

# RULES AND REGULATIONS FOR ENHANCING METRO RAIL ACCESSIBILITY IN A DEVELOPING COUNTRY

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## Abstract

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This study aims to investigate the variables affecting the accessibility of rail transit services for Bangkok and its surrounding residents and the problems in establishing a central clearing house (CCH) to develop rules and regulations for a common ticketing system in Thailand. This study employed mixed methodologies — a combination of quantitative and qualitative methodologies. For data analysis, binary logistic regression analysis and content analysis were employed. Currently, a relatively small fraction of commuters takes metro trains (Satranarakun & Kraiwanit, 2021). Access to rail transit services among users and all non-users is influenced by the number of transfers, city of residence, monthly transportation costs, monthly expenses, and use of Pinterest, WhatsApp, YouTube, Facebook, private vehicles, and motorcycle taxis. Access among users and potential non-users is influenced by using Pinterest, motorcycle taxis, and private vehicles. CCH should be administered by a government agency or an impartial organisation. Service providers should advertise and launch promotions via social networks and place emphasis on those with the potential to pay for transportation but not use the services. Metro rail systems should collaborate with community organisations and advocates to develop programs and initiatives that address the specific needs of vulnerable populations while also promoting universal access to public transportation. Overall, metro rail accessibility laws, rules, and regulations should prioritise affordability and accessibility for all individuals.

**Keywords:** Rail Transit Service, Mass Transit Service, Metro Train, Central Clearing House, Common Ticketing System, Rules, Regulations

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## 1. INTRODUCTION

Accessibility is one of the most essential transportation system outcomes. “Door-to-door mobility” may make public transit more appealing, and the expansion of transportation services is a crucial aspect of social equality. Designing and

assessing a transit system in terms of mobility and sustainability has placed a premium on the accessibility of public transport. Aside from the transportation system itself, the perceived accessibility of public transportation influences life satisfaction (Saif et al., 2019). Typically, accessibility is described as physical access to goods, services,

and locations (Jamei et al., 2021). Accessibility is described in terms of urban economics and geography as the facilitation of access to a certain region or place. It is one of the most significant transportation system outcomes (Mavoa et al., 2012). It evaluates a zone's or a region's locational advantage in comparison to other zones and places (Biosca et al., 2013). The primary objective of public transport accessibility evaluation is to improve connections between people and locations in order to reduce vehicle congestion. Basically, mobility by public transit affords the possibility of mitigating the unfavourable impacts of automobile usage on the environment and health (Yatskiv et al., 2017). By offering an efficient transportation system, a city's mobility may be enhanced. Therefore, the accessibility of public transport terminals, the connectedness of public transport modes, and system mobility should be addressed in order to establish a user-friendly public transportation system (Cheng & Chen, 2015).

In 2019, the National Statistical Office of Thailand reported that 10.9 million people resided in the Bangkok Metropolitan Region, an area that includes Bangkok and the five adjacent provinces of Nakhon Pathom, Pathum Thani, Nonthaburi, Samut Prakan, and Samut Sakhon (National Statistical Office [NSO], 2021). According to the Office of Transport and Traffic Policy and Planning, Ministry of Transport of Thailand (2017), the Bangkok Metropolitan Region recorded 32.65 million journeys per day in 2017. The majority of trips, 54.2%, were inside Bangkok, followed by trips between Samut Prakan and Bangkok and Nonthaburi and Bangkok, which accounted for 2.40% and 2.05%, respectively. Only 20.2% of individuals in the Bangkok Metropolitan Region used public transportation, and 3.33% of passengers took electrified trains, which at that time included the Bangkok Mass Transit System (BTS Skytrain or BTS), the Metropolitan Rapid Transit (MRTT), and the Airport Rail Link (ARL). However, in 2018, the percentage of passengers using public transportation declined to 17.90%, while the percentage of passengers using electrified trains rose to 3.8% (Office of Transport and Traffic Policy and Planning, Ministry of Transport of Thailand, 2018). Compared to individuals who drive their own automobiles, the number of people who take rail transportation services is still relatively low. Numerous variables impact public usage of the mass transit system, including the system's incompleteness in many places, the high cost of tickets, and the unpredictability of public transportation timetables (Satranarakun & Kraiwanit, 2021).

Because a lack of access to public transportation can contribute to social exclusion, transportation and land use policies prioritise accessibility and attempt to enable citizens to reach their destinations at acceptable costs and in reasonable lengths of time (Hawas et al., 2016). Therefore, providing accessible public transportation is one of the key objectives of policymakers and planners in metropolitan locations worldwide (Saghapour et al., 2016). This study aims to investigate the variables affecting the accessibility of rail transit services for Bangkok and its surrounding residents and the problems in establishing a central clearing house (CCH) to develop rules and regulations for a common

