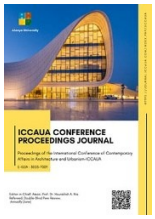

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Informal mobility typologies towards a better understanding of Informal public transportation

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A b s t r a c t

Bangkok, the capital of Thailand, is known for its cultural heritage and thriving tourism, however, it is also notorious for its traffic congestion and air pollution, which are frequently ranked amongst the world's worst. In response to these challenges, the city has focused on the development and expansion of mass transit systems, such as metro rail networks and bus rapid transit (BRT) systems, to improve mobility and reduce reliance on private vehicles. However, while improvement efforts are concentrated on formal transportation infrastructure, informal mobility options remain largely overlooked in terms of urban transportation. Informal public transportation, which includes motorcycle taxis, shared minivans, tuk-tuks, and other flexible transport modes, plays a crucial role in urban mobility, particularly for last-mile connectivity and accessibility in areas where formal transportation options are limited.

This research aims to study the various types of informal public transportation, with their systematic classification according to their common characteristics, by developing a framework for analyzing informal transportation systems with the use of a criteria matrix for the systematic evaluation of various transportation types. This matrix serves as a tool for examining mobility systems, offering insights into their functions, patterns, and contributions to urban and suburban transportation networks. Additionally, it enables the identification and analysis of unique traits such as the role of motorcycle taxi stations or ride-hailing applications, travel distance, and mode of transportation. Such findings help us to understand the systems and behaviors within Bangkok, which can enhance the understanding of informal transportation systems and their integration with formal transportation networks for more efficient urban mobility planning.

K e y w o r d s : Urban Mobility, Informal transportation, Criteria Matrix, Motorcycle Taxi.

1. Introduction

1.1 Problem Statement

Southeast Asian cities were among the five most polluted in the world on January 2025, according to air-monitoring organization IQAir, with Bangkok ranked fifth, respectively (Reuters, 2025). Traffic congestion remains a major issue in Southeast Asia, with Bangkok ranked 43 (Tom Tom, 2024). Air pollution remains the major problem globally, according to IQ Air (2023), out of 7812, Bangkok ranks at 1052.

These rankings are mainly due to traffic issues, which come from the increase in privately owned vehicles as well as public transportation systems unable to meet the demand of the population. Moreover, there are problems with public transportation, such as the requirement of maintenance, and the city has insufficient road space, with only 8% road-to-area ratio (Office of Transport and Traffic Policy and Planning, January 2024).

1.2 Traffic Safety

Global road traffic accidents remain a pressing public health concern, with millions of lives affected each year. According to global statistics, road traffic accidents are the leading cause of death for people aged 5–29 years (UN-Habitat, 2022). The distribution of these incidents, however, is not uniform across the globe. While high-income countries tend to have stricter road safety regulations and better infrastructure, low- and middle-income countries disproportionately bear the burden of road traffic injuries and fatalities. Among all regions, Southeast Asia stands out as having the highest number of road traffic accidents. Thailand has a road traffic death rate of 25.4 per 100,000 population (Luu & Chu & Xuan, 2020), Approximately 1.19 million people die each year due to road traffic accidents in Asia, which contributes significantly to the global total. (UN-Habitat, 2022; WHO, 2023).

ASI (Avoid-Shift-Improve) is a framework used in urban planning and sustainable transportation, and it is used to create more sustainable cities. With regards to ASI, this research will primarily focus on Shift, which is to Shift to Public transport which are environmentally friendly, but currently mass transit rail systems suffer from overcrowding and capacity limitations,

inadequate coverage and accessibility, poorly integrated systems, affordability problems, which is what lead to the emergence of informal transportation (ASEAN 2022).

1.3 Failure of TOD in Bangkok - inconvenience in formal transport and emergence of Informal transport

This model of Transit-Oriented Development (TOD) actively connects transportation infrastructure with housing, services, and employment to support the growth of well-connected, compact urban areas, but all too often, transport planning is attempting to catch up with urban growth when it should instead be leading it and it has often prioritized quick fixes without adequately considering accessibility (ASEAN2022).

This oversight has encouraged the use of private vehicles, further exacerbating the problem of traffic congestion. As formal transportation systems continue to struggle, people begin to exercise their "Right to the City" by seeking alternative solutions to the shortcomings of formal transit. One such solution is the emergence of informal transportation systems, which exist in the space between formal public transit and privately owned vehicles. These informal systems represent people's adaptive responses to unmet transportation needs, offering both mobility and employment opportunities. Ultimately, they help fill the gaps left by formal transportation networks (Nakamura, Fumei, Vasinee, Vichiensan, and Hayashi, 2016).

Bangkok has recently achieved measurable improvements in traffic flow due to concerted management efforts. Addressing traffic congestion in Bangkok requires ongoing infrastructure development, transport planning is attempting to catch up with urban growth when it should instead be leading it; cities that plan beyond their current boundaries will be best placed to guide their future growth and not use transportation as a solution that starts to appear over time. (ASEAN, 2022).

