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Modelling Mode Choice Preference to Access the Electrified Train Station (ETS): A Case Study in Ipoh City, Malaysia

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Abstract: This study presents an analysis of the access mode choice by the travellers of the Electrified Train System (ETS) at the Ipoh train station. Data collection was done in conjunction with the Chinese New Year holiday to get an understanding on the mode choice preference of the ETS travellers during the peak season. Respondents in this study were required to fill in the survey form with the assistance of the project staffs. The results showed that most of the passengers intended to get a car ride with the help of other people to go the train station followed by self-driving and use of taxi. However, only a small percentage of the respondents were likely to use the bus. Logistic regression analysis was performed to examine the factors that affect the passengers mode choice preference to access the Ipoh train station. Factors such as the location, from where the passengers begin and end their journey, significantly affected the preferable choice of mode. In addition, the travel cost and travel time also showed the substantial influence. The passengers that intended to get a ride from others were likely to save their travel cost and travel time. The passengers who used the taxi saved their travel time at the expense of excessive taxi fare. In contrast, the passengers, who used bus, preferred to travel longer over the travel cost. The findings from this study can be utilized in the future development of the infrastructure (providing accessibility) and public transportation network to the Ipoh train station.

Key words: Mode choice, accessibility, railway travelers, electrified train service

INTRODUCTION

During the last few decades, Malaysia like many other countries, underwent a spectacular growth in mobility; the total number of registered vehicles reached 21,401,269 in 2011 compared to 14,816,407 in 2005. This not only resulted in a heavy traffic and congestion but also in the increase of the road accidents. It was reported that 817,151 motor vehicles were involved in road accidents in 2011 compared to 581,136 48 vehicles in 2005 (MoT, 2011). In the list of world rankings, Malaysia is ranked 46th of 172 countries with regards to the occurrence of deaths, in registered vehicles, due to road accidents (WHO, 2009). Therefore, the development of rail-based electric power generation systems that expanded fast in Malaysia are aimed not only to reduce the traffic congestion but also to decrease the road accidents. The Electric Train Service system which is known as ETS was launched in August 2010 and has been well received by the public due to its speed up to 140 km h^{-1}. The ETS trains are divided into two classes which are known as gold class and silver class. The gold class trains take 2 h and 20 min from the Ipoh station to Kuala Lumpur (KL) Sentral with 8 stop stations. Conversely, the silver class train takes 2 h and 30 min to arrive at Kuala Lumpur (KL) Sentral with 14 stop stations. Normally, in Malaysia, many efforts to increase the usage of the train has been focused on the rail service itself without taking into account the traveller's accessibility to the train network. The lack of understanding of the traveller's travel behavior to the train station would cause the potential of decreasing the usage of the train. There are many factors that caused people's unwillingness to use trains as their mode of travel, among those the main factor is the difficulty to access the train station.

Previous study conducted by Prasertsubpakij et al. (2011) indicated that the accessibility problems are influenced by multi-dimensional forces such as the built environment, socioeconomic, vehicle ownership, temporal and psychological factors. On the other hand, in terms of built environment, Din et al. (2009) found that people are more interested in using the train if the train stations are provided with the proper walking access. However, the stations with high walking accessibility are normally located in close proximity to the buildings within the urban areas. This is contrasted with the intercity rail system where sometimes the stations are located quite far from the residential areas. Givoni and Rietveld (2007) examined the effect of vehicle ownership on the traveller's mode choice to reach the train station in the Netherlands and found that the availability of the car did

not significantly affect the mode choice. Besides, most of the travellers who own cars chose to get to or from the railway station on foot, by bicycle and by public transport. In addition, Wardman and Tyler (2000) also indicated that travel distance has the highest effect on the train usage and the traveller'smode choice. This is in accordance with the Dutch experience where Keijer and Rietveld (2000) indicated that most of the travellers intended to use bicycles as their main mode to go to the train stations, especially those who live in the ring of 500 m around the station. The areas where it is impossible to use bicycles, Martens (2004) suggested that the improvement of public transport service as a feeder transport to train station might encourage the people to be less dependent on their own vehicles.