ticketing system in Thailand. The study included quantitative and qualitative approaches. The quantitative approach of binary logistic regression analysis was performed to examine factors influencing the accessibility of rail transit services. The qualitative approach of in-depth interviews was used to investigate the existing circumstances and issues associated with operating a CCH in Thailand, as well as the effects of a single ticketing system on increasing passenger numbers. In this study, access to rail transportation services is determined by whether or not the services are used. The findings are divided into three parts. The first and second parts explore the factors influencing access, while the third part is a summary of an in-depth interview. In the first part, we compared users' and non-users' access to rail transit services. The best predictive model showed that the number of transfers, city of residence, monthly transportation costs, monthly expenses, and the use of Pinterest, WhatsApp, YouTube, Facebook, private vehicles, buses, and motorcycle taxis are all significant factors that affect access to rail transit services. In the second part, users and non-users with potential access to rail transit services were compared. The best predictive model indicated that the use of Pinterest, motorcycle taxis, and private vehicles are all significant factors that impact access to rail transit services. In the last part, it is indicated that there are two major obstacles to establishing a CCH in Thailand: the overlapping of roles and interests among several key organisations and the absence of laws and regulations to monitor, manage, and administer autonomous revenue collection in the transportation sector. According to the opinions of key interviewees, the CCH should be operated by a government agency or an impartial organisation, and if the functions of a ticket are appealing, a common ticketing system might increase the number of rail transport users.

To explain the framework of the study, the paper is separated into six sections. Section 1 is an introduction. Section 2 is a literature review. Section 3 describes research methodologies. Section 4 and Section 5 present the study's findings and discussions, respectively. Section 6 contains the study's conclusion, including its limits, its implications, and recommendations for further research. The research findings may be adopted by policymakers and rail transport operators as a reference for enhancing service quality and expanding service accessibility. Thus, more individuals may access public transportation, relieving traffic congestion and reducing pollution caused by an excessive number of private vehicles.

## 2. LITERATURE REVIEW

Understanding the regularity and patterns of passenger mobility is essential for public sector urban and transportation planning. Travel behaviour refers to the complicated decisions travellers make about means of transportation, routes, departure times, and final destinations. These processes are controlled by urban spatial patterns, land use, and street networks, among other variables (Qi et al., 2019). According to Liu and Xu (2018), lifestyle changes have resulted in major alterations in travel behaviour over the past two decades, and these

trends are anticipated to continue. Consequently, urban transportation systems must be modified to improve urban mobility, the environment, the economy, and society. According to the Office of Transport and Traffic Strategy and Planning, Ministry of Transport of Thailand (2018), the number of private automobiles is significantly more than the proportion of public transportation users. This may be due to the lack of accessibility to public transportation. According to the European Commission (n.d.), automobile ownership is vital for a lot of citizens since it imparts prestige and fosters a sense of autonomy. Long-distance travel is impossible without a car since there is no public transit in rural places. Driving is usually the only independent mobility option for elderly folk who have more difficulties walking (to the bus stop) and cycling. People's decisions to choose private automobiles or public transit are influenced by a number of variables. Numerous studies have demonstrated that socio-demographic characteristics impact transportation mode selection. Age, for instance, might affect a person's propensity to travel, and health issues can have a substantial impact on travel decisions (Zajickova et al., 2014). According to Li et al. (2018), gender and automobile ownership have affected China's transportation mode preferences. A variety of economic circumstances also have an impact. To encourage greater use of public transportation, it is vital to comprehend local travel patterns. Numerous studies have examined options for forms of public transportation. Factors such as quality, comfort, safety, and dependability encourage the growing usage of public transportation.

Given that door-to-door vehicles typically meet people's needs better than public transport due to their superior speed, convenience, and dependability, and the enhanced sense of freedom and standard of living they provide, the success of a shift from household vehicles to public transport is predicated primarily on the satisfaction of regular and potential passengers. Accessible public transport stops, service frequency, vehicle fleet modernization, on-time performance, and trip duration are characteristics of high-quality public transport services (Burian et al., 2018). The lengthy journey times connected with public transit are one of the key reasons why many commuters prefer driving their own cars to work every day. According to Al Doori (2017), the waiting time has a substantial impact on the selection of modes of transportation. In this study, passengers were more likely to switch to public transportation if the wait time was shorter than 10 minutes. In addition, the accessibility, convenience, and service environment of public transportation are strongly connected with mode selection (Witchayaphong et al., 2020). Many individuals are unable to use Bangkok's mass transit systems, and commuters may be reluctant to use public transportation as a result (Charoentrakulpeeti et al., 2006). According to Witchayaphong et al. (2020), for Thailand to transition to a broad use of public transportation, planners must implement effective management techniques to lower the number of private automobiles on the road. The choice of travel mode is influenced by people's behaviours and lifestyles, which provide diverse and complex travel requirements. Therefore, planners'

efforts should focus on influencing passengers' behaviour and determining what encourages them to take public transportation.

### 3. RESEARCH METHODOLOGY

This study employed mixed methodologies, a combination of quantitative and qualitative methodologies. According to Chalabang (2017), mixed-method research is a pragmatic, philosophy-influenced research approach. It incorporates both quantitative and qualitative research methods to analyse extensive, in-depth, and clear research results to comprehend the topic under investigation.