Figure 01. Public transportation in Thailand problem (photo by Krittanat Tuesaksri).

1.4 Transportation type

Bangkok showcases a vibrant mix of formal and informal transportation systems, shaped by rapid urbanization, population growth, and local culture. In terms of formal transportation, Bangkok has a developed and structured network. The city offers a range of mass transit options such as the BTS Skytrain, MRT subway, and Airport Rail Link, which provide efficient, air-conditioned travel across various districts.

When it comes to informal transportation, Bangkok is known for their dynamic and flexible options. Bangkok features "tuk-tuks" as a signature informal transport option. These three-wheeled vehicles offer short, negotiable rides and are popular among tourists and locals alike. Win motorbike taxis are also widespread in Bangkok, with drivers typically registered to specific stations. (Fig. 02).

Despite the existence of formal transportation, people still prefer to use informal transportation because of the convenience and affordability. Informal transport tends to be more flexible than formal systems, allowing for door-to-door services or pickups in areas not served by formal transport networks. Another significant advantage is the variety of choices available to commuters. Informal transport often includes a wide range of vehicle types and services, from motorbikes to vans, which allow customers to customize to their specific needs. Lastly, Affordability is also a major reason why many people prefer informal transport. These services usually have lower fares compared to formal transit options. This led to people having less interest in formal transportation because of hard to hard-to-access transportation, pricing, and inconvenience.

Overall, Bangkok's transportation infrastructure illustrates how formal and informal systems coexist to serve the demands of growing urban populations.

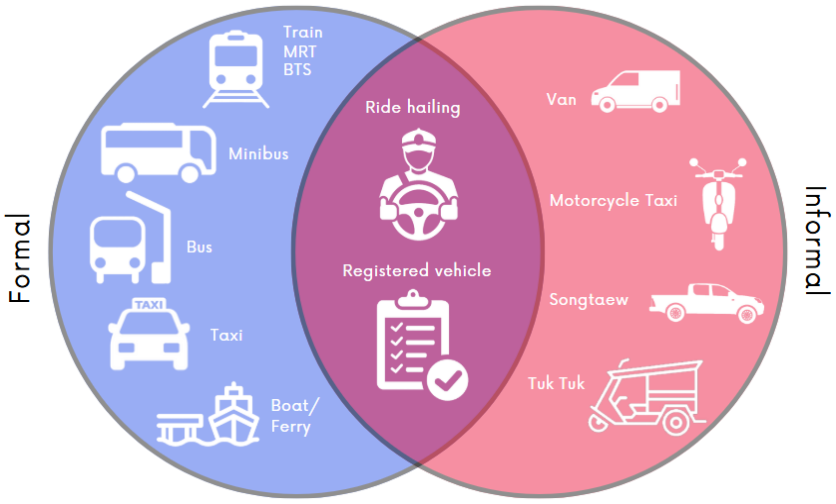
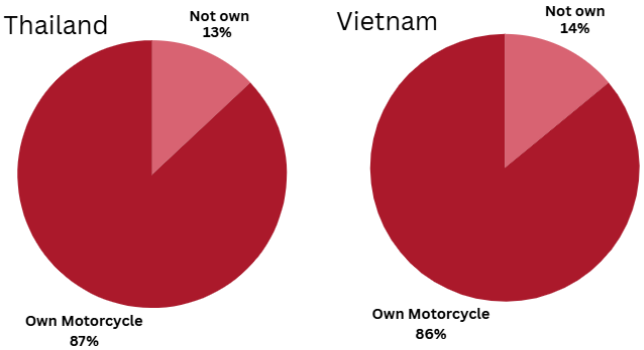


Figure 02.The transportation type in Bangkok.

1.5 Rationale - Motorcycle ownership

Motorcycles are a dominant mode of transportation in Thailand, as shown in the pie chart, with ownership rates of 87% (Fig. 03). These high percentages reflect the reliance on motorcycles as an affordable and efficient means of navigating dense urban traffic. However, despite similar ownership levels, the experience of motorcycle ownership can differ significantly due to variations in government regulations, infrastructure quality, and the cost of ownership (Miaschi, WorldAtlas 2019). For instance, Thailand has invested in improving road infrastructure and safety measures (Turner, 2020). These factors shape how residents use and perceive motorcycles in daily life.



Country	City	Travel time world rank	Congestion world rank	Average travel time per 10 km	Congestion level (%)	Year during rush hours(hours)
Thailand	Bangkok	161	2	21 min 51s	50	96 hours

Figure 03. Miaschi, WorldAtlas 2019, Motorcycle ownership rate(above), Traffic congestion rate (below) (Tran,(TomTom Traffic Index), Jan 2025).

