytical techniques. These include physical analysis, cognitive or attitudinal analysis, utility assessments, and evaluations of the quality of the service system. The choice of specific tools and methodologies employed in each study varies depending on the study's objectives and scope. Prioritizing research into the quality of life within the realm of transportation is of paramount importance.[4] Enhancements to the transportation system have the potential to significantly augment overall quality of life by facilitating opportunities for travel and access to various activities, particularly in the realms of education and employment. These activities, in turn, contribute to skill development, knowledge acquisition, and increased income levels, thereby fostering personal growth and well-being.

1.2 Spatial configuration and transport network

Spatial configuration, integral to the domain of urban morphology, pertains to the examination of the physical layout and structure of cities. This field of knowledge delves into the evolution and arrangement of urban areas, with a notable emphasis on the role of road networks as a significant component within this framework.[26] The discourse surrounding access inequality has gained considerable traction in recent times. It is increasingly recognized that urban spatial arrangements correspond to varying concepts of accessibility.[7] Consequently, cities are under growing pressure to establish well-crafted spatial arrangements that prioritize the creation of accessible opportunities for their residents. Within this context, spatial configuration analysis serves as a valuable tool for elucidating relationships pertaining to urban form, the shape of the built environment, and other pertinent spatial characteristics.[4]

1.3 Accessibility transportation for enhancing quality of life

Urban transportation and mobility play a crucial role in driving urban development, fostering social and economic inclusion by providing opportunities for individuals to engage in a wide array of activities, from employment to education and healthcare access. In the context of assessing or researching transportation systems, keywords related to accessibility assume significant importance. Accessibility keywords allow us to assess how easily individuals can access various destinations and services within a city, facilitating the fulfillment of their needs and desires.[27,28] It is worth noting that accessibility analysis in research varies across different perspectives. For instance, the concept of personal accessibility was pointed out to delineate the locations an individual can access. This concept is contingent upon factors such as the availability of services, modes of travel, and the individuals' income and affordability.[29]

A definition of accessibility was provided as the ease with which individuals can access and interact with destinations or activities.[30] By adding to this perspective, the consideration of accessibility as the measurement of the ability to access a location from various points could be emphasized as the crucial role of transportation infrastructure and mobility in determining accessibility.[31] In contrast, the concept of "personal-based" accessibility was introduced by focusing on individuals' access to different types of facilities throughout the day as they move within an area.[32] In contemporary research, multiple techniques and approaches are employed to assess accessibility, including infrastructure-based, location-based, person-based, and utility-based measures.[33-34] Consequently, it is imperative to prioritize accessible transportation from both individual and location perspectives in the planning of mobility-related policies and urban development initiatives.[7] This emphasis not only enhances transportation systems, but also contributes to the overall quality of life for urban residents.

2. Methodology

2.1 Study area

The capital city of Thailand is known as Bangkok (as depicted in Fig. 1), which constitutes a single urban area with a population of more than ten million people. Activities within this megacity are characterized by their intensity, both in terms

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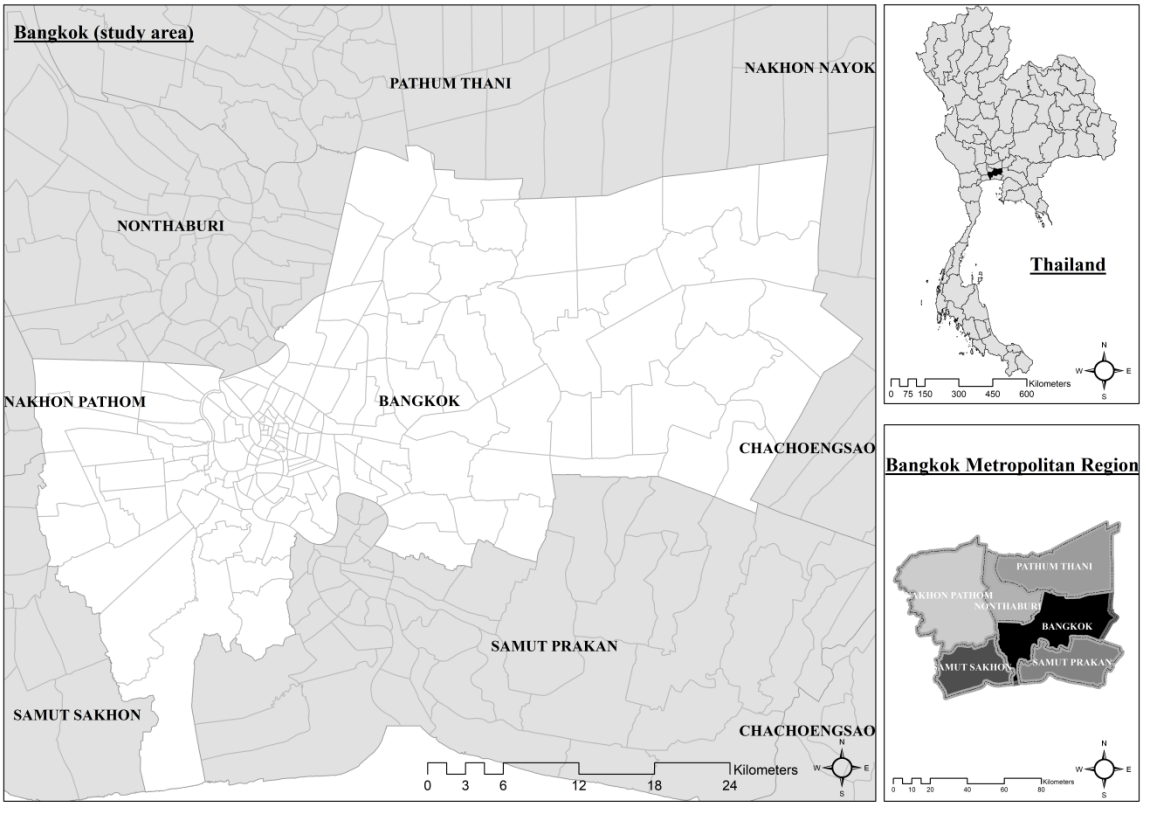

Fig. 1 Geographic Scope: Bangkok, the Capital of Thailand (Source: Authors).

of quantity and quality. These activities encompass various facets, including the provision of suitable housing and a diverse range of small to large-scale economic activities. These economic endeavors serve as sources of employment, generating income for the local population, while also attracting people from outside the area into the city. People from rural areas are drawn to Bangkok in pursuit of opportunities for improved social and economic access, as well as access to a robust education and healthcare system.[7]

Therefore, the transportation system within the area is highly diversified, offering various options for the people.[1] These options include personal vehicles, public transportation, rail transportation, mass transit, and para transit. Furthermore, the area boasts a well-developed infrastructure to support different modes of travel, including footpaths and bicycle lanes. However, as previously mentioned, transportation coverage is not uniform across the area, resulting in varying transport services in different regions. The diversity and quality of this extensive transportation system are often classified as a critical aspect of the local economy. This classification arises from the necessity to allocate transportation systems in accordance with travel demands and the cost-effectiveness of investing in infrastructure development. Therefore, Bangkok serves as an ideal study area for examining spatial disparities in access to transportation systems and their impact on the quality of life in terms of intra-city or inter-city travel for its residents.