#### 3.1. Quantitative method

Since rail transit services are currently only available in the Bangkok Metropolitan Region, which comprises Bangkok and the five adjacent provinces of Nakhon Pathom, Pathum Thani, Nonthaburi, Samut Prakan, and Samut Sakhon, the population of this study consists of Thai commuters who reside in the Bangkok Metropolitan Region and typically travel within it. According to Obilor (2023), convenience sampling is a technique in which a sample is drawn from the population that is close to hand, easily accessible, or convenient. Convenience sampling is a non-probability sampling technique used by researchers in which data is collected from a readily available and easily accessible pool of respondents. The selection of the 815 samples was based on convenience sampling, as recommended by Kraiwanit (2021). The sample size is adequate to provide extremely accurate and precise results and can decrease abnormal data distribution. The data were collected via a Google Forms-created online survey that was distributed across many online networks. The questionnaire items were developed based on reliable and valid research data, and the questionnaire was pre-tested on 30 respondents to obtain a dedicated questionnaire, as recommended by Sitthipon et al. (2022) and Limna et al. (2023). The data were further analysed using descriptive statistics and binary logistic regression analysis. The access of Thai commuters to rail transportation services within the Bangkok Metropolitan Region is the dependent variable. This is indicated by the use of metro train services, including the Bangkok Mass Transit System (BTS Skytrain or BTS), the Metropolitan Rapid Transit (MRT), the Airport Rail Link (ARL), and the Red Line Commuter Train System (Red Line). Those who use the services are deemed able to access them (scoring 1 = use the services), whilst those who do not use the services are deemed unable to access them (scoring 0 = do not use the services). Independent variables are 1) demographic factors (gender, occupation, age, education level, monthly income, monthly savings, number of transfers from home to a destination, number of household members, type of house, city of residence, monthly transport expense, monthly expense); 2) a frequently used social media platform (Instagram: IG, LINE, Pinterest, WhatsApp, YouTube, Podcast, Blogger, and Facebook); and 3) transportation modes (motorcycle taxi, private vehicle, bus, taxi, and truck taxi).

The quantitative data was analysed using binary logistic regression. Classification using binary

logistic regression utilises one or more continuous or categorical predictor factors to predict the target variable classes (Patel, 2021). However, if the dependent variable includes more than two categories and these categories can be ordered in a sensible or logical manner, organised logistic regression can be employed in the future (Rasca & Saeed, 2022).

### 3.2. Qualitative method

Qualitative research aims to investigate every context in which people or groups make decisions and act, as well as to explain why that particular observed phenomenon occurred in that way (Limna & Kraivanit, 2022). Furthermore, in-depth interviews provide detailed answers on a specific topic, resulting in accurate information to meet the research objectives (Siripipatthanakul et al., 2022a; Sonsuphap, 2022). An in-depth interview was conducted to investigate three issues:

1) What are the current circumstances and challenges to operating a CCH in Thailand?

2) Which organisation should administer the CCH in Thailand?

3) How will the common ticketing system increase passenger numbers?

The key informants are six experts in mass transit systems and services: 1) the chief executive of a rail consultant engineering firm; 2) an officer of the Office of Railway Project Management, State Railway of Thailand; 3) a lecturer from the Faculty of Engineering; 4) a specialist in metro train systems and high-speed trains; 5) an officer from the Fare Media Business Department, Mass Rapid Transit Authority of Thailand; and 6) an officer from the Office of Common Ticketing System Management, the Office of Transport and Traffic Policy and Planning. The CCH, a mechanism used for electronic financial transactions, operates as an intermediary to facilitate transactions and classify them according to their respective service provider (Bloomenthal, 2020). As a standard system, a CCH is necessary for all businesses. Not only is it practical, but it can also support very huge sums of money and improve safety and dependability (EFKON, n.d.). A CCH is the last component of an automated fare collection system (AFC) and electronic data capturing (EDC). It collects information from all levels and organises it according to the service provider. The current Thai service providers in the CCH network include Rabbit Card, Rabbit Line Pay, Mangmoom, and the banks. Retail firms (Rabbit Reader) and transportation services (EDC and AFC) are the two largest users of the CCH system in the country currently (BPS, n.d.). The successful CCH will promote the seamless operation of the common ticketing system and result in a great experience for mass transit passengers; subsequently, this may attract new users to rail transit services and increase their accessibility (Office of Transport and Traffic Policy and Planning, Ministry of Transport, 2020).

Qualitative content analysis typically begins with the systematic transformation of a large amount of text into a concise summary of key findings (Siripipatthanakul et al., 2022b). This method is used to explain and quantify specific phenomena comprehensively and objectively

through valid inferences derived from verbal, visual, or written data; it is known as content analysis (Viphanphong et al., 2023). Therefore, content analysis was employed to analyse the qualitative data in this study.

## 4. RESULTS

In this study, the access to rail transport services, the dependent variable, is represented by the use of Bangkok's metro train network, which includes the BTS, MRT, ARL, and Red Line trains. Respondents who use the services are classified as having access to these services, while those who do not use the services are classified as lacking access. When examining the monthly transportation costs of the group using rail transit services or those who have access to the services, the mean is THB 2,282.60. Consequently, it was initially expected that individuals who can use the rail transit services will have the ability to spend more than THB 2,282.60 per month on transportation, whereas others who cannot access the rail transit services will likely spend less than THB 2,282.60 per month on transportation. However, the average monthly transportation costs for the second group are THB 3,013.59, compared to THB 2,282.60 for the first group. Consequently, this group was investigated in further detail, and the results revealed that those classified as being unable to use the services may be separated into two groups. The first category consists of those who have the ability to spend at least THB 2,282.60 per month on transportation costs but do not use the services. In other words, this group has the capacity to utilise the metro rail services but they choose not to do so for reasons unrelated to finances. Consequently, this group is designated as "potential". Another category consists of people who spend less than THB 2,282.60 per month on transportation. This indicates that this group has no potential to spend on mass transit services, hence they are unable to use them; consequently, they have been labelled a "non-potential" group or a group that lacks access.