This data on motorcycle ownership rate and traffic congestion rate highlights that in suburban and rural areas, the lack of alternative public transportation options makes mobility highly limited, thereby making personal vehicle ownership, particularly motorcycles and cars, a necessity. With public transport systems often concentrated in urban centers, residents in less developed regions are left with few choices for daily travel. As a result, owning a motorcycle becomes essential. This reliance on personal vehicles underscores the critical role motorcycles play in enabling mobility and maintaining livelihoods in areas where infrastructure is underdeveloped or public transit is unavailable (Miaschi, WorldAtlas 2019).

1.6 Policy and Regulation

In Thailand, control over the use of state-owned vehicles and public transportation, as well as the enforcement of related laws and regulations, faces significant challenges. Vehicle registration is often inadequate, with many vehicles either unregistered or registered with limited oversight (Tanchalee, 2018). Identifying drivers poses an additional challenge due to incomplete or inconsistent record-keeping. Although laws exist, they are frequently violated. This includes difficulties in enforcing regulations to check the criminal records of drivers, leading to potential safety risks. Fare regulation is another area of concern: while the Department of Land Transport has established fare rates for certain types of vehicles, drivers often disregard these rates, charging fees that exceed the legal limits. This research highlights that while there are laws and regulations governing both formal and informal transportation systems, these are often ineffective due to weak enforcement by authorities, legal loopholes, and the lack

of oversight for smaller infractions, which tend to go unnoticed. Strengthening enforcement mechanisms and addressing these gaps is essential for effective regulation (Tanchalee, 2018).

In April 2025, the Department of Land Transport (DLT) intensified efforts to penalize motorcycle taxi drivers exploiting passengers, particularly in tourist-heavy areas like Pattaya and Patong. Despite these measures, enforcement remains inconsistent, and many drivers continue to overcharge with minimal consequences. For instance, in November 2024, Pattaya police warned drivers against overcharging during the International Fireworks Festival, yet such practices persisted. Similarly, in May 2024, a Phuket motorcycle taxi rider was fined for overcharging and threatening a passenger, highlighting ongoing issues with driver conduct. These incidents underscore the challenges in enforcing regulations and the need for more effective oversight to protect passengers (Digital MKT, April 2025; The Pattaya News, November 2024).

1.7 Research Gap

The distinction between formal and informal transportation modes, while once clearly defined, has become increasingly blurred over time due to evolving transportation trends, legal frameworks, and organizational structures. Data and classifications from Portes, Castells, and Benton (1989) (Table. 1) are now considered outdated, as many of the characteristics that once separated formal from informal modes, such as registration status, fare structures, or regulatory oversight, and technologies, have significantly changed. For example, ride-hailing apps like Grab or Gojek have transformed traditional informal services like motorbike taxis into more structured, semi-formalized operations, often with licensing and digital payment systems. These changes make it difficult to apply older comparison matrices to today's urban mobility contexts, as the boundaries between formal and informal modes continue to shift and overlap in dynamic ways.

Table 1. Portes, A., Castells, M. & Benton, L. (eds.), 1989, Difference between formal and informal transportation.

Dimension	Formal transport system	Informal transport system
Service structure	Fixed route, standardised	Variable route, adaptive
Scheduling	Fixed timetable	Market-driven, adaptive
Reliability	Reasonably dependable	Inconsistent
Economic standing	Middle and upper classes	Lower class, poor
Legitimacy	Legal, regulated	Illegal, unregulated
Assets and capitalisation	Intensive	Minimal
Political influence	Strong, empowered	Weak
Society and culture	Modern	Traditional
Financing	Commercial banks	Family and loan sharks
Skill levels	Knowledge based	Cognitive labour-based, adaptive
Technology	High-tech	Low-tech
Internal organisation	Orderly, vertically integrated	Less structured, horizontally integrated
Legal status	Registered	Registered, Unregistered

Analyzing transportation systems often becomes complex due to the presence of semi-formal services, which blend characteristics of both formal and informal aspects(Table 2). These hybrid systems may operate with some level of regulation or government tolerance but lack full integration into formal planning structures. When information on mobility is presented without distinguishing clearly between formal, informal, and semi-informal categories, it can lead to misleading conclusions. Treating semi-formal modes as purely informal can obscure important differences in quality, coverage, and accountability. Therefore, it is crucial to categorize transportation data accurately to understand urban mobility systems effectively and to design policies that reflect the reality on the ground.

Table 2. Formal and Informal Public Transport Characteristics according to Permana et al. (2018).