2.2 Research methods and design

This study employed an observational and analytical approach with a quantitative methodology to investigate accessibility among different modes within urban transportation systems, examining their impact on the quality of life in travel. The ultimate goal is to enhance the overall quality of life for urban residents. The data were collected from residents in Bangkok aged 18 years and above. A purposive convenient sample of 600 participants was selected from residential areas, specifically those individuals with prior travel experience within the designated area. The sample size was determined using the formula by Krejcie and Morgan[35] for sample size calculation, with 384 samples identified as the minimum number of sample groups (allowing for a 5% margin of error). Consequently, the participants in this study were residents of Bangkok, with a screening of 600 individuals, all of whom had engaged in various forms of travel for at least one year.

For data collection, two types of data were obtained: secondary data sourced from geographic information systems, encompassing the physical aspects of the transportation system. This includes details such as types of mode choices (*e.g.*, water transport, public transport, and rail mass transit),

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locations of stations or piers for each mode choice, routes for each mode (*e.g.*, service routes of rail mass transit and public transport), and road networks. This information addresses accessibility issues, considering both the availability of services that people can access and the level of access required to transport individuals to their intended destinations. The distribution of the questionnaire involves considering not only respondents' travel experiences but also their spatial distribution within a 500 × 500 square meter grid. To ensure the reliability and feasibility of the questionnaire, the researcher conducted a pilot study and refined the final questionnaire. The survey's reliability, assessed through Cronbach's Alpha, yielded a value of 0.802, signifying a high level of reliability, given the threshold value of 0.7.[36,37] The questionnaire was structured in two parts: the first part collected information on the socioeconomic characteristics of the respondents, while the second section gathered life satisfaction data through seven indicators. These indicators, which include accessibility, safety, cost, mobility, environment, information, and design, were assessed using the Satisfaction With Life scale (SWL), consisting of seven scales ranging from one (very dissatisfied) to seven (very satisfied). During the data collection process, particular attention was paid to the questionnaire design, involving collaboration with transportation specialists and a rigorous pre-testing phase before finalizing the questionnaire. Additionally, the questionnaire distribution and data collection adhered to ethical considerations, with approval granted by the Human Research Ethics Committee of Thammasat University No. 2 Social Sciences (approval number 146/2021).

2.3 Analysis

This study aims to comprehensively understand spatial disparities in modal accessibility, which significantly impact the quality of life concerning transportation. All factors gathered through data collection have been spatially transformed into grid of analysis.[38] Accessibility considerations in this study encompass two key dimensions: personal accessibility and location-based accessibility. Personal accessibility examines the availability of transportation services accessible to individuals, encompassing factors such as mode choice and affordability. Meanwhile, location-based accessibility assesses spatial reach, contingent upon distances and various travel modes. From Fig. 2, the analytical process can be delineated as follows: firstly, personal accessibility factor data layers are integrated into Geographical Information System (GIS) analysis, accounting for heterogeneity and density within each grid cell. In the realm of accessibility, geographic information systems are employed for network analysis. This approach facilitates the measurement of accessibility across different locations and modes of travel, incorporating factors such as distance, travel time, cost, congestion, reliability, and safety. Spatial techniques (*e.g.*, best route analysis, service area analysis, closest facility analysis, and origin-destination cost matrix analysis) are employed. This study centers its focus on the transport system network, with particular emphasis on service area analysis. As a crucial step, all accessibility data is spatially transformed into grid-based areas, facilitating joint analysis with travel-related quality-of-life factors. Subsequently, travel-related life satisfaction data in terms of accessibility and affordability dimensions were employed to evaluate travel-related quality of life, employing a 5-point scale ranging from one (very dissatisfied) to five (very satisfied). These data points were then converted into grid-based formats to prepare them for concurrent analysis with accessibility considerations. To conduct this analysis, we employed a spatial statistical modeling approach, utilizing Geographically Weighted Regression (GWR). The use of spatial modeling is a common practice in assessments conducted through GIS.[38] GWR was employed to investigate the relationship between accessibility among different modes and the impact on quality of life variables with a spatial dimension. GWR, as a local regression technique, provides a set of statistics indicating local relationships and can be used to map the spatial distribution. R-squared serves as a measure of goodness of fit, while AICc is a measure of model performance and can be utilized for comparing regression models.[39]

Furthermore, this spatial approach serves as a robust spatial statistical tool in the evaluation of quality of life and is used to generate visualized maps based on spatially oriented statistical analyses. The application of the spatial statistical approach proves instrumental for urban planners, facilitating their comprehension, assessment, and enhancement of the spatial distribution and connectivity of transportation systems-ultimately contributing to the promotion of an improved quality of life.

3. Results

This study centers on enhancing the quality of life in travel by examining physical accessibility factors and travel satisfaction (person accessibility). Quality of life indicators were assessed by gathering responses from a sample of 600 individuals in Bangkok who had experience with various modes of travel within the study area. From Table 1, among the collected data, 80% of respondents were female (A_2), while 19% were male (A_1). In terms of age distribution, the majority (47%) fell

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Table 1. Respondents' profile.

Aspect	Variables	Private vehicle	Walking and cycling	Bus transit	Rail mass transit	Para transit	p-value
Gender							
Male	A_1	29.6	24.3	11.3	20.0	14.8	0.309
Female	A_2	33.5	16.8	15.9	17.2	16.6	
Age (years)							
18 – 25	B_1	36.1	7.4	16.4	32.8	7.4	0.000*
26 – 35	B_2	31.4	20.7	13.9	15.4	18.6	
36 – 59	B_3	32.3	21.0	16.4	11.8	18.5	
More than 59	B_4	33.3	33.3	0.0	33.3	0.0	
Marital status							
Married	C_1	33.2	18.0	14.3	23.5	11.1	0.114
Single	C_2	32.5	18.7	15.5	14.1	19.3	
Divorce	C_3	31.4	14.3	17.1	20.0	17.1	
Education level							
Junior high school	D_1	50.0	50.0	0.0	0.0	0.0	0.250
High school	D_2	19.2	23.1	30.8	7.7	19.2	
Vocational college	D_3	45.5	0.0	36.4	9.1	9.1	
Bachelor's degree	D_4	32.9	18.2	14.1	18.4	16.3	
Postgraduate	D_5	50.0	0.0	0.0	50.0	0.0	
Income (baht/month/person)							
Less than 10,000	E_1	0.0	0.0	50.0	50.0	0.0	0.000*
10,001 - 25,000	E_2	24.2	19.6	17.7	21.7	16.8	
25,001 - 40,000	E_3	42.7	15.4	10.5	11.9	19.6	
40,001 - 55,000	E_4	44.9	10.2	16.3	16.3	12.2	
More than 55,000	E_5	63.2	26.3	5.3	2.6	2.6	

Note: Total data is 600 sets; *Significance level at $p < 0.001$.

within the 26-35 years (B_2), followed by 33% in the 36-59 years (B_3), and 20% in the 18-25 years (B_1). Concerning economic status, the study revealed that more than 61% of respondents fell within the same income level of 10,001-25,000 baht (E_2), with the next most common income range being 25,001-40,000 baht (24%) (E_3).