Considering other factors such as cost, Cheng *et al.* (2007) figured out that the travellers who considered cost as their main factor would likely to use the bus to go/leave the train station. This is contrasted with the travellers who considered time and convenience level as their main factors where they would likely to choose taxi or their own private vehicle to go/leave the train station. Meanwhile, with respect to the Malaysian scenario, still there is less information available on the people's characteristics and mode choice to the train stations without which it is difficult to make improvements in terms of feeder transport such as buses, taxis and infrastructure (e.g., car park, motorcycle park, bicycle park) that might be required at the train stations. Consequently, this study is aimed to investigate the traveller's mode choice preference to the ETS stations and determine the factors that influence the mode choice accessibility.

MATERIALS AND METHODS

Survey and analysis: Face to face interview surveys were specially designed to understand the ETS train traveller's travel behavior to the Ipoh train station. The interview surveys targeted departing travellers whose journey origin was Ipoh. Surveys were carried out at the departure platform of the Ipoh train station from 7th (Thursday) to 9th (Saturday) February 2013; in conjunction with Chinese New Year holiday season. The questionnaire was designed to be comprehended and completed in average of 10 min. The survey aimed 600 respondents and a token of appreciation was given to the travellers who took part in this survey. The successful response rate was 94.5% (i.e., 567 train traveller's). The questionnaire form was divided into three sections. The first section queried about the socio-demographic information of the respondents followed by the second section comprising of preference statement about the choice of modes and

conditions to access the train station. Third section inquired about the traveller's origin-destination mode to access the train station costs involved, travel time and distance from the origin of the train station.

Among 567 samples, 44% were male and 56% were female. The age range of the respondents was between 11 and 80. However, the average age of the respondents was 32 years. The 60% of the respondents were Malay, 24% Chinese, 11% Indian and the others were only 5%. The other main characteristics of the travellers that have been surveyed are summarized in Table 1.

In conjunction of the holiday season, the finding shows that the majority (78%) of the respondents were travelling for the holiday purpose such as going back to hometown, visiting relatives or vacation. Only 19% were business travellers and the remaining were travelling for other purposes. In this study, the access mode refers to the final mode used by the respondents to go to the train station and the modal split at the Ipoh train station is shown in Table 2.

In general, the private modes especially cars dominate the access pattern to the train station. Almost 37% of the travellers intended to get a lift from a friend or

Table 1: Descriptive data of the respondents at Ipoh train station

|	Frequency	
Bil and attributes	No.	%
Gender		
Male	247	43.60
Female	320	56.40
Race		
Malay	340	60.00
Chinese	135	23.80
Indian	62	10.90
Others	30	5.30
Marital status		
Single	350	61.70
Married	204	36.00
Divorced	13	2.30
Monthly income		
<RM1000	207	36.50
RM1000-RM2000	113	19.90
RM2000-RM4000	87	15.30
RM5000 and above	45	7.90
No income	115	20.30
Education		
Certificate/SPM/STPM	214	37.70
Diploma	124	21.90
Bachelor/Master/PhD	229	40.40
Vehicle ownership		
Car	289	51.00
Motorcycle	83	15.00
Van/lorry	7	0.01
No vehicle ownership	188	34.00
Frequency trip		
4 or more trips/week	35	6.20
1-3 trips/week	19	3.40
1-3 trips/months	155	27.30
<12 trips/year	358	63.14
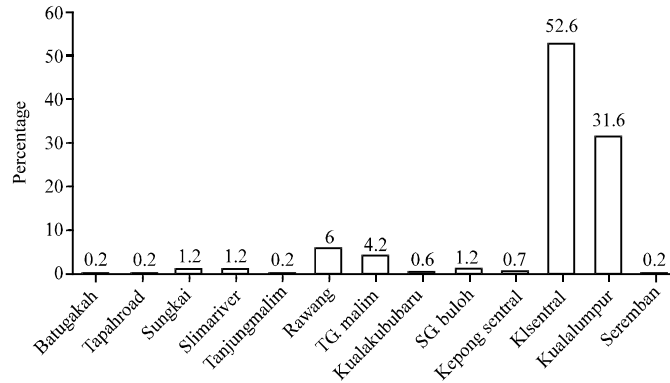
Fig. 1: Destination stations of the ETS respondents