Aspect	Formal public transport	Semi-formal and informal public transport
Service delivery	Designated, fixed, and personalized routes	Personalized routes, Adaptive
Schedule	Semi-fixed, passenger-driven	Flexible, passenger-driven
Reliability of service	Inconsistent to reliable, depending on the type	Inconsistent to semi-reliable
Vehicle capacity	4-seat to 500-seat passengers	2-seat passengers
Vehicle type	Motorized	Motorized and non-motorized
Ownership	Public and Private	Private, Individual
Market perspective	Monopolist(public), Entrepreneurial(private)	Entrepreneurial(private), individual
Labor	Semi-skilled	Semi- to non-skilled labor
Organization	Bureaucracy, route associations	Individual, social associations
User's social status	Lower to medium income	Low to medium income
Fare structure	Fixed, standardized	Variable, non-standardized

1.8 Research framework

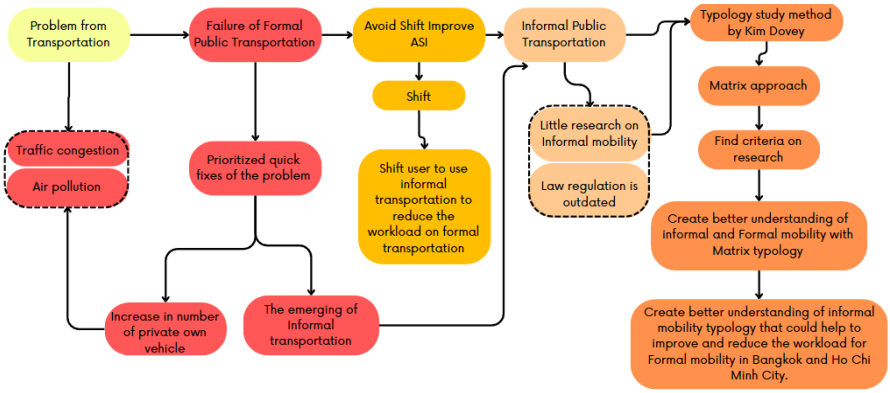


Figure 4. Research framework, Diagram by Author, 2025.

1.9 Research questions

This research asks: What are the key characteristics that distinguish formal and informal transportation systems, and where do they intersect or overlap?

In what ways do informal mobility characteristics differ and align from each other, and how can they stand out among themselves, considering cultural, spatial, and economic contexts?

How can a typological understanding of informal mobility contribute to the development of more inclusive and efficient urban transportation systems in Bangkok?

1.10 Research Aims

This research aims to explore the different types of formal and informal public transportation by identifying them based on their shared characteristics. By creating a systematic classification, the study seeks to better understand how these transport systems function, how they differ, and where they may overlap. This structured approach makes it easier to compare services, recognize patterns, and support better planning and policy-making for urban mobility, especially in areas where both formal and informal systems play important roles.

1.11 Research Objectives

i. Define Formal and Informal Transportation

This research aims to clearly define formal transport, regulated, structured, and government-supported, from informal transport, which operates without official oversight and includes flexible, community-based services like minibuses or motorcycle taxis, while in contrast some informal transportation can be define as semi-formal that have official oversight while retain the positive trait from informal transport traits.

ii. Classifying Informal Transportation

To better explain informal transport, the study sets classification criteria such as vehicle type, level of regulation, service structure, and route flexibility. This helps identify the wide variety within informal systems.

iii. Creating a Classification Matrix

A typology matrix will be developed to organize and compare informal transport types. This tool helps visualize patterns and gaps, improving understanding and integration into broader mobility planning.

1.12 Research flow

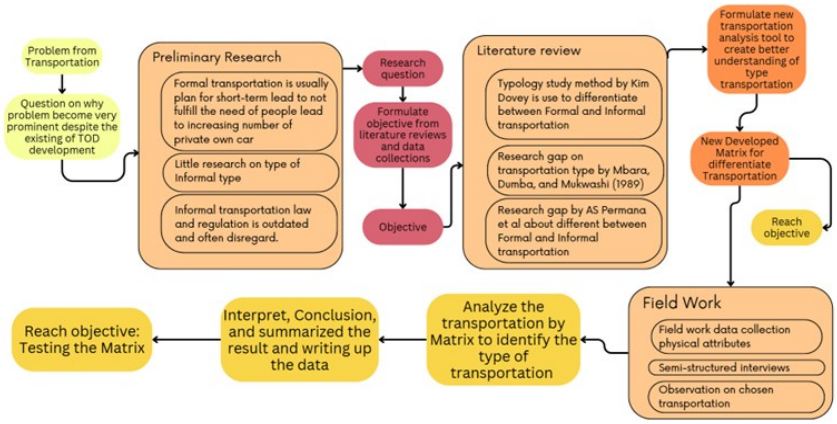


Figure 5. Research flow, Diagram by Author, 2025.

2. Research Method

In order to answer the question about what the difference is between informal and formal transportation and how understanding informal mobility will contribute to the development, this research will look at informal mobility types, specifically Motorcycle Taxis. As a pilot study, Thammasat University campuses in Thailand were chosen to be studied due to high usage of motorcycle taxis with diverse customer and driver types.

2.1 Observation

In this research, observations were guided by a predefined matrix and set of criteria, categorized according to physical, economic, and legal aspects, including factors such as ride frequency, wait times, and adherence to safety measures. Passive observation can facilitate the discovery of new matrix topics, enabling improvements to the matrix table for future studies and the identification of topics that may not emerge through interviews. The data was collected by observing activity around transportation stations at Thammasat University in various surroundings, providing clear insights into how different types of transport operate in the university in the peri-urban context.