3.1 Transport network and accessibility

When examining transportation accessibility within the study area, our primary focus was on intra-local public transport, as these modes of transportation play a vital role in fostering travel equity and enhancing the overall quality of life. Public transport networks offer improved access to activities and opportunities within the city. In this study, we analyzed the network data of three key modes of public transportation: the rail mass transit system (AC_1), the water transport system (AC_2), and the public bus system (AC_3). To analyze the results, we utilized network analysis, categorizing access levels into four distinct levels: less than 500m, 500-1,000m, 1,000-1,500m, and 1,500-2,000m, as depicted in Fig. 3.

Figure 4 illustrates the distribution of transportation system access across each grid. The data analysis reveals that the majority of water transport options (AC_2), comprising over 32 %, fall within the 1,500 - 2,000m access range, followed by 1,000 - 1,500m (26 %) and 500 - 1,000 meters (22 %). Concerning rail mass transit (AC_1), a substantial portion, more than 29 %, lies within the 1,500 - 2,000m access range, followed by 1,000 - 1,500m (25 %) and 500 - 1,000m (24 %). On the other hand, the data for bus transportation (AC_3) reveals that the majority, exceeding 45 %, falls within the 0-500m access range, followed by 500 - 1,000m (24 %) and 1,000 - 1,500m (17 %), as depicted in Fig. 5. The data demonstrates that public buses offer a broader coverage compared to other modes of transportation, primarily due to the extensive network of services operating along both primary and secondary roads within the study area. Following closely behind are the rail mass transit systems envisioned under the rail mass transit development plan, which aims to establish an integrated transportation system connecting Bangkok and its surrounding regions. Currently, several routes are already operational, while others are in various stages of development. The aforementioned data highlights the varying

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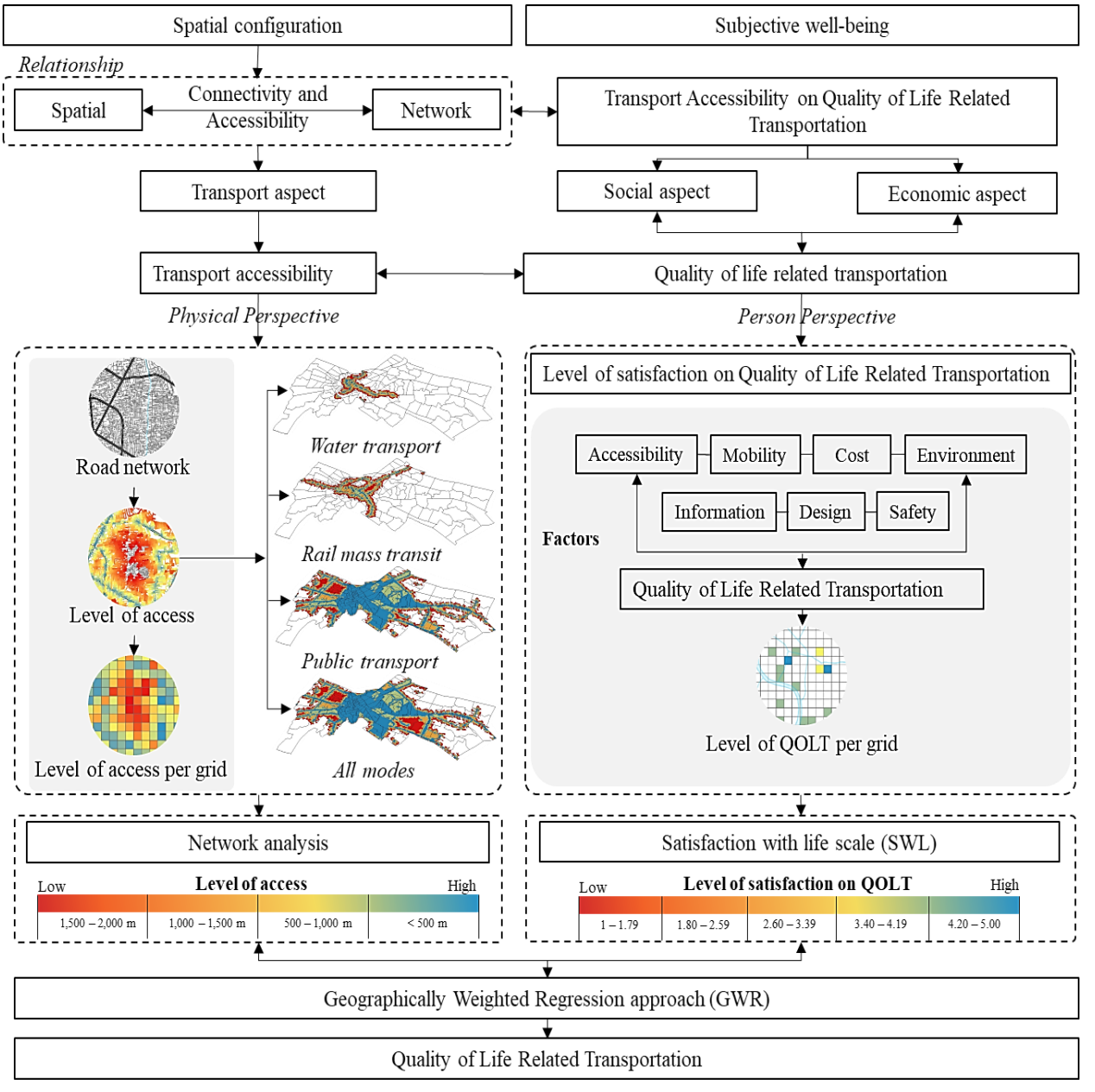

Fig. 2 Spatial configuration framework and its association with subjective well-being.(Source: Authors).

degrees of physical accessibility within different areas and grids, as each grid receives distinct types of service.