The access to rail transit services in this study is summarised in Table 1 based on the use of the services and monthly transportation expenses of each respondent group. The access may be split into the following four groups:

Group A: those that use or are able to access rail transit services.

Group B: non-users, comprising Groups C and D.

Group C: those who have the ability to pay for the services but do not do so.

Group D: those who are unable to pay for the services and do not use them.

**Table 1.** The access to rail transit services based on the use of the services and monthly transport expense

<i>The uses of rail transit services</i>	<i>n</i>	<i>%</i>	<i>Means of monthly transport expenses (THB/month)</i>
Use (Group A)	467	57.3	2,282.60
Do not use (Group B):	348	42.7	3,013.59
Potential group (Group C)	142	17.43	3,837.32
Non-potential group (Group D)	206	25.27	2,189.86

According to Table 1, 57.3% of people use rail transit services (Group A), which is defined as having access to the services, whereas 42.7% of people do not use rail transit services (Group B), which is defined as having no access to rail transit services. Group A's average transportation expenditures are THB 2,282.60, while Group B's are THB 3,013.59. Group B can be subdivided into the potential group (Group C) and the non-potential group (Group D). Group C consists of individuals who have the ability to spend at least THB 2,282.60 per month on transportation costs; nevertheless, they do not use rail transit services. This group represents 17.43% of the population and spends an average of THB 3,837.32 per month on transportation. Group D consists of those who spend less than THB 2,282.60 per month on transportation costs and who do not use rail transit services. This group accounts for 25.27% of the population and spends an average of THB 2,189.86 per month on transportation.

In this study, researchers are interested in comparing two pairs of sample groups:

1) those who use rail transportation services (Group A, n = 467) to all those who do not use the services (Group B, n = 348); hence, the sample size in this group totals 815;

2) rail transit users (Group A, n = 467) and non-users with potentiality (Group C, n = 142); hence, the total number of samples in this group is 609.

**4.1. Comparing Group A to Group B: Users vs. all non-users**

Dependent variables (rail transit users and all non-users) were tested against each group of independent variables (demographic factors, a frequently used social media platform, and

transportation modes) and the best models from each group are shown below.

When running demographic variables, the model that uses only significant demographic factors shows the highest percentage accuracy. This is called Model 1. Table 2 shows the contribution of each significant demographic factor to Model 1 and its statistical significance. The model can be described by the following equation:

$$P = \frac{1}{1 + e^{-z}} \tag{1}$$

where, *P* is the probability of access to rail transport services, and

*Model 1*

$$Z = -1.854 + 0.893(X_1) + 0.052(X_3) + 0.787(X_7) - 0.307(X_8) + 0.512(X_{10}) \tag{2}$$

This means that the odds of males accessing rail transport services are 1.62 times higher than those of females. For every 1-unit increase in age, the access to rail transport services will increase by 1.012 times. For every 1-unit increase in the number of transfers, the access to rail transport services will increase by 2.600 times. For every 1-unit increase in the number of household members, the access to rail transport services will decrease by 29.2% (1 - 0.708 = 0.292). The rate of access to rail transport services for people residing in Bangkok is 1.767 times higher than that of those living in other cities. To test how well Model 1 is able to predict the correct category once the demographic variables in Table 2 are added to the study, a classification table was used. The results show that the model correctly classified 72.0% of cases overall at the cut value of 0.500. The specificity for this model is 67.5% and the sensitivity for the model is 75.4%.

**Table 2.** Demographic variables in Model 1

<i>Demographic factors</i>		<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>df</i>	<i>Sig.</i>	<i>Exp(B)</i>
Step 1 <sup>a</sup>	Gender ( <i>X</i> <sub>1</sub> )	0.483	0.196	6.099	1	0.014	1.621
	Age ( <i>X</i> <sub>2</sub> )	0.012	0.010	1.469	1	0.226	1.012
	Number of transfers ( <i>X</i> <sub>3</sub> )	0.955	0.107	79.953	1	0.000	2.600
	Number of household members ( <i>X</i> <sub>4</sub> )	-0.346	0.057	36.461	1	0.000	0.708
	City of residence ( <i>X</i> <sub>10</sub> )	0.569	0.162	12.276	1	0.000	1.767
	Constant	-1.134	0.344	10.847	1	0.001	0.322

Note: a. Variables entered in step 1: *X*<sub>1</sub>, *X*<sub>2</sub>, *X*<sub>3</sub>, *X*<sub>4</sub>, *X*<sub>8</sub>, *X*<sub>10</sub>

Focusing on a frequently used social media platform, the model that uses only significant variables related to a frequently used social media platform reveals the highest percentage accuracy. This is called Model 2. Table 3 shows

the relationship between the predictors (a frequently used social media platform) and the outcome (the access to rail transit services). The model can be described by Eq. (1):

*Model 2*

$$Z = 3.012 - 4.026(X_{13}) - 0.432(X_{14}) + 0.624(X_{15}) + 1.270(X_{16}) + 0.896(X_{17}) + 0.610(X_{20}) \tag{3}$$

This indicates that using IG will decrease access to rail transport services by 98.2% (1 - 0.018 = 0.982), while the use of LINE will decrease access by 35.1% (1 - 0.649 = 0.351). Using Pinterest and WhatsApp will increase access by 1.867 and 3.560 times, respectively. The use of

YouTube and Facebook will raise access to the services by 2.451 and 1.840 times, respectively. The results of the classification table show that Model 2 correctly classified 66.6% of cases overall at the cut value of 0.500. The specificity for this model is 48.6% and the sensitivity for the model is 80.1%.