Table 2: ETS train traveller's modal split percentages by the trip purpose for accessing the train station

Parameters	Self-driver	Get-a-lift	Motorcycle	Taxi	Bus	No. of samples
			----(%)----			
Business	7.76	7.58	0.35	2.47	1.06	109
Non-business (e.g., visit family, vacation)	17.81	28.39	2.47	17.99	10.40	443
Others	0.88	0.88	0.18	0.35	0.35	15
Total	26.45	36.86	2.99	20.81	11.81	567

family that owned a car to reach at the train station especially for non-business trips (28%). This is followed by drove their own car (26%), bus (12%), taxi (10%) and motorcycle (3%). Nonetheless, for the travellers with business trip purpose, most of them were likely to use their private cars (7.8%) or get a ride from others to access the train station (7.6%). The small percentage of business trips and large percentage of non-business trips might be due to the selection of survey period i.e., Chinese New Year holiday season.

Figure 1 shows the destination stations of the respondents in this study. Almost 53% of the respondents got off at KL Sentral station, meanwhile 32% got off at the Kuala Lumpur station. The remaining small percentages of the respondents were alighted from the train at other stations. In terms of the distance to the train station, the result (Fig. 2a) shows that most of the train users (51%) travelled more than 5 km to the train station and the majority of the respondents used car especially those who asked other people to provide them with the lift. This is followed by the travellers who used taxi to reach the train station. The numbers of travellers who used the bus were only 67 whereas 57% of them travelled more than 5 km and the rest travelled between 500-1 km to arrive at the station. In addition, even only 4.4% of the respondents travelled less than 5 km to the train station but the results show that they still depended on car rather than other modes of transport. Figure 2b shows the bar charts on travel costs of the train travellers to reach the Ipoh train station. The lowest travel cost expended to the train station was less than RM5 and the most expensive