3.2 Perceived perspective on quality-of-life related transportation

To evaluate accessibility issues through the Quality of Life of Travel indicators, we considered seven key indicators: accessibility, safety, cost, mobility, environment, information, and design, which were evaluated using the Satisfaction with Life Scale (SWL) ranging from one (very dissatisfied) to five (very satisfied). Our analysis revealed an average SWL score ranging from 3.16 (minimum) to 4.12 (maximum), falling within the range of slightly dissatisfied to very satisfied. Examining the mean values of each indicator (see Fig. 6), we found that safety (Q_3) received the highest satisfaction score ($\bar{x}$ = 4.12), followed by accessibility (Q_1) ($\bar{x}$ = 4.01), information (Q_7) ($\bar{x}$ = 4.00), and mobility (Q_6) ($\bar{x}$ = 3.73), respectively. Cost (Q_4) had a slightly lower mean satisfaction score ($\bar{x}$ = 3.65). In summary, the overall mean satisfaction score across all indicators was 3.74 (see Fig. 7).

3.3 The spatial configuration and transport accessibility on perspective on quality-of-life related transportation

The examination of physical accessibility and accessibility influenced by personal attitudes prompts an exploration of the relationship between these two dimensions through a spatial

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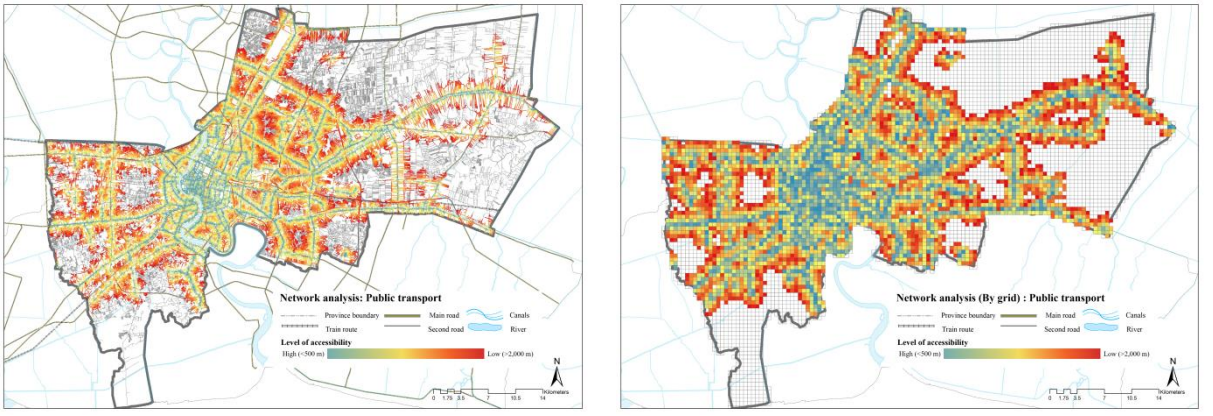

e. Public transport (AC_3) f. Public transport by grid (AC_{3g})

Fig. 3 Transport network and accessibility classified by modes (Source: Authors).

statistical modeling approach, employing the Geographically Weighted Regression (GWR) method. As depicted in Fig. 8, there is a noticeable trend of higher SWL scores within the access range of 1,000 meters. Notably, the overall averages across all dimensions fall within the high average range. Fig. 8 illustrates the association of socioeconomic characteristics with the average satisfaction regarding the quality of life related to transportation. Analysis of the data revealed that females exhibited higher satisfaction levels than males, reaching a high level ($\bar{x}$ = 3.40 - 4.19). Regarding marital status, it was observed that single individuals reported higher satisfaction levels compared to those who were married or divorced. This trend was also notable among those with a bachelor's degree and individuals with personal incomes in the range of 25,001 - 40,000 baht. The satisfaction levels for these three groups predominantly fell within the medium range ($\bar{x}$ = 2.60 - 3.39).

To investigate the relationship between transport accessibility from both a physical and personal perspective concerning quality-of-life-related transportation, we conducted an analysis using the Geographically Weighted Regression (GWR) method. The results, as shown in Table 2, indicate that the analytical coefficients for each travel mode were similar. Physical access demonstrated a significant association with attitudes toward quality of life in travel. These findings suggest a significant mutual relationship between accessibility in both dimensions, with areas having high accessibility within the range of 1,000 meters exhibiting

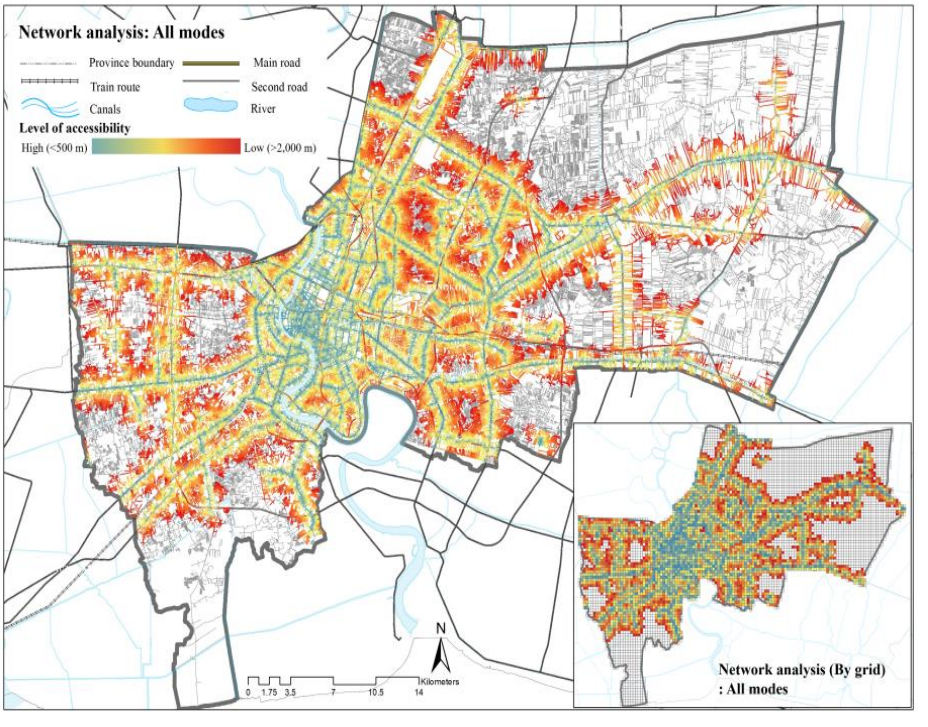

Fig. 4 Transport network and accessibility by all modes (Source: Authors).