2.2 Interviews & Focus Groups

As part of the research, interviews and focus groups were conducted to gather deeper insights into informal transportation based on the matrix criteria. In Thailand, interviews with both local residents and drivers helped uncover practical details about how informal transport operates and provided valuable data for refining the classification system. The interview questionnaire included questions about demographics (age, gender, occupation, etc), for motorcycle taxi drivers, questions related to hours of work, places, for customers, as well as other relevant topics.

2.2.1 Interview questions

In this interview, demographic questions such as age, gender, occupation, and experience with motorcycle taxis provide important context for understanding the perspectives and behaviors of respondents.

This set of interviews for Motorcycle taxi questions aims to capture a comprehensive view of the daily experiences and working conditions of motorcycle taxi drivers.

The customer interview questions aim to understand customer behavior and perceptions toward motorcycle taxi services. Asking how often they use the service and how far they typically travel helps reveal usage patterns and demand.

Lastly, the general perception questions explore broader opinions on the role of motorcycle taxi services in urban mobility. Asking whether they contribute to urban transport, suggestions for improvements, whether someone would recommend the service, and questions about regulation or management by local authorities

2.3 Matrix and criteria

The research develops and employs a matrix-based (Fig. 6) based on criteria identified(Table 03) through literature review to classify different types of transportation, which will be revised based on discoveries from interviews and observations. In Thailand, the matrix was specifically developed and tailored to the local context, allowing for a more accurate analysis of informal and formal transport systems. This cross-application made it easier to compare transportation types between the motorcycle taxi sub-category and identify similarities and differences in their mobility systems.

2.4 Typology study method

In developing a research method to study transportation typologies, a method of categorization by Kim Dovey for informal settlement typologies will be introduced (Dovey, 2011). Dovey's study of informal settlements primarily looks at their main physical features, or morphological characteristics, which are closely linked to the local context in which they develop. In this research, the idea of a "type" is not used as a strict label, but as a flexible way to understand the variety and similarities among different settlement patterns (Dovey, 2011). This approach allows for a better understanding of how informal areas grow and change. It also helps when applying this knowledge to develop a matrix for transportation typology research, where different types can be linked to specific mobility patterns and transportation needs.

2.5 Research design: Criteria identification

i. Criteria: Dimensions and Definitions

Table 03. Criteria: Dimensions and Definitions.

Service structure	Ease of accessibility and flexibility for passengers
Reliability	Consistency in service delivery across different times and locations
Scheduling	Frequency of service during peak and off-peak hours
Economic support	Dependence on subsidies or external funding sources
Legitimacy	Reputation and the historical performance of service providers
Assets and Capitalization	Ownership structure (publicly owned, privately operated, or hybrid)
Political influence	Role of transportation in policy-making and urban planning
Society and culture	Cultural acceptance and usage of different transportation modes
Financing and Credit Access	Availability of financial support for operators and infrastructure projects
Skill levels	The level of specialization required knowledge or labor-based
Technology	Adoption of digital tools (e.g., GPS, booking apps, payment systems)

Internal organization	Degree of formal organization among service providers
Legal status	Registered/Non-registered
Route	Flexibility of routes to accommodate passenger demand
Average distance	Average trip length served by the mode
Travel radius	Geographical scope of operations (urban, suburban, rural)
Station	Availability of designated or informal boarding and alighting points
Prices	Variability of fares based on distance, demand, or time of day
Affordability	Suitability of fares for low-income passengers
Safety	Frequency of accidents or safety incidents
Driver behavior	Showed courteousness and professionalism toward passengers

ii. Typology matrix and How to distinguish between the formal and informal transportation

Scale of relationship: Low ○ Medium ◒ High ●

Criteria (Physical)	Regulated	Not Regulated	Maintain	Flexible	Short (400m to 800m)	Long (800 to 1Km.)
Service structure						
Route						
Average distance						
Further Radius						
Stations						
Reliability						
Scheduling						

Criteria (Economic)	Regulated	Not regulated	Flexible	Government	Private	Independence
Economic support						
Internal organisation/Investment						
Financing and creadit access						
Society and culture						
Prices						
Affordability						
Assets and capitalisation						

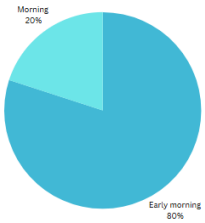
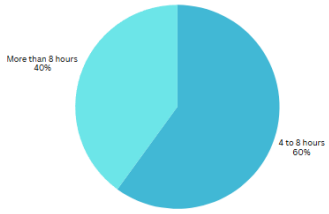
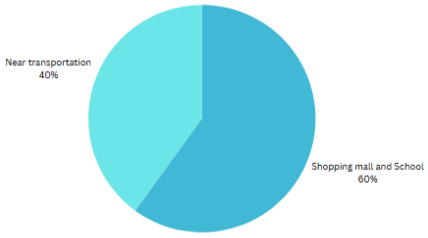
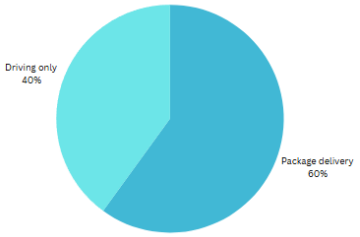
Criteria (Legal)	Regulated	Not regulated	Flexible	Required	Not required	Influenced	Non-Influenced	Rare	Common
Safety									
Driver behavior									
Legitimacy									
Political influence									
Legal status									
Skill levels									
Technology									