was more than RM50. The travellers that used to get a lift from others to the train station were the largest number of the respondents that travelled with less than RM5. This was followed by the travellers who drove to the train station by themselves and also the travellers that used buses. The travellers that got a lift from other people to the train station were also dominating the travel cost; from RM5 to RM10 followed by those who drove their own car, used taxi and bus. In the case of the travellers that chose taxi to the train station, most of them (63%) had to pay RM11 to RM20. However, there were also travellers who had to spend more than RM50 in order to go to the train station by using car, taxi and bus, which may be because of the fact that they came from outside of the Ipoh area. Figure 2c depicts the bar chart on the traveller's travel time to go to the train station based on the mode choice. The travellers who used car (either drove or got a lift) were the highest proportion of the travellers that arrived at the train station in less than 10 min. The results also showed that most of the travellers of any modes (self-drivers (44%), get-a-lift travellers (46%), taxi (53%) and bus (20%)) took about 10-30 min to reach the train station. This followed by 21.3% of self-drivers, 35% get-a-lift travelers, 28% taxi users and 12% bus users who travelled about 10-30 min to arrive at the train station. There were small percentages of travellers who travelled 46-60 min by using bus and also got a lift from other persons. Nevertheless, small percentages of the travellers who travelled more than 60 min; including all types of modes, were also distinguished.
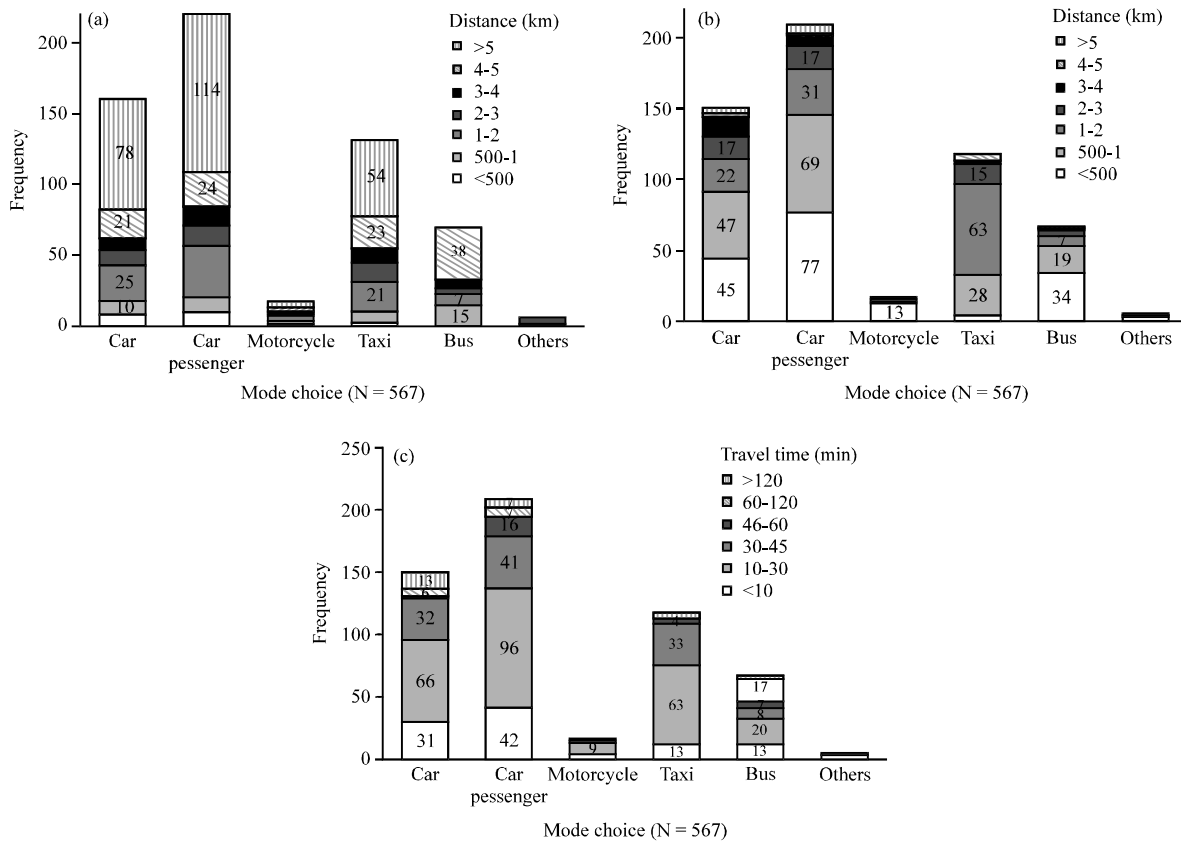
Fig. 2(a-c): Mode choice to train station based on (a) Travel distance, (b) Travel cost and (c) Travel time

Statistical analysis: In this study, the analyses from the first and third part of the questionnaire are reported. For analysis purposes, the computation of descriptive statistics using SPSS was carried out, followed by binary logistic regression analysis of the association of transport mode against the covariates (vehicle ownership, frequency of using ETS, origin of the journey, the destination of the journey, travel cost to the station, distance taken to reach at station and travel time to the station).