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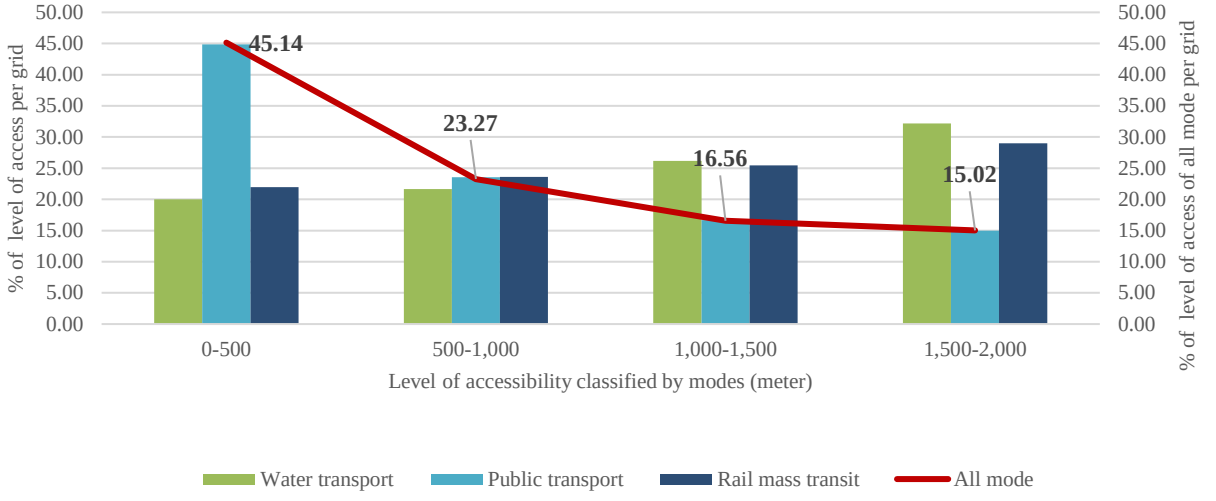

Fig. 5 Level of accessibility by all modes (Source: Authors).

Table 2. The relationship between transport accessibility and personal perspective on quality-of-life related transportation.

Model	Independent variable		Coefficient				R squared	AICc
			Min	Max	Mean	Std.		
Model 1	Overall	All modes	0.77	0.87	0.86	0.01	0.17	297.05
Model 2	Separate by mode	Water transport	0.55	0.58	0.57	0.04	0.09	202.58
		Rail mass transit	0.54	0.58	0.57	0.04	0.09	199.88
		Public bus transport	0.52	0.57	0.56	0.06	0.24	202.60

higher average travel satisfaction compared to areas with longer accessibility. However, it is worth noting that the R-squared value in the analytical model was relatively low.

4. Discussion

In contemporary urban settings, transportation issues have become increasingly challenging. Problems stemming from transportation have been on the rise and have taken center stage as the primary concerns within cities. These issues encompass traffic congestion, pollution, road safety, and transportation accessibility, all of which significantly impact the overall quality of life for urban residents. Moreover, alongside these pressing challenges, there is a pronounced concern about spatial inequality in travel. Current developmental strategies are oriented towards the creation and enhancement of transportation systems with the goal of mitigating this spatial inequality in travel. This approach involves not only improving accessibility but also encouraging greater utilization of public transportation, with the dual purpose of both enhancing access and reducing the reliance on private cars which is a prominent issue in contemporary urban development. Viewed from a specific perspective, the study of quality of life demonstrates significant importance as afundamental mechanism in urban planning. Advancements in transportation systems have the potential to elevate the quality of life by facilitating improved travel experiences, thereby contributing to an overall better quality of life. Accessibility considerations are a fundamental element at the core of the development of transport systems. However, projections indicate that the urbanization process has led to growing disparities in spatial development, a trend likely to persist in the future, affecting transportation systems. This trend results in greater spatial inequality, reflecting disparities in people's quality of life. This study explores the relationship between physical access and personal access, using quality of life indicators in the context of travel.[1]

The findings suggest a significant mutual relationship between accessibility in both dimensions, with areas featuring high accessibility within the range of 1000 meters exhibiting higher average travel satisfaction compared to those with more extended accessibility. Nevertheless, it is noteworthy that the R-squared value in the analytical model is relatively low. However, the results reveal disparities in accessibility, particularly in the accessibility of various public transport modes, consistent with findings in Ref. [31], which emphasizes the crucial role of transportation infrastructure and mobility in determining accessibility. Ref. [40] suggests that enhanced accessibility creates pathways to access improved life opportunities, and Ref. [4] addresses issues highlighting that accessibility can ultimately contribute to an enhanced

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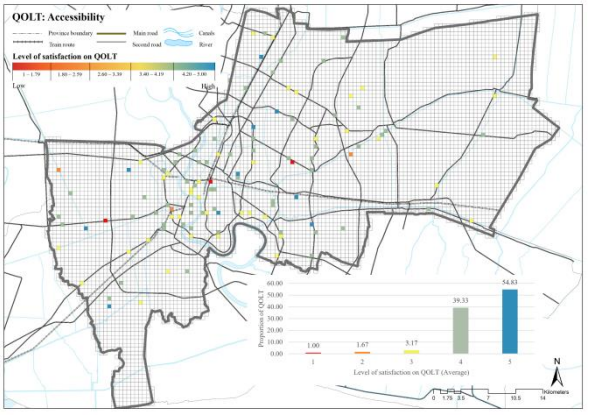
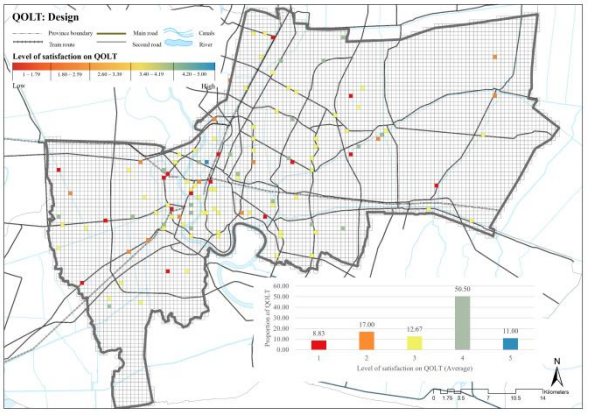
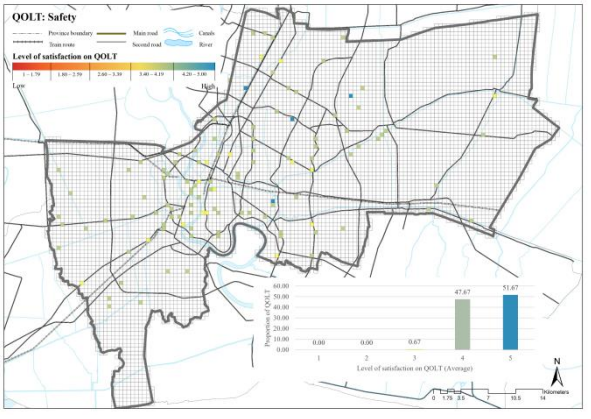


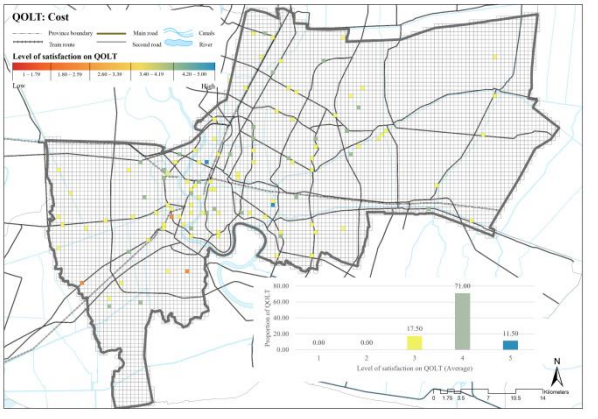
a. Accessibility (Q_1)