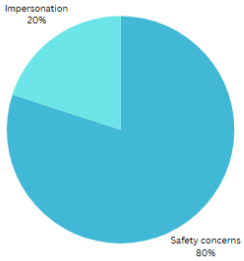
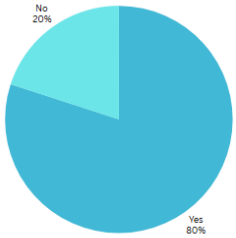
Aspect	Formal Public Transport	Informal Public Transport	Semi-formal
Service Delivery	Designated, fixed and personalized routes	Personalized routes, adaptive	Personalized routes, adaptive
Schedule	Fixed	Flexible, passenger-driven	Flexible, passenger-driven
Reliability of service	Consistent but heavily depending on the type and the time	Inconsistent to semi-reliable	Somewhat consistent to semi-reliable
Vehicle Capacity	4-seat to 500-seat passengers	2-8 seat passengers	2-30 seat passengers
Vehicle Type	Public access vehicle with constant maintenance	Modified vehicle, Non-registered vehicle	The company provided vehicle, Registered vehicle
Ownership	Public and Private	Mainly Individual	Private company, individual
Market Perspective	Monopolist (public), Entrepreneurial (private)	Mostly Individual, Entrepreneurial	Entrepreneurial, individual
Labor	Required Qualification	Semi- to non-skilled labor	Qualified labor and Semi-skilled Labor
Organization	Bureaucracy, route associations	Individual, social associations	Company associations, Social associations
User's social status	Low to medium income and medium to high income depend on type	Low to medium income	Low to medium income
Fare structure	Fixed, standardized	Variable, non-standardized, Driver decision	Variable, non-standardized

Figure 6. Typology matrix based on physical, economic, and legal Criteria classification to identify the type of transportation.

3. Findings
3.1 Interview results
3.1.1. Motorcycle Taxi driver (Sample size 5)

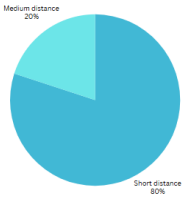
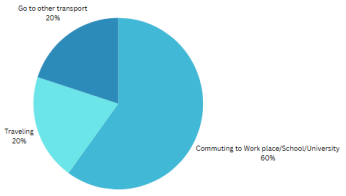
Table 04. Motorcycle taxi interview results in Thailand.

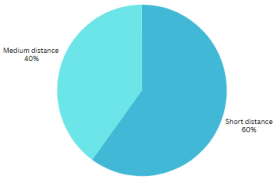
What time do they start working	Early morning (5 AM to 6 AM) (80% of responses) 
How many hours do you usually work per day?	4 to 8 hours (60% of responses) 
Is there any specific place you tend to work around	Shopping mall, School (60% of responses) 
Besides motorcycle taxi do you have other work using motorbike, please specify	Package delivery (60% of responses) Driving only (40% of responses) 
How far do you go when you drive Motorcycle taxi	Medium distance (1 - 2km) (100% of responses) (Short >1 km, Long < 2km)
What is your primary method of finding customers?	Standing at designated stations (100% of responses)
What are the main problems you face as a motorcycle taxi driver?	Safety concerns (80% of responses)

	
Do you find working with your company/app hard to work with	Yes, sometimes it takes a long time for the authority to respond (80% of responses) 
Do you think motorcycle taxi services help contribute to urban mobility	Yes (100% of responses)
What improvements would you suggest for motorcycle taxi services?	Try to enforce the rule to reduce the impersonation of motorcycle taxi driver
Would you recommend motorcycle taxi services to others?	Yes, It can be use with all age and it is cheap and convenient
Why or why not? Do you think the use of motorcycle taxis should be better regulated or managed by local authorities?	Yes, Authority should have moderate control but allow some to have flexibility

3.1.4 Customer (Sample size 5)

Table 05. Customer interview results in Thailand.