RESULTS

Table 3 shows the regression models that were performed to estimate the factors affecting the traveller's choice of specific mode (e.g., self-driving, get-a-lift, taxi and bus) to go to the train station. Variables such as age, race, vehicle ownership, frequency of travel, location start, location end, travel distance, travel cost and travel time were selected to be tested for each model. Statistical analysis of the motorcycle was eliminated as the percentage of travellers depending upon a motorcycle to

access the station was very low. In the case of the respondents who drove their own car to access the train station, factors such as car ownership, origin and destination locations have shown the significant effects. The travellers who started their journey from home were more likely to drive themselves to the station. This is contrasted with the travellers who ended their journey at home, where they would likely not to use car to access the Ipoh train station. In addition, the results also disclosed that the travellers that have car ownership were also not likely to use their cars as a mode of access to the train station which might be due to the insufficient parking lots for their cars.

Meanwhile, factors such as location of starting journey, travel cost, frequency of using ETS and motorcycle ownership were affected the travellers tendency to get a lift from their family/friend. The results indicated that the travellers, who owned a motorcycle and a frequent user of ETS, were intended to ask for a lift if they started the journey either from home or office. However if the travel cost for the ride were increased the result shows that the travellers would likely to choose

Table 3: Factors affecting the mode choice preference to the ETS station

Mode	Affecting factors	Standardize coefficient	t-stat
Self-driver			
$x^2 = 94.00$; df $= 14$	Car ownership	-0.26	-3.48
-2 LL $= 561.182$; Cox and snell	Journey started from home	0.66	3.31
$R^2 = 0.153$; Nagelkerke $R^2 = 0.223$	Journey ended at home	-0.37	-3.01
Get-a-lift traveler			
$x^2 = 35.65$; df $= 14$	Journey started from office	0.86	3.42
-2 LL $= 710.757$; Cox and snell	Journey started from home	0.40	3.08
$R^2 = 0.061$; Nagelkerke $R^2 = 0.083$	Travel cost	-0.16	-2.46
	Frequency of using ETS	0.15	2.52
	Motorcycle ownership	0.12	1.98
Taxi			
$x^2 = 73.04$; df $= 14$	Journey started from office	-0.75	-1.85
-2 LL $= 506.944$; Cox and snell	Journey ended at home	0.33	2.15
$R^2 = 0.121$; Nagelkerke $R^2 = 0.189$	Travel cost	0.42	5.82
	Motorcycle ownership	-0.12	-1.72
	Travel time	-0.21	-2.75
	Car ownership	0.13	1.65
Bus			
$x^2 = 138.57$; df $= 14$	Journey started from home	-1.13	-5.98
-2 LL $= 273.361$; Cox and snell	Journey started from office	-1.07	-1.96
$R^2 = 0.217$; Nagelkerke $R^2 = 0.420$	Travel cost	-0.61	-4.33
	Travel time	0.48	4.74
	Car ownership	0.41	3.53

other modes. Additionally, the results also showed that car ownership is a significant factor that affected the traveller's choice to get a taxi to reach the train station. This also leads to the parking problem at the train station. Travellers whose journey end at home also intended to ride a taxi may be due to their heavy luggage while travelling in Ipoh. However, the travellers who had motorcycle ownership and who started their journey from their office were not likely to use a taxi. Travel cost and travel time were also also found to be the significant effects towards the traveller's choice of using taxi. The results indicated that even though by using taxi they needed to spend higher travel cost but concurrently, they also saved their travel time. Moreover, the travellers who owned a car were also found to use a bus. Other factors such as the origin of the journey (either home or office), travel time and travel cost also affected the likeliness of using bus to the train station. The results indicated that the travellers who chose to use bus were likely to spend less cost and had longer travel time. Nevertheless, the travellers who started journey from home or office were not likely to use bus to the train station.

DISCUSSION

Malaysia is known as a country where the use of the car is common. However, the network for the intercity rapid railway known as ETS has been improved on the large scale to meet the needs of the transportation system. Now a days, Malaysian roads witness the increasing number of vehicles each year. Therefore, the ETS railway service is targeted to reduce the road congestion and

safety problem, especially during the festive seasons. However, without proper and systematic feeder system, the train service would not provide the desired implication as a whole.