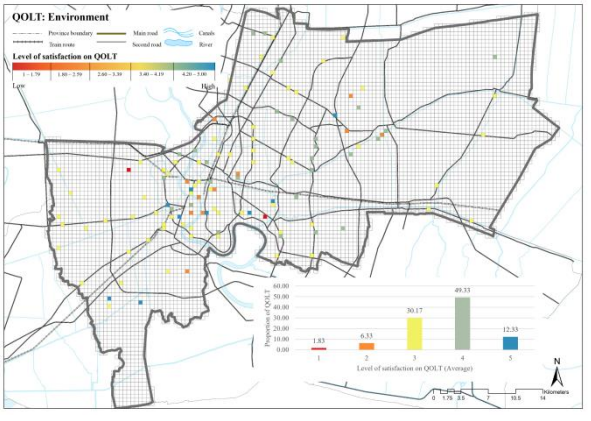
b. Design (Q_2)



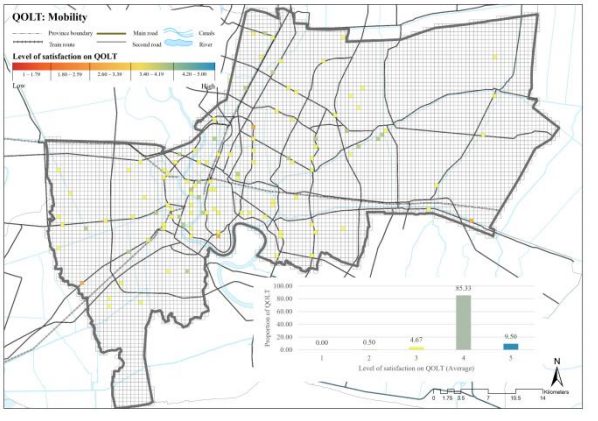
c. Safety (Q_3)



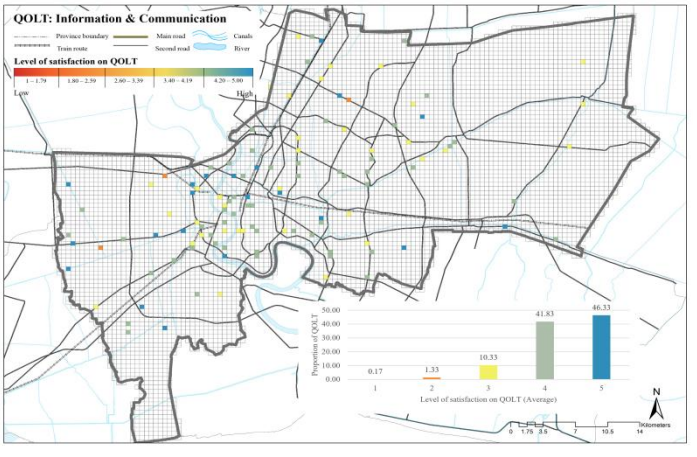
d. Cost (Q_4)



e. Environment (Q_5)



f. Mobility (Q_6)



g. Information and Communication (Q_7)

Fig. 6 Level of satisfaction on quality-of-life related transportation by grid (Source: Authors).

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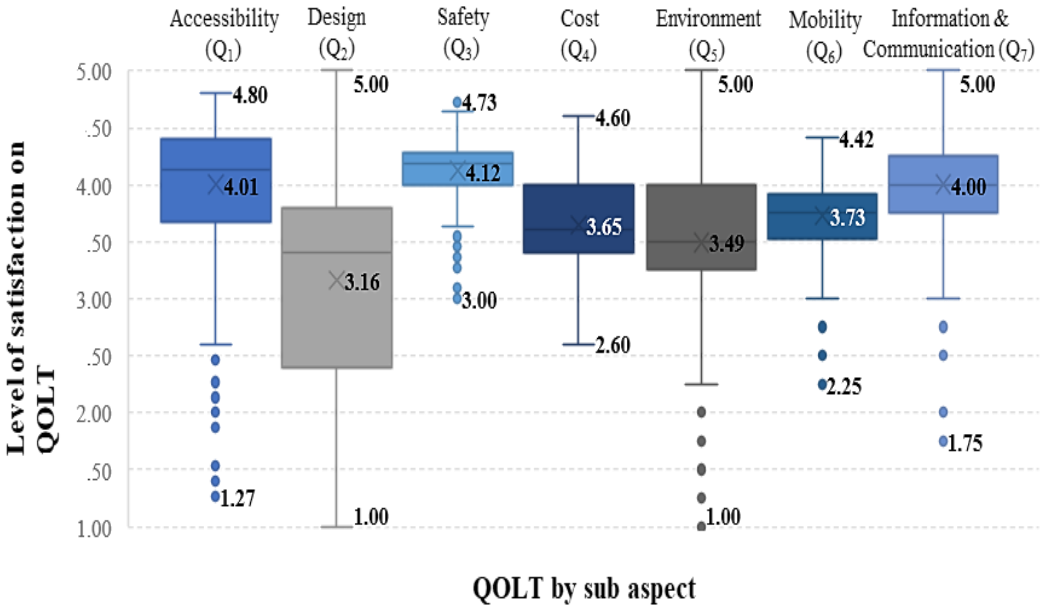

Fig. 7 Level of satisfaction on quality-of-life related transportation (Source: Authors).