**Table 3.** Variables related to a frequently used social media platform in Model 2

<i>Social media platform</i>		<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>df</i>	<i>Sig.</i>	<i>Exp(B)</i>
Step 1 <sup>a</sup>	IG ( $X_{13}$ )	-4.026	1.024	15.466	1	0.000	0.018
	Line ( $X_{14}$ )	-0.432	0.211	4.166	1	0.041	0.649
	Pinterest ( $X_{15}$ )	0.624	0.163	14.749	1	0.000	1.867
	WhatsApp ( $X_{16}$ )	1.270	0.243	27.347	1	0.000	3.560
	Youtube ( $X_{17}$ )	0.896	0.257	12.193	1	0.000	2.451
	Facebook ( $X_{18}$ )	0.610	0.170	12.811	1	0.000	1.840
	Constant	3.012	1.061	8.058	1	0.005	20.330

Note: a. Variables entered in step 1:  $X_{13}$ ,  $X_{14}$ ,  $X_{15}$ ,  $X_{16}$ ,  $X_{17}$ ,  $X_{18}$ .

When running transportation modes against the access to rail transit services, the model that uses only significant variables of transportation modes provides the highest percentage accuracy, which is Model 3. Table 4 shows the relationship

between the independent variables (transportation modes) and the dependent variable (access to rail transit services). The model can be described by Eq. (1):

*Model 3*

$$Z = 2.241 + 0.685(X_{21}) + 1.077(X_{22}) + 2.036(X_{23}) + 0.686(X_{24}) \tag{4}$$

This indicates that motorcycle taxi users boost access to rail transport services by 1.985 times, while private vehicle drivers raise the access by 2.935 times. Bus and taxi users increase access by 7.662 and 1.986, respectively. The results of

the classification table indicate that the rate of correct classification of Model 3 is 76.68% of cases overall at the cut value of 0.500. The specificity for this model is 70.4% and the sensitivity for the model is 80.1%.

**Table 4.** Variables related to transportation modes in Model 3

<i>Transportation modes</i>		<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>df</i>	<i>Sig.</i>	<i>Exp(B)</i>
Step 1 <sup>a</sup>	Motorcycle taxi ( $X_{21}$ )	0.685	0.206	11.123	1	0.001	1.985
	Private vehicles ( $X_{22}$ )	1.077	0.215	25.179	1	0.000	2.935
	Bus ( $X_{23}$ )	2.036	0.198	105.246	1	0.000	7.662
	Taxi ( $X_{24}$ )	0.686	0.194	12.548	1	0.000	1.986
	Constant	2.241	0.235	90.817	1	0.000	0.106

Note: a. Variables entered in step 1:  $X_{21}$ ,  $X_{22}$ ,  $X_{23}$ ,  $X_{24}$ .

When running all significant variables in all three groups of independent variables against the access to rail transit services, Model 4 provides the highest percentage accuracy. Table 5 shows

the relationship between the significant independent variables and the dependent variable. The model can be described by Eq. (1):

*Model 4*

$$Z = -28.924 + 0.401(X_7) + 0.436(X_{10}) - 1.610(X_{11}) + 1.224(X_{12}) + 0.810(X_{15}) + 0.630(X_{16}) + 0.930(X_{17}) + 0.608(X_{20}) + 0.564(X_{21}) + 1.438(X_{22}) + 1.570(X_{23}) \tag{5}$$

Focusing on demographic factors, when the number of transfers increases by 1 unit, the access to rail transport services will rise by 1.493 times, while those living in Bangkok have 1.547 times the chance of accessing rail transportation services. For every 1-unit increase in the monthly transport expense, the access to rail transport services will decline by 80% ( $1 - 0.200 = 0.8$ ). When the monthly expense increases by 1 unit, the access to rail transport services will increase by 2.248 times. Placing emphasis on a frequently used social media platform, using Pinterest will increase access by

2.248 times, while using WhatsApp will raise access by 1.877 times. The use of YouTube and Facebook will boost access to the services by 2.534 and 1.837 times, respectively. Focusing on modes of transportation, using motorcycle taxis and private vehicles will increase access to rail transport services by 1.757 and 4.213 times, respectively, while using buses will increase access by 4.808 times. At the cut value of 0.500, the classification table indicates that the rate of correct classification of Model 4 is 81.4% of cases overall. The specificity for this model is 80.5% and the sensitivity for the model is 82.0%.