In this study, the majority of the respondents had travelled more than 5 km to access the train station. It shows that most of the respondents came from outside area of Ipoh City. This might be the reason for them to choose car as their mode of transport to access the train station. It is contradicted with the developed country such as Netherlands where the rail passengers were preferred to use bicycle to access the train station with the average distance travelled 5 km (Keijer and Rietveld, 2000; Givoni and Rietveld, 2007). Meanwhile in China, people would likely to walk to the train station if the walking distance was less than 2 km (Guan *et al.*, 2009). This situation supported that distance plays an important role for the passsenger's choice of transportation to access the train station.

Moreover, the respondents in this study were likely to have a car ride from friends or families to the train station instead of driving by themselves. This may be due to the inconvenient and limited parking spaces at the train station. It is suggested that the train stations should be provided with the safest and convenient parking spaces as there might be the train passengers that would likely to leave their car for a few days in the provided parking spaces. In addition, a study of Bay Area Rapid Transit (BART) in US showed that people would likely to walk to the station if the parking spaces are not provided near the station. However, if there are high levels of retail activity near the station areas, it might increase the

proportion of walk trips (Loutzenheiser, 1997). Therefore, the idea to expand the retail and commercial areas that close to the train station is might be needed to be considered for future development in Ipoh City. This is important in order to improve the pedestrian and cyclists facilities such as walkways and bicycle lane, at the same time to promote the culture of green modes to the train station.

The statistical analysis in this study found that the respondents who drove their own car would likely to be the persons who started their journey from home. It was also the similar situation for the respondents that intended to be a car passenger. However, the respondents who were likely to get a lift from other people also intended to start their journey from the office and identified as the frequent users of ETS. This study also figured out that the respondents intended to get a ride from others because it was saving their travel cost. The taxi was the next preferred transport after car that had been chosen as a feeder mode to reach the train station. The travellers who used taxi to access the station needed to pay high taxi fare as compared to the users who embraced other mode of transports. Though, the taxi was found to save the travel time of those travellers. Besides, the travellers who used taxi were also likely to end their journey at home which can be assumed that the travellers premeditated to carry heavy luggage or stuffs. In order to get a comfortable and convenient journey, the taxi was the best choice to reach the train station. In the meantime, only small percentages of the travellers used bus to access the train station which resulted in the longest travel time but cheaper than the other public transport modes especially taxi. The statistical analysis showed that the respondents who used bus did not start their journey either from home or office. This might be referred to the individuals that were working or studying far away from home (i.e., individuals who rent a house or university student that stayed in the campus). This study also showed that the active modes of travel such as cycling and walking are not an option for reaching the train station. This may be because the parking space for bicycles and the pedestrian pathway were not being provided at the train station. Even the motorcycle parking was also not available at the train station.

As a conclusion, this study indicates that most of the train passengers were depended on the car to go to the train station and most of them started their journey from a location that was inappropriate for walking, distance or cycling. An inadequate bus route network to the residential or business areas also had caused the limited choice of transportation to the passengers in order to access the train station. According to a study by

O'Sullivan and Morall (1996), people would likely to walk farther to reach a train station than a bus stop. It might be because of the longer waiting time and travel time for the bus compare to the train. In addition, many previous studies had revealed that longer waiting time and travel time while using bus were found significant to give impact to reduce usage of bus (Xin and Wang, 2014; Mishalani *et al.*, 2006; Yim and Ceder, 2006; Wardman, 2004). Besides, the factor such as heavy luggage could be a restriction for the travellers to use public bus to access the train station. However, further study should be conducted to determine whether the passengers are willing to change their mode of transportation from car to other modes of transportation or not. Likewise, the understanding of the taxi and the bus route network is also required in order to provide a systematic feeder transportation system to the train station. Even though the data in this study presented the passenger's mode choice in conjunction with the Chinese New Year holiday only but the findings are still important because the problem regarding the feeder transport to the train station is more difficult to resolve during other festive and holiday seasons as well.

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