Aspects		Accessibility (Q1)					Design (Q2)					Safety (Q3)					Cost (Q4)					Environment (Q5)					Mobility (Q6)					Information (Q7)				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Gender	A1	0.2	0.3	5.8	10.5	2.3	3.0	1.5	11.0	3.2	0.5	0.0	0.0	3.2	15.7	0.3	0.0	0.7	13.3	4.8	0.3	0.2	1.8	11.5	4.7	1.0	0.0	0.2	15.0	4.0	0.0	0.0	0.7	6.5	7.5	4.5
	A2	1.2	2.8	27.8	40.5	8.2	14.8	8.8	40.3	15.3	1.2	0.0	0.0	16.8	64.3	2.3	0.0	2.5	57.8	19.5	0.7	1.7	9.8	45.7	19.0	4.3	0.0	0.8	62.3	17.3	0.0	0.2	3.3	24.3	32.3	20.3
Age	B1	0.5	1.0	6.7	10.0	2.2	3.5	2.2	11.5	3.2	0.0	0.0	0.0	3.7	16.2	0.5	0.0	0.5	14.8	5.0	0.0	0.3	2.2	12.3	4.5	1.0	0.0	0.7	15.7	4.0	0.0	0.0	0.5	5.3	9.7	4.8
	B2	0.2	0.8	15.7	24.7	5.3	7.5	5.2	23.7	9.8	0.5	0.0	0.0	8.2	37.3	1.2	0.0	1.7	32.8	11.2	1.0	1.0	5.8	25.5	11.5	2.8	0.0	0.3	37.2	9.2	0.0	0.0	1.7	15.2	18.7	11.2
	B3	0.7	1.3	11.0	16.5	3.0	6.7	2.8	16.2	5.7	1.2	0.0	0.0	8.0	23.5	1.0	0.0	1.0	23.3	8.2	0.0	0.5	3.8	19.0	7.7	1.5	0.0	0.0	24.5	8.0	0.0	0.2	1.8	10.3	11.5	8.7
	B4	0.0	0.0	0.3	0.2	0.0	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.2	0.2	0.2
Married status	C1	0.7	1.3	11.2	19.0	4.0	5.0	3.8	20.3	6.7	0.3	0.0	0.0	6.8	28.3	1.0	0.0	0.8	25.0	9.8	0.5	0.7	3.7	22.0	8.0	1.8	0.0	0.8	27.7	7.7	0.0	0.2	1.2	11.3	14.8	8.7
	C2	0.5	1.7	20.5	29.0	6.3	11.3	6.0	28.2	11.2	1.3	0.0	0.0	11.7	45.2	1.2	0.0	2.3	41.8	13.3	0.5	0.7	7.0	32.3	14.7	3.3	0.0	0.2	45.5	12.3	0.0	0.0	2.3	18.2	23.2	14.3
	C3	0.2	0.2	2.2	3.3	0.2	1.5	0.5	3.0	0.8	0.0	0.0	0.0	1.7	3.7	0.5	0.0	0.0	4.7	1.2	0.0	0.5	1.2	2.8	1.2	0.2	0.0	0.0	4.3	1.5	0.0	0.0	0.5	1.5	2.0	1.8
Education level	D1	0.0	0.0	0.3	0.0	0.5	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.3	0.0
	D2	0.0	0.0	1.2	2.7	0.3	0.3	0.5	2.8	0.5	0.2	0.0	0.0	0.3	4.0	0.0	0.0	0.3	3.0	0.8	0.2	0.0	0.3	2.3	1.5	0.2	0.0	0.0	3.2	1.2	0.0	0.0	0.2	1.3	1.7	1.2
	D3	0.0	0.0	0.8	0.7	9.5	0.5	0.3	0.7	0.3	0.0	0.0	0.0	0.5	1.3	0.0	0.0	0.2	1.0	0.5	0.2	0.0	0.5	1.2	0.2	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.2	1.0	0.7
	D4	1.3	3.0	31.3	48.0	0.2	16.7	9.5	47.8	17.7	1.5	0.0	0.0	19.0	71.5	2.7	0.0	2.7	66.8	23.0	0.7	1.8	11.0	53.5	21.8	5.0	0.0	1.0	72.0	20.2	0.0	0.2	3.8	29.3	36.8	23.0
	D5	0.0	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.2	0.2	0.0

	E_1	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.20	0.20	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.20	0.20	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.20	0.00	0.20
Income level (baht per month per person)	E_2	1.00	1.80	22.20	29.70	6.77	11.77	7.25	31.50	10.00	1.00	0.00	0.00	11.77	48.33	1.30	0.05	1.53	43.00	16.02	0.07	1.55	5.70	34.88	15.77	3.70	0.07	0.72	47.25	13.50	0.00	0.00	1.77	18.55	26.22	15.00
	E_3	0.02	0.08	6.33	14.33	2.02	3.51	1.28	13.88	5.03	0.03	0.00	0.00	4.33	19.00	0.05	0.03	1.33	17.88	4.77	0.02	0.24	4.03	13.88	5.03	0.08	0.03	0.33	17.77	5.88	0.00	0.00	1.33	7.55	8.33	6.77
	E_4	0.00	0.02	3.24	4.00	0.08	1.51	1.20	4.04	1.30	0.02	0.00	0.00	2.55	5.33	0.03	0.02	2.05	5.22	2.77	2.02	2.02	0.85	5.22	1.33	2.02	0.00	0.00	6.81	1.30	0.00	0.24	7.00	3.33	2.81	1.20
	E_5	0.02	0.03	2.03	3.00	0.08	1.20	0.81	2.04	2.22	0.02	0.00	0.00	1.77	4.25	0.05	0.02	2.05	5.33	0.77	2.02	0.00	1.33	3.00	1.81	7.02	0.00	0.00	5.55	0.81	0.00	0.00	3.00	1.55	2.77	1.81
All modes	F_1	2.66	1.88	29.88	42.11	6.11	11.44	10.55	43.99	15.88	0.09	0.00	0.00	13.22	66.77	2.66	0.06	2.66	57.00	21.11	1.88	0.99	9.66	47.44	20.22	4.44	0.06	2.66	64.99	14.99	0.00	0.00	1.88	27.22	37.77	15.88
	F_2	0.00	0.09	4.44	5.33	0.09	2.66	0.90	6.11	1.80	0.00	0.00	0.00	0.00	10.55	0.09	0.00	0.00	9.66	1.80	0.00	0.00	0.00	6.11	2.66	2.66	0.00	0.09	7.00	3.55	0.00	0.00	0.09	0.90	7.00	2.66
	F_3	0.00	0.00	0.00	2.66	1.88	0.00	0.00	3.55	0.90	0.00	0.00	0.00	0.90	3.55	0.00	0.00	0.00	3.55	0.90	0.00	0.09	0.00	2.66	0.00	0.09	0.00	0.00	4.44	0.00	0.00	0.00	0.00	2.66	1.80	0.00
	F_4	0.00	0.00	0.00	1.80	0.00	0.00	0.00	1.80	0.00	0.00	0.00	0.00	0.00	1.80	0.00	0.00	0.00	0.90	0.90	0.00	0.00	0.00	0.90	0.90	0.00	0.00	0.00	0.90	0.90	0.00	0.00	0.00	0.00	1.80	0.00
Water transport	G_1	0.29	2.66	29.88	36.00	8.88	10.55	11.44	42.11	14.00	0.00	0.00	0.00	8.88	66.77	2.66	0.06	2.66	55.33	20.22	0.08	1.88	6.11	48.22	16.77	5.33	0.05	3.55	59.66	14.99	0.00	0.00	2.66	25.44	37.77	12.33
	G_2	0.00	0.00	0.00	4.44	0.00	0.00	0.00	2.66	1.80	0.00	0.00	0.00	1.80	2.66	0.00	0.00	0.00	3.55	0.90	0.00	0.00	2.66	0.90	0.90	0.00	0.00	0.00	3.55	0.90	0.00	0.00	0.00	1.80	2.66	0.00
	G_3	0.99	0.00	1.80	4.44	0.00	0.90	0.00	3.55	2.66	0.00	0.00	0.00	0.90	5.33	0.99	0.00	0.00	6.11	0.90	0.00	0.00	0.90	1.80	1.80	2.66	0.00	0.00	5.33	1.80	0.00	0.00	0.00	2.66	1.80	2.66
	G_4	0.99	0.00	2.66	7.00	0.00	2.66	0.00	7.00	0.00	0.09	0.00	0.00	2.66	7.90	0.00	0.00	0.00	6.11	2.66	1.80	0.00	0.00	6.11	4.44	0.00	0.00	0.00	8.81	1.80	0.00	0.00	0.00	0.90	6.11	3.55
Rail mass transit	H_1	1.88	1.88	27.22	38.66	6.11	9.66	9.66	42.11	13.22	0.09	0.00	0.00	11.44	60.55	3.55	0.08	1.88	54.44	18.44	0.09	0.99	7.00	42.11	19.33	6.11	0.06	2.66	60.55	12.33	0.00	0.00	1.88	25.44	35.11	13.22
	H_2	0.00	0.09	4.44	5.33	0.09	2.66	0.90	5.33	2.66	0.00	0.00	0.00	0.90	10.55	0.00	0.00	0.09	7.90	2.66	0.00	0.09	0.90	7.00	1.80	0.09	0.00	0.00	7.90	3.55	0.00	0.00	0.09	2.66	6.11	1.80
	H_3	0.09	0.00	1.80	6.11	0.09	0.90	0.90	5.33	2.66	0.00	0.00	0.00	0.90	8.80	0.00	0.00	0.00	7.00	2.66	0.00	0.00	1.80	4.44	2.66	0.09	0.00	0.00	7.00	2.66	0.00	0.00	0.00	1.80	5.33	2.66
	H_4	0.00	0.00	0.90	1.80	0.09	0.90	0.00	2.66	0.00	0.00	0.00	0.00	0.90	2.66	0.00	0.00	0.00	1.80	0.90	0.09	0.00	0.00	3.55	0.00	0.00	0.00	0.09	1.80	0.90	0.00	0.00	0.00	0.90	1.80	0.90
Public transport	I_1	2.66	1.88	30.77	39.55	6.11	11.44	11.44	43.00	14.00	0.09	0.00	0.00	13.22	64.99	2.66	0.06	2.66	55.33	21.11	1.88	0.99	8.88	45.66	20.22	5.33	0.06	2.66	62.33	15.88	0.00	0.00	1.88	26.33	38.66	14.00
	I_2	0.00	0.09	3.55	7.90	0.09	2.66	0.00	7.00	3.55	0.00	0.00	0.00	0.00	12.33	0.00	0.00	0.00	11.44	1.80	0.00	0.00	0.90	7.90	2.66	1.88	0.00	0.09	9.66	2.66	0.00	0.00	0.09	1.80	6.11	4.44
	I_3	0.00	0.00	0.00	2.66	1.88	0.00	0.00	3.55	0.90	0.00	0.00	0.00	0.90	3.55	0.00	0.00	0.00	3.55	0.90	0.00	0.09	0.00	2.66	0.00	0.09	0.00	0.00	4.44	0.00	0.00	0.00	0.00	2.66	1.80	0.00
	I_4	0.00	0.00	0.00	1.80	0.00	0.00	0.00	1.80	0.00	0.00	0.00	0.00	0.00	1.80	0.00	0.00	0.00	0.90	0.90	0.00	0.00	0.00	0.90	0.90	0.00	0.00	0.00	0.90	0.90	0.00	0.00	0.00	0.00	1.80	0.00