**Table 5.** Variables in Model 4 (running all significant variables in three-group independent variables)

<i>Independent variables</i>		<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>df</i>	<i>Sig.</i>	<i>Exp(B)</i>
Step 1 <sup>a</sup>	Number of transfers ( $X_1$ )	0.401	0.141	8.109	1	0.004	1.493
	City of residence ( $X_{10}$ )	0.436	0.212	4.232	1	0.040	1.547
	Monthly transport expense ( $X_{11}$ )	-1.610	0.430	14.001	1	0.000	0.200
	Monthly expense ( $X_{12}$ )	1.224	0.246	24.799	1	0.000	3.400
	Pinterest ( $X_{13}$ )	0.810	0.231	12.309	1	0.000	2.248
	WhatsApp ( $X_{16}$ )	0.630	0.316	3.967	1	0.046	1.877
	YouTube ( $X_{17}$ )	0.930	0.360	6.677	1	0.010	2.534
	Facebook ( $X_{20}$ )	0.608	0.227	7.179	1	0.007	1.837
	Motorcycle taxi ( $X_{21}$ )	0.564	0.250	5.080	1	0.024	1.757
	Private vehicles ( $X_{22}$ )	1.438	0.286	25.289	1	0.000	4.213
Bus ( $X_{23}$ )	1.570	0.242	41.931	1	0.000	4.808	
Constant	-28.924	154.271	0.035	1	0.851	0.000	

Note: a. Variables entered in step 1:  $X_1, X_{10}, X_{11}, X_{12}, X_{13}, X_{16}, X_{17}, X_{20}, X_{21}, X_{22}, X_{23}$ .

**4.2. Comparing Group A to Group C: Users vs. non-users with potential**

Dependent variables (rail transit users and non-users with potential) were tested against three groups of independent variables and the best models with the highest percentage accuracy of each group are shown below.

*Model 5*

$$Z = -5.935 - 0.037(X_3) + 0.382(X_4) - 2.350(X_6) + 1.207(X_7) + 1.456(X_{10}) \tag{6}$$

This means the access to rail transport services will drop by 4.5% ( $1 - 0.964 = 0.045$ ) for every 1-unit increase in age. For every 1-unit increase in education level, the access will increase by 1.466 times. For every 1-unit increase in monthly savings, the access to rail transport services will decrease by 0.5% ( $1 - 0.095 = 0.005$ ). For every 1-unit increase in the number of transfers, the access to rail transport services will increase by 3.344 times. Those residing

Model 5, which runs only significant demographic factors, shows the highest percentage accuracy, and Table 6 shows the contribution of each significant factor to the model and its statistical significance. The model described by Eq. (1) is shown below:

in Bangkok are 4.290 times more likely to have access to rail transportation services than those residing in other cities. A classification table was used to determine how effectively Model 5 can predict the correct category if demographic factors in Table 6 are introduced to the analysis. At the threshold value of 0.500, the model successfully categorised 73.6% of cases overall. The specificity of this model is 67.6%, while its sensitivity is 78.4%.

**Table 6.** Demographic variables in Model 5

<i>Demographic factors</i>		<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>df</i>	<i>Sig.</i>	<i>Exp(B)</i>
Step 1 <sup>a</sup>	Age ( $X_3$ )	-0.037	0.013	8.449	1	0.004	0.964
	Education level ( $X_4$ )	0.382	0.091	17.617	1	0.000	1.466
	Monthly savings ( $X_6$ )	-2.350	0.627	14.058	1	0.000	0.095
	Number of transfers ( $X_7$ )	1.207	0.198	37.138	1	0.000	3.344
	City of residence ( $X_{10}$ )	1.456	0.315	21.367	1	0.000	4.290
	Constant	-5.935	1.510	15.442	1	0.000	0.003

Note: a. Variables entered in step 1:  $X_3, X_4, X_6, X_7, X_{10}, X_{12}$ .

Focusing on a frequently used social media platform, Model 6 is the model that includes just significant variables related to a frequently used social media platform and provides the best percentage of accuracy. The association between

the predictor (a frequently used social media platform) and the outcome (access to rail transit services) is depicted in Table 7. Eq. (1) explains the model:

*Model 6*

$$Z = 0.799 + 2.384(X_{13}) + 0.648(X_{14}) + 1.046(X_{15}) \tag{7}$$

This means that using IG increases access to rail transport services by 10.849 times while using LINE increases access by 1.913 times. The use of Pinterest increased access by 2.847 times.

The results of the classification table show that Model 6 correctly classified 68.9% of cases overall at the cut value of 0.500. The specificity for this model is 53.5%, and the sensitivity for the model is 81.3%.

**Table 7.** Variables related to a frequently used social media platform in Model 6

<i>Social media platform</i>		<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>df</i>	<i>Sig.</i>	<i>Exp(B)</i>
Step 1 <sup>a</sup>	IG ( $X_{13}$ )	2.384	0.576	17.116	1	0.000	10.849
	Line ( $X_{14}$ )	0.648	0.261	6.174	1	0.013	1.913
	Pinterest ( $X_{15}$ )	1.046	0.350	8.914	1	0.003	2.847
	Constant	0.799	0.272	8.663	1	0.003	2.224

Note: a. Variables entered in step 1:  $X_{13}$ ,  $X_{14}$ ,  $X_{15}$ .