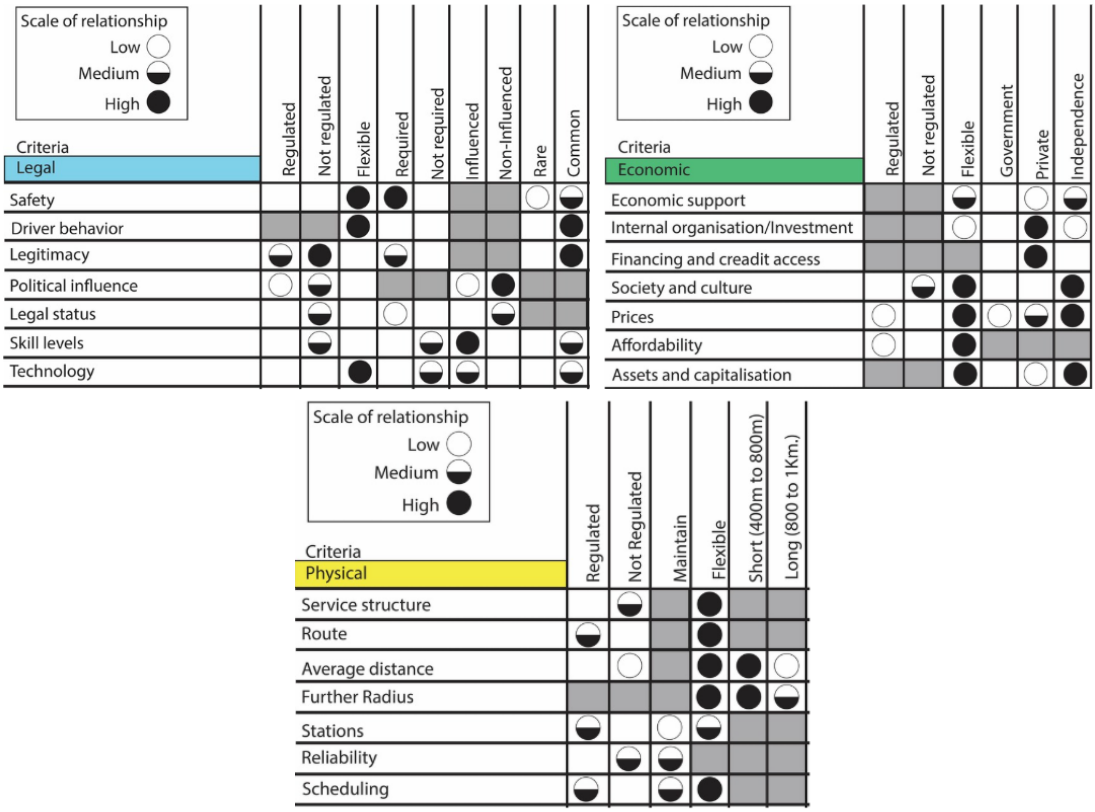
How often do you use motorcycle taxi services?	A few times per week (100% of responses)
How far do you go when you a Motorcycle taxi	Short distance (Under 1 km) (80% of responses) (Medium 1 - 2 km, Long < 2km) 
What is the main purpose you use motorcycle taxi ?	Commuting to workplace/School/University (60% of responses) 

What is the main advantage when you choose a motorcycle taxi?	Price, Convenience (100% of responses)
What is your overall experience with motorcycle taxis in terms of safety?	Neutral (100% of responses)
What are the main problems you have encountered when using motorcycle taxi services?	Safety concerns (80% of responses) 
Do you think motorcycle taxi services help contribute to urban mobility	Yes (100% of responses)
What improvements would you suggest for motorcycle taxi services?	Enforce the safety of motorcycle taxi to prevent the accidents
Would you recommend motorcycle taxi services to others?	Yes, It can be cheap, convenient and they are everywhere for quick travel
Why or why not? Do you think the use of motorcycle taxis should be better regulated or managed by local authorities?	Not sure (100% of responses)

3.2 Applying the Criteria Matrix

Informal transportation: Motorcycle Taxi - Thailand

How to distinguish between the formal and informal transportation - Thailand



Aspect	Formal Public Transport	Informal Public Transport	Semi-formal
Service Delivery	Designated, fixed and personalized routes	Personalized routes, adaptive	Personalized routes, adaptive
Schedule	Fixed	Flexible, passenger-driven	Flexible, passenger-driven
Reliability of service	Consistent but heavily depending on the type and the time	Inconsistent to semi-reliable	Somewhat consistent to semi-reliable
Vehicle Capacity	4-seat to 500-seat passengers	2-8 seat passengers	2-30 seat passengers
Vehicle Type	Public access vehicle with constant maintenance	Modified vehicle, Non-registered vehicle	The company provided vehicle, Registered vehicle
Ownership	Public and Private	Mainly Individual	Private company, individual
Market Perspective	Monopolist (public), Entrepreneurial (private)	Mostly Individual, Entrepreneurial	Entrepreneurial, individual
Labor	Required Qualification	Semi- to non-skilled labor	Qualified labor and Semi-skilled Labor
Organization	Bureaucracy, route associations	Individual, social associations	Company associations, Social associations
User's social status	Low to medium income and medium to high income depend on type	Low to medium income	Low to medium income
Fare structure	Fixed, standardized	Variable, non-standardized, Driver decision	Variable, non-standardized

Figure 7. Matrix result for Motorcycle taxi in Thailand.