Remark: Male (A_1), Female (A_2), 18 – 25 year (B_1), 26 – 35 year (B_2), 36 – 59 year (B_3), More than 59 year (B_4), Married (C_1), Single (C_2), Divorce (C_3), Junior high school (D_1), High school (D_2), Vocational college (D_3), Bachelor's degree (D_4), Postgraduate (D_5), Less than 10,000 (E_1), 10,001 - 25,000 (E_2), 25,001 - 40,000 (E_3), 40,001 - 55,000 (E_4), More than 55,000 (E_5), All mode <500 m (F_1), 500 – 1,000 (F_2), 1,000 – 1,500 (F_3), 1,500 – 2,000 (F_4), Water transport <500 m (G_1), 500 – 1,000 (G_2), 1,000 – 1,500 (G_3), 1,500 – 2,000 (G_4), Rail mass transit <500 m (H_1), 500 – 1,000 (H_2), 1,000 – 1,500 (H_3), 1,500 – 2,000 (H_4), Public transport <500 m (I_1), 500 – 1,000 (I_2), 1,000 – 1,500 (I_3), 1,500 – 2,000 (I_4).

Fig. 8 Transport accessibility and personal perspective on quality-of-life related transportation.

overall quality of life. A limitation of this study is the absence of a comparison with accessibility by multitype of vehicles. Although the focus is on accessibility through public transportation to drive sustainable mobility development, it is inevitable that individuals primarily choose personal vehicles for travel within major cities. Furthermore, this study

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primarily concentrates on accessibility factors, however, it is important to acknowledge that these factors are not limited solely to the quality of life in travel. Future studies should consider additional factors aligned with the study's objectives, particularly social and economic accessibility in the context of travel. Given the diverse housing options available in megacity, Bangkok, such differences can significantly influence individuals' choices of transportation modes. This represents an intriguing area for further research, aiming to strike a balance between personal and spatial accessibility while ensuring ease of access and affordability of transportation services.

5. Conclusion

While every individual embarks on their travel from a distinct vantage point, it remains imperative that equitable access to opportunities designed to enhance their quality of life is ensured. The urban environment must serve as a dynamic space with the capacity to engender life-enhancing prospects for all residents. This mandate involves the provision of well-suited services, infrastructure, and the fostering of a nurturing living environment. Achieving equilibrium in mitigating spatial disparities stands as a vital concern for urban planners and policymakers deeply committed to propelling urban development and fostering social and economic progress within metropolitan areas. This study highlights the significant impact of spatial disparities in access on the quality of life in the context of travel. Interestingly, the data indicates that the mere availability of a wide range of transportation services or proximity to transportation options does not guarantee a high quality of life in commuting, as demonstrated by the relatively weak correlation observed. This is because the availability of transportation services alone does not always align with the demand for their use. Travel decisions are influenced by factors beyond spatial accessibility, including affordability, safety, and service quality, among others. Furthermore, the study's results point out the importance of evolving transportation systems. Instead of solely focusing on expanding the infrastructures, the emphasis should be on developing systems that provide high-quality, safe, and affordable services. Importantly, urban planning should not aim for uniformity in service distribution across all areas but should strive to meet the specific transportation needs of the local population.

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Conflict of Interest

There is no conflict of interest.

Supporting Information

Not applicable.

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