When comparing modes of transportation to access to rail transit services, the model that employs just significant variables for modes of transportation (Model 7) delivers the best percentage

of accuracy. The link between the independent variables (transportation modes) and the dependent variable (access to rail transit services) is depicted in Table 8. Eq. (1) may be used to explain the model:

Model 7

$$Z = -2.504 + 2.056(X_{21}) + 1.391(X_{22}) + 1.067(X_{24}) \tag{8}$$

This indicates that motorcycle taxi users, private vehicle users, and taxi users raise access to rail transport services by 7.816, 4.019, and 2.906 times, respectively. The results of the

classification table indicate that the rate of correct classification for Model 7 is 74.8% of cases overall at the cut value of 0.500. The specificity for this model is 76.1%, and the sensitivity for the model is 73.9%.

**Table 8.** Variables related to transportation modes in Model 7

<i>Transportation modes</i>		<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>df</i>	<i>Sig.</i>	<i>Exp(B)</i>
Step 1 <sup>a</sup>	Motorcycle taxi ( $X_{21}$ )	2.056	0.316	42.425	1	0.000	7.816
	Private vehicles ( $X_{22}$ )	1.391	0.334	17.374	1	0.000	4.019
	Taxi ( $X_{24}$ )	1.067	0.289	13.648	1	0.000	2.906
	Constant	-2.504	0.380	43.368	1	0.000	0.082

Note: a. Variables entered in step 1:  $X_{21}$ ,  $X_{22}$ ,  $X_{24}$ .

When running all significant variables in all three groups of independent variables against the access to rail transit services, Model 8 provides the highest percentage accuracy. Table 9 shows the

relationship between the significant independent variables and the dependent variable. The model can be described by Eq. (1):

Model 8

$$Z = -6.500 + 1.721(X_{15}) + 2.474(X_{21}) + 2.586(X_{22}) \tag{9}$$

In this examination, all demographic factors are not statistically significant to the dependent variable. Emphasising a frequently used social media platform, the use of Pinterest will increase access to rail transport services by 5.591 times. Focusing on modes of transportation, using motorcycle taxis and private vehicles will increase access to rail transport

services by 11.868 and 13.275 times, respectively. At the cut value of 0.500, the classification table indicates that the rate of correct classification of Model 8 is 81.0% of cases overall. The specificity for this model is 75.2% and the sensitivity for the model is 85.0%.

**Table 9.** Variables in Model 8 (running all significant variables in three-group independent variables)

<i>Independent variables</i>		<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>df</i>	<i>Sig.</i>	<i>Exp(B)</i>
Step 1 <sup>a</sup>	Pinterest ( $X_{15}$ )	1.721	0.436	15.566	1	0.000	5.591
	Motorcycle taxi ( $X_{21}$ )	2.474	0.446	30.828	1	0.000	11.868
	Private vehicles ( $X_{22}$ )	2.586	0.556	21.627	1	0.000	13.275
	Constant	-6.500	1.630	15.908	1	0.000	0.002

Note: a. Variables entered in step 1:  $X_{15}$ ,  $X_{21}$ ,  $X_{22}$ .

### 4.3. In-depth interview results

The results of an in-depth interview related to the CCH and the common ticketing system can be summarised as follows.

In recent years, establishing a CCH in Thailand has been fraught with several difficulties. The overlapping of responsibilities and interests across several relevant organisations is a significant barrier. Numerous government and business sectors have invested in electric railway projects concurrently. These government agencies include

the State Railway of Thailand (SRT), the Mass Rapid Transit Authority of Thailand (MRTA), and the Bangkok Metropolitan Administration (BMA), while the private sector has two major operators: BTS Group Holdings Public Company Limited (BTSG), which operates the BTS Skytrain, and Bangkok Expressway and Metro Public Company Limited (BEM), which operates two metro lines and expressways in Bangkok. Asia Era One, formerly known as the Eastern High-Speed Rail Linking Three Airports Company Limited, is the new company in charge of Airport Rail Link (ARL) services and high-speed rail lines linking the three major airports (Don



Mueang, Suvarnabhumi, and U-Tapao). The absence of legislation and regulations to monitor, supervise, and administer autonomous revenue collection in the transportation sector is another issue with the CCH in Thailand. This includes the absence of a clear directive at both the policy level and the practice unit level to create an operational plan for the automatic revenue collection system of all relevant departments, which intends to employ the same central revenue management centre. Consequently, overlapping responsibilities and interests continue to exist inside the business. Moreover, there are currently no agencies with legal jurisdiction to control the CCH. To fulfil its responsibilities, the CCH must have the legal authority to support its operations, since it may be required to compel transport service providers to link their data and establish reasonable service prices. Moreover, the operation of a CCH must generate at least enough revenue to cover its expenses. Therefore, when establishing the CCH, it is vital to anticipate potential future revenues and costs. Nowadays, as there are several concessionaires handling the public transportation fare collection system, each company has built its own fare collection system with its own admission fee in order to maximise the benefits. While these enterprises do not like to lose the benefits of their own admission fee, transport service providers do not wish to pay fees or request the lowest possible charge. Consequently, this is the difficulty faced by the organisation that will manage the CCH.