3.3 Presentation of Key Findings

One major outcome of this study in Thailand was the identification of three dominant types: community-based services, transit-connecting services, and freelance drivers. Community-based services typically operate within defined residential areas, offering short-distance rides and fostering close relationships between drivers and residents. Motorcycle taxis, often stationed near BTS or MRT stations, serve as first- and last-mile connectors, and are integrated to address shortcomings in the city's mobility systems, including critical gaps with the formal public transport system.(ASEAN,202) Meanwhile, freelance drivers are more flexible and opportunistic, often found roaming around commercial districts or responding to app-based ride requests.

4. Discussion

4.1 Interpretation of Key Findings

The matrix analysis led to key findings regarding motorcycle taxi operations, with the following notable points identified.

i. Safety

Safety remains a significant concern in the operation of motorcycle taxis in Thailand. Many drivers fail to provide helmets for their passengers, thereby increasing the risk of serious injury in the event of an accident. This lack of basic safety equipment underscores a broader issue regarding the enforcement of safety standards.

ii. Legitimacy

Motorcycle taxi drivers in Thailand are required to wear official uniforms as a visual marker of their accreditation and legitimacy. However, these uniforms are relatively easy to acquire, making it possible for unlicensed individuals to pose as authorized drivers. This loophole not only undermines the regulatory framework intended to protect passengers but also raises concerns about accountability and service quality.

iii. Operational Structure

Motorcycle taxis in Thailand typically operate from designated stations, which serve as pickup and drop-off points. These stations are used by both officially recognized Win drivers and other independent riders. While this shared system allows for a flexible and responsive transportation option, it can also lead to confusion regarding driver legitimacy and fare consistency.

iv. Travel Distance
The average travel distance for motorcycle taxi rides in Thailand is relatively short, generally covering no more than two kilometers. This limited range reflects the service's role in navigating densely populated urban areas where longer trips may be impractical due to traffic congestion. Short distances also make motorcycle taxis a convenient choice for quick, point-to-point travel within neighborhoods or between transit hubs.

v. Transportation Role
Motorcycle taxis are commonly regarded as a secondary mode of transportation in Thailand, primarily serving as a last-mile solution. They help bridge the gap between passengers' homes or workplaces and formal public transit systems such as buses and trains. By providing this critical link, motorcycle taxis enhance the overall accessibility and efficiency of the transportation network, especially in areas where larger vehicles cannot easily operate.

vi. Driver behavior
Motorcycle taxi drivers operate under traffic laws and regulations, but these rules are often inconsistently followed. Common violations include exceeding speed limits, driving in the opposite direction of traffic, riding on pedestrian walkways, and ignoring traffic signals. While regulations are in place, enforcement is often lax, leading to certain rules being disregarded more frequently than others. These behaviors are partly influenced by the need to navigate congested streets quickly and respond to passenger demand, but they also reflect gaps in law enforcement and road safety culture.

vii. Service structure
Thailand faces significant challenges in its ride-hailing service structures, particularly during rush hours. Customers often struggle to find available drivers, as there are not enough drivers accepting ride requests during peak times on both the station-based and Ride-hailing apps. This driver shortage leads to increased wait times and customer highlighting a need for better driver supply management and incentive systems to meet high-demand periods.

5.0 Conclusions

5.1 Summary of Key Findings

In conclusion, this study underscores the vital role informal public transportation plays in Bangkok's urban mobility, particularly in areas where formal transit falls short. Modes like motorcycle taxis, tuk-tuks, and shared vans not only provide accessible and flexible transport options but also contribute significantly to the daily commute of many residents as the last-mile connection from people to formal transport. However, to enhance their effectiveness and ensure public safety, there is a pressing need for regulatory improvements. Prioritizing mandatory safety measures, such as helmet use for passengers, and implementing policies that promote legitimacy and improve in behaviors, like proper passenger identification, can help integrate these informal systems more seamlessly into the broader urban transport framework while protecting the rights and safety of all users.

5.2 Implications of the Findings

This research highlights the critical need to understand informal public transportation by applying the 3-I's Approach: Improve, Integrate, and Include.

Improve: Recognizing and analyzing informal mobility is essential to acknowledging its role within the broader urban transportation ecosystem. Doing so can lead to meaningful improvements in the overall transport system by addressing existing gaps and inefficiencies.

Integrate: Through proper classification and analysis, researchers and policymakers can develop more effective strategies to integrate informal transport into formal systems. This transformation can turn a previously overlooked mode of transit into a valuable asset that enhances the efficiency, accessibility, and resilience of urban mobility.

Include: Gaining a deeper understanding of the structure and operations of informal transport can foster more inclusive and sustainable urban transport policies. This not only ensures that the needs of all users are considered but also opens the door for more focused research into specific aspects of informal mobility.

In essence, the 3-I'sApproach of Improve, Integrate, and Include provides a strategic lens through which informal transportation can be studied, valued, and incorporated into the future of urban mobility planning.

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