According to the viewpoint of key informants, the CCH should be administered with honesty, integrity, and transparency by a government agency or impartial organisation. For instance, the Office of Transport and Traffic Policy and Planning of the Ministry of Transport can administer the bus and boat fee systems. However, if you do not wish to join the bus and boat passenger systems, operating under the Department of Rail Transport is a viable alternative. The government should enact legislation mandating that all future concessionaires adopt the uniform ticketing system. Depending on the outcome of discussions with the former concessionaires, the government may be required to pay for the transition from the old fare collection system to the new one. Therefore, both the previous and new suppliers will leverage the same system in order to synchronise and exchange data in a single system.

Considering whether the common ticketing system boosts the number of rail transit users, key informants state that it depends on a ticket's functions. If it is clear that the card issued by a central authority can be used to pay for fares or special toll fees in every system that is open for services, along with some discounts, this common ticket will be popular among users who use it to take public transport or use the expressway. This will lead to an increase in the number of rail transit users as it is convenient to use and there are cost savings.

## 5. DISCUSSION

Access to rail transportation services is measured in this study by whether or not the services are used. Those who use a service are considered to have

access to that service, while those who do not use a service are considered to have no access to that service. Non-users can be separated into two groups when identifying users and non-users based on monthly transportation costs: potential and non-potential groups. The potential group consists of people who can pay for the services but do not use them, whereas the non-potential group consists of those who cannot pay for the services and so do not use them. This study compares two pairs in relation to access to rail transportation services. The first pair is users and all non-users, and the second pair is users and non-users with potential. The best predictive models of both pairs are the ones running through significant variables of three-group independent variables (demographic factors, a frequently used social media platform, and transportation modes). Model 4 for the first pair and Model 8 for the second pair. Both models provide the highest percentage accuracy among all those running along each pair. Model 4 shows that the factors that are significant to the access to rail transit services among users and all non-users are the number of transfers, city of residence, monthly transportation costs, monthly expenses, and the use of Pinterest, WhatsApp, YouTube, Facebook, private vehicles, buses, and motorcycle taxis, while Model 8 indicates that the use of Pinterest, motorcycle taxis, and private vehicles are all significant factors that impact access to rail transit services among users and non-users with potential. It can be shown that the access of the first pair (users vs all non-users) is affected by a greater number of factors than that of the second pair (users vs non-users with potential), which is unaffected by demographic characteristics.

According to an in-depth interview, the views of experts regarding the establishment of the CCH include the duplication of roles and interests among several key organisations and the absence of laws and regulations to monitor, manage, and administer autonomous revenue collection in the transportation sector. Since each rail transport operator has developed its own fare collection system and attempted to minimise losses, the organisation that would oversee the CCH may have operational challenges. Therefore, according to the experts, the CCH must have the legal power to support its activities, as it may be necessary to compel transport service providers to link their data and create appropriate service fees. All experts believe that the most suitable agency to govern the CCH is a government agency or an impartial organisation, which should prioritise merging all public transport ticketing systems into a single system. Both current and incoming concessionaires should operate under the same CCH network. The experts believe that the number of rail transit users would grow following the implementation of a common ticketing system if the tickets can be used to pay for all mass transit services and express motorways, in addition to giving discounts.

## 6. CONCLUSION

To ensure that metro rail services are affordable and accessible to all individuals, regardless of their financial status, design laws, rules, and regulations should also consider pricing and promotion. Some examples include: 1) offering fare reduction

programs for individuals with disabilities, seniors, and low-income individuals; 2) providing promotions and discounts to encourage individuals with disabilities to use the services, such as free rides on certain days or discounts during off-peak hours; 3) receiving subsidies from local or state governments to offset the cost of providing accessible services, 4) implementing transparent pricing structures that do not discriminate against individuals with disabilities or other vulnerable populations; 5) providing clear and accessible information about fares, promotions, and discounts on their websites, in their stations, and through other communication channels. Metro rail systems should work with community organisations and advocates to develop programs and initiatives that address the specific needs of vulnerable populations and promote access to public transportation for all. Overall, design laws, rules, and regulations for metro rail accessibility should prioritise affordability and accessibility for all individuals.

Access to rail transit services among users and all non-users is affected by the number of transfers, city of residence, monthly transportation costs, monthly expenses, and the use of Pinterest, WhatsApp, YouTube, Facebook, private vehicles, buses, and motorcycle taxis, whereas access among users and potential non-users, is influenced by the use of Pinterest, motorcycle taxis, and private vehicles. The overlapping of functions and interests

among multiple relevant organisations and the absence of laws and regulations to manage autonomous revenue collection are two main challenges in creating a CCH in Thailand. According to the perspectives of key respondents, the CCH should be administered by a government agency or an impartial organisation, and if the functions of a ticket are desirable, a common ticketing system might increase the number of rail transport passengers. The following are the recommendations based on the findings. Since the usage of social media platforms by rail transit users and non-users is substantial, metro train companies may promote and run promotions via these online platforms based on their unique features. It is intriguing that when transportation prices increase, access to rail transit services decreases. This means that if people spend more on transportation, they are likely not to access metro trains or they may pay to use other transportation modes. Therefore, rail transport companies may consider these commuter groups since they can pay for transportation. The limitation of this study is that the non-potential group, which comprises more than 25% of the samples, was not examined. This population should not be abandoned, and access to rail transport services should be increased for this group. Therefore, future research should investigate this demographic to determine how to entice them to use rail transit services